Cluster and Factor Analysis of Structural Economic Indicators for Selected European Countries

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Abstract: - The last wave of EU enlargement ended on 1st January 2007 with the accession of Romania and Bulgaria. Many countries of the South-Eastern Europe aspire to join the EU. Croatia appears to be the next prospective member, so the aim of this paper was to classify Croatia and EU 27 Member States according to the structural economic indicators. These countries were gathered into homogenous groups in terms of the following structural economic indicators: GDP per capita, total employment rate, comparative price levels, employment rate of older workers, long term unemployment and productivity of national economies expressed in relation to the European Union (EU-27) average. Firstly, the cluster analysis was used on three structural cluster analysis and non-hierarchical cluster analysis were applied and gave similar results. The factor analysis was then provided to find out the common factors of six structural economic indicators: GDP per capita, total employment rate of older workers, long term unemployment rate of older workers, long term unemployment rate of older workers. The hierarchical cluster analysis were applied and gave similar results. The factor analysis was then provided to find out the common factors of six structural economic indicators: GDP per capita, total employment rate of older workers, long term unemployment rate of older workers, long term unemployment and productivity of national economies. Two factors were extracted and the factor scores for each observation were calculated. The factor scores were used in further cluster analysis and again similar results of classification was given.

Key-Words: - Classification, Structural economic indicators, Multivariate methods, Hierarchical cluster analysis, Non-hierarchical cluster analysis, Factor analysis.

1 Introduction

At the end of the 1980s and the beginning of 1990s, after the Cold war, and after the collapse of communism there was an opportunity for the European integration process to focus on countries of former Eastern Bloc [14]. This enlargement is distinguished by its importance, however, both politically and economically. Indeed, it is for the first time when countries belonging to the former communist bloc have become members of the single market [10].

The increasing openness of the Eastern European countries [4] during the gradual transition to market economy makes these to become targets for foreign investors. Their specificities have played an important role in the attractiveness of different types of investments, leading to changes in the market structure [9]. After the unification of Germany, or to be more precise, ten years later, 5th expansion wave of European Union took place and it symbolised the biggest swing in the integration of European continent by the number of new members as well as by abolition of segmentation on European East and West. On 1st May 2004, EU expanded on 10 new countries: Estonia, Lithuania, Latvia, Poland, Czech Republic, Slovakia, Hungary, Slovenia, Malta and Cyprus. The last (5th) wave of enlargement ended on 1st January 2007 with the accession of Romania and Bulgaria. Many countries of South-Eastern Europe aspire to join the EU [14].

The integration of these countries raises one third of the population and the area of EU, while wealth increases only by five percent. In fact, the real convergence is at the centre of all economic issues of EU enlargement towards East. The existence of wealth difference among members brings up the question of economic sustainability of this enlargement. This integration represents a challenge for the EU, integrating countries whose per capita income is less than 40% of EU average measured in purchasing power parity [10].

However, jet many countries of South-Eastern Europe aspire to join the EU [14] and Croatia appears to be the next prospective member. Apart from Croatia, Macedonia and Turkey already have the candidate status, while Albania, Bosnia and Herzegovina, Serbia and Montenegro participate to different extent in the Stabilisation and а Association process (which provides a legal framework for the relations between the EU and potential members in the period prior to possible accession). In many cases, these partnerships are seen as a first step towards closer integration, but they are not a guarantee for full membership [6]. It is a common view that enlargement poses a severe challenge for EU structural and cohesion policies. Far less clear and uncontroversial is the empirical and analytical basis for that statement.

At its meeting in Lisbon in March 2000, the European Council set a strategic goal for the next decade of making Europe "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" (the Lisbon agenda for reform in Europe, whose goal is to improve Europe's global competitiveness [11]). In 2005, a new approach to the Lisbon strategy was decided upon, focusing on growth and employment. The structural indicators provide a tool for the objective assessment of progress made towards the Lisbon objectives and are used by the European Commission to support their analysis in the Annual Progress Report to the European Council [15].

This paper focuses on chosen structural economic indicators of Croatia in comparison to the ones of EU 27. The main purpose is to investigate to what extent Croatian economy resembles economies of EU 27 Member States in terms of structural economic indicators. In other words: in what group of countries does Croatia come under, since it's natural to suppose that it should group with the countries with a similar historical and political background (Central and Eastern European countries).

According to the research of Christian Weise (German Institute for Economic Research), despite recent growth rates above EU 15 average, economic convergence remains limited. Poland, Slovenia, Hungary, Slovakia and Czech Republic

display the most positive macroeconomic indicators. Considerable labour market changes have occurred associated with the process of privatisation economics restructuring, and liberalization. These include a sharp fall in industrial employment and a substantial rise in noticeable service sector employment, but differences with the employment structure of the EU Member States remain. Unemployment has risen in all CEE countries to varying extents. Income levels and standard of living have declined and poverty has spread considerably with a variation between countries and a disproportional effect on certain social groups. The spread of subnational disparities in GDP and unemployment in the CEECs is smaller than in other EU Member States.

According to the previously mentioned research, disparity patterns (at NUTS II level) include the following: GDP per capita in CEE regions is considerably less than EU average (only Prague and Bratislava lie above this level), regional unemployment is relatively low in CEE in comparison to the EU 15 (with noticeable subnational variation), CEE regions are in general more sparsely populated then the EU 15 and dominates agriculture regional employment structures in, for example, Romania and Poland to much greater extent than in the EU 15. However, the increasing uncertainties regarding the EU absorption capacity and its future enlargements, as well as unsorted institutional issues seem not to be affecting Croatia's current path towards the accession [12].

Croatia's small size causes little concern about the impact it would have on EU institutions, policies and its budget. Therefore it has been repeatedly confirmed by EU officials that Croatia would join the EU as quickly as possible, provided that it fulfils all the required accession criteria which primarily relate to the progress with adopting and implementing the EU law. In some areas, however, they also include broader political and economic reforms [6].

2 **Problem Formulation**

In this paper the following structural indicators of Croatian economy (CR) were analysed: GDP per capita (GDPpc), total employment rate (EMPL), comparative price levels (PRICE), employment rate of older workers (EMPLOLD), long term unemployment (UNEMPL) and productivity of Croatian economy expressed in relation to the European Union (EU-27) average (PROD). The enumerated indicators were analysed in comparison with those of the following countries: Belgium (BE), France (FR), Italy (IT), Greece (GR), Spain (SP), Czech Republic (CZ), Lithuania (LI), Estonia (ES), Latvia (LA), Cyprus (CY), Portugal (PT), Slovenia (SN), Bulgaria (BU), Hungary (HU), Poland (PL), Romania (RO), Slovakia (SK), Malta (MA), Denmark (DE), Germany (GE), Austria (AU), United Kingdom (UK), Netherlands (NE), Sweden (SW), Ireland (IR), Finland (FI) and Luxembourg (LU). Using cluster as well as factor analysis, the main purpose of the paper was to explore in which group of countries Croatia fits in, based on enumerated structural economic indicators [1, 2, 3, 5, 7, 8]. The data for the analysis were taken from Eurostat web site for the year 2007.

As an indicator of economic activity, Gross domestic product (GDP) was chosen. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. The volume index of GDP per capita in Purchasing Power Standards (PPS) is expressed in relation to the European Union (EU-27) average set to equal 100. Basic figures are expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries allowing meaningful volume comparisons of GDP between countries.

Another structural indicator of interest is total employment rate. The employment rate is calculated by dividing the number of persons aged 15 to 64 in employment by the total population of the same age group. The indicator is based on the EU Labour Force Survey. The survey covers the entire population living in private households and excludes those in collective households such as boarding houses, halls of residence and hospitals. Employed population consists of those persons who during the reference week did any work for pay or profit for at least one hour, or were not working but had jobs from which they were temporarily absent.

However, the employment rate of older workers is calculated by dividing the number of persons aged 55 to 64 in employment by the total population of the same age group.

Long-term unemployed (12 months and more) persons are defined as those aged at least 15 years not living in collective households who are without work within the next two weeks, are available to start work within the next two weeks and who are seeking work (have actively sought employment at some time during the previous four weeks or are not seeking a job because they have already found a job to start later). Where as the total active

population (labour force) is the total number of the employed and unemployed population. The duration of unemployment is defined as the duration of a search for a job or as the length of the period since the last job was held (if this period is shorter than the duration of the search for a job).

Comparative price level is also an indicator chosen for this analysis. Comparative price level is the ratio between Purchasing power parities (PPPs) and market exchange rate for each country. The ratio is shown in relation to the EU average (EU27 = 100).

Finally, GDP per person employed that intended to give an overall impression of the productivity of national economies expressed in relation to the European Union (EU-27) average last entered the analysis. If the index of a country is higher than 100, this country's level of GDP per person employed is higher than the EU average and vice versa. Basic figures are expressed in PPS where it should be noted that in this indicator 'persons employed' does not distinguish between full-time and part-time employment

Although this analysis is accompanied by a number of constraints that have to be taken into account when interpreting the results, it is quite interesting to know in which groups of EU 27 countries was Croatia classified.

3 Problem Solution

The cluster analysis and factor analysis were applied to classify EU 27 countries and Croatia according to the following structural economic indicators: GDP per capita, total employment rate, comparative price levels, employment rate of older workers, long term unemployment and productivity of national economies expressed in relation to the European Union (EU-27) average.

Firstly, the hierarchical cluster analysis was run on three following variables: GDP per capita, total employment rate and comparative price levels. The non-hierarchical cluster analysis was then used to improve the results of the given hierarchical cluster solution.

The cluster analysis was also run to classify Croatia and 12 European countries which joined during the last two waves of enlargement. The hierarchical and non-hierarchical cluster analyses were also applied.

The factor analysis was then applied to find out the common factors of six structural economic indicators: GDP per capita, total employment rate, comparative price levels, employment rate of older workers, long term unemployment and productivity of national economies in relation to the European Union (EU-27) average. Two factors were extracted. Factor scores were calculated for the extracted factors, respectively for each country. Those factor scores were used in cluster analysis, hierarchical and non-hierarchical.

3.1 Hierarchical cluster analysis on standardized variables

The hierarchical cluster analysis was applied on the standardized variables (SGDPpc, SEMPL and SPRICE) to avoid measurement differences.

The multicollinearity was examined. All VIF values were smaller than 5 which denote that there is no high multicollinearity.

Various methods of hierarchical cluster analysis were provided to find out the number of clusters and the four-cluster solution given by the Ward's method with squared Euclidean distances was chosen as the best solution.

Figure 1 shows the dendrogram obtained by Ward's method with Squared Euclidean distances. The analysed countries are listed along the left vertical axis of the dendrogram.

Fig.1 Dendrogram (Ward's method, Squared Euclidean distances)



On the basis of the dendrogram in Figure 1 and by examining the linkage distances the solution with two or four clusters might be chosen.

In the two-cluster solution the first cluster comprises nineteen countries and the second nine countries. The first cluster consist of the following countries: Belgium, France, Italy, Greece, Spain, Czech Republic, Lithuania, Estonia, Latvia, Cyprus, Portugal, Slovenia, Bulgaria, Hungary, Croatia, Poland, Romania, Slovakia and Malta. The second cluster consists of: Denmark, Germany, Austria, United Kingdom, Netherlands, Sweden, Ireland, Finland and Luxembourg. Table 1 shows the classification of countries in the four clusters obtained by the Ward's method with the Squared Euclidean distances.

In the four-cluster solution the first cluster comprises twelve countries (Belgium, France, Italy, Greece, Spain, Czech Republic, Lithuania, Estonia, Latvia, Cyprus, Portugal, Slovenia), the second cluster seven (Bulgaria, Hungary, Croatia, Poland, Romania, Slovakia, Malta), the third cluster eight (Denmark, Germany, Austria, United Kingdom, Netherlands, Sweden, Ireland, Finland) and the fourth cluster only one country, Luxembourg.

It can be seen that on the basis of the three chosen structural economic indicators and Ward's method with Squared Euclidean distances Croatia was classified in the group of countries that have similar historical and political background: Bulgaria, Hungary, Poland, Romania, Slovakia and Malta.

Croatia's GDP pc is 61,9 PPS or 38,1% below EU 27 average, which is similar to the level of the same indicator in Hungary, Malta, Poland and Slovakia. However, Bulgaria and Rumania that gathered into the same group have much lover GDP pc reaching approximately 40% of average value of that indicator in EU 27.

When comparing total employment rate in the second cluster, the situation is quite different. Bulgaria and Slovakia have the highest employment rates (around 60% or 5.4% below EU 27 average), while other countries of the same cluster have lower employment rates being approximately around 57%.

Malta and Croatia have the highest comparative price levels in the second cluster (around 70 PPS or 30% below EU 27 average), while other countries in the same cluster reach around 60 PPS or 40% below EU 27 average. The lowest Comparative price levels are in Bulgaria, reaching 46.5 PPS.

3.2 Non-hierarchical cluster analysis on standardized variables

The non-hierarchical cluster analysis was used to improve the previously mentioned four-cluster solution given by the hierarchical cluster analysis, Ward's method with squared Euclidean distances. The K-means method of non-hierarchical cluster analysis with the Euclidean distances was provided and the standardized variables (SGDPpc, SEMPL and SPRICE) were used.

Table 1 shows the classification of countries in four clusters given by the Ward's method and by the K-means method. It can be noticed that the Kmeans method resulted in similar structure of the clusters as the clusters given by the Ward's method with squared Euclidean distances. Only Lithuania was classified differently using K-means method. Lithuania was classified with Belgium, France, Italy, Greece, Spain, Czech Republic, Estonia, Latvia, Cyprus, Portugal, and Slovenia and by the K-means method with Bulgaria, Hungary, Croatia, Poland, Romania, Slovakia and Malta when the Ward's method was applied.

On the basis of three chosen structural economic indicators and K-means method Croatia was grouped along with Bulgaria, Hungary, Poland, Romania, Slovakia, Malta and Lithuania.

7	Гable	1	Classification	on c	of	cour	ntries	in	four	clusters	\$
(Ward	's	method and	K-1	me	eans	meth	od)			

	Ward's	K-means
Country	method	method
Belgium	1	3
France	1	3
Italy	1	3
Greece	1	3
Spain	1	3
Czech Republic	1	3
Lithuania	1	4
Estonia	1	3
Latvia	1	3
Cyprus	1	3
Portugal	1	3
Slovenia	1	3
Bulgaria	2	4
Hungary	2	4
Croatia	2	4
Poland	2	4
Romania	2	4
Slovakia	2	4
Malta	2	4
Denmark	3	1
Germany	3	1
Austria	3	1

United Kingdom	3	1
Netherlands	3	1
Sweden	3	1
Ireland	3	1
Finland	3	1
Luxembourg	4	2

The way to identify the nature of each cluster is to examine their means on each dimension. For this purpose the plot of means for each cluster was constructed. Figure 2 shows the plot of means for the four clusters obtained by the K-means method.

Fig.2 Plot of means for four clusters



Figure 2 shows that in the fourth cluster, all three examined structural economic indicators are below average. On the other hand, in second cluster, where Luxembourg was grouped, GDP pc is well above the EU 27 average.

3.3 Hierarchical cluster analysis on standardized variables for thirteen European countries

The cluster analysis was run using the standardized variables (SGDPpc, SEMPL and SPRICE). The two-cluster solution given by Ward's method with squared Euclidean distances was chosen. Figure 3 shows the dendrogram obtained by Ward's method with Squared Euclidean distances.





According to the dendrogram based on 13 analysed countries, the first cluster consists of seven countries: Bulgaria, Hungary, Croatia, Poland, Romania, Slovakia and Malta. The following countries were grouped in the second cluster: Czech Republic, Lithuania, Estonia, Latvia, Cyprus and Slovenia. These results confirmed the results of cluster analysis on 28 countries.

3.4 Non-hierarchical cluster analysis on standardized variables for thirteen European countries

The K-means method of non-hierarchical cluster analysis with the Euclidean distances was provided on standardized variables (SGDPpc, SEMPL and SPRICE). Table 2 shows the classification of countries in two clusters given by the Ward's method and the K-means method.

Table 2 Classification of countries in two clusters (Ward's method and K-means method)

		/
Country	Ward's	K-means
Country	method	method
Bulgaria	1	1
Hungary	1	1
Croatia	1	1

1	1
1	1
1	1
1	1
2	2
2	2
2	2
2	2
2	2
2	2
	1 1 1 2 2 2 2 2 2 2 2 2 2 2

It can be noticed that the K-means method resulted in the same structure of clusters as the clusters given by the Ward's method with the squared Euclidean distances.

Figure 4 shows the plot of means for two clusters obtained by the K-means method.





Figure 4 shows that in the first cluster, in which Croatia was grouped, all of the three examined structural economic indicators are below average.

3.5 Factor analysis of six structural economic indicators for selected European countries

Factor analysis was applied for the synthesis of the following structural economic indicators: GDP per capita, total employment rate, comparative price levels, employment rate of older workers, long term unemployment and productivity of national economies expressed in relation to the European Union (EU-27) average. The data were analyzed by the component factor analysis.

Factor analysis procedures are based on the matrix of correlation among the variables. It has been carried out in the following steps:

- evaluation of appropriateness of factor analysis,
- determination of number of factors,
- varimax rotation of factors,
- calculation of factor scores.

Evaluation of appropriateness of variables examination of means the fundamental requirements for factor analysis. Appropriateness of factor analysis can be examined by the calculation of Kaiser-Meyer-Olkin measure which compares the magnitudes of the observed correlation coefficients with the magnitudes of the partial correlation coefficients. Table 3 shows Kaiser-Meyer-Olkin measures for each variable and overall Kaiser-Meyer-Olkin measure. It can be noticed that KMO measures for variables and overall KMO measure are all greater than 0,5. This indicates that the variables are appropriate to be subjected to factor analysis.

Table 3 Kaiser-Meyer-Olkin mesures

Variable	KMO measure
GDPpc	0,617
prod	0,545
empl	0,709
emplold	0,658
price	0,660
unempl	0,886
overall KMO	0,654

Three criteria were used to determine the number of factors:

- the Kaiser criterion (eigenvalue greater than one),
- the percentage of variance criterion and
- the scree plot.

As it can be noticed in Table 4, only two factors have eigenvalues greater than one (3,495 and 1,659). This means that the minimum number of factors that should be extracted is two. Based on the Kaiser criterion two factors were chosen.

The percentage of variance criterion suggests extracting a factor if it accounts for a certain percentage of the variance. Looking at Table 4, this means that the minimum number of factors that should be extracted is two. The first factor accounts for 58,25% of the total variance and the second factor for 27,65%. It can be noticed that the third factor accounts for 7,90% and the fourth factor only for 3,29% of the total variance. The first and the second factor together account for 85,90% of the total variance. According to the percentage of variance criterion two factors were chosen.

Table 4	Eigenvalues,	proportions	and	cumulative
proportio	ons of variance	e		

		Proportion	Cumulative
Factors	Eigenvalues	of	proportion
		variance	of variance
1	3,495	58,251	58,251
2	1,659	27,646	85,897
3	0,474	7,902	93,799
4	0,197	3,286	97,085
5	0,144	2,401	99,485
6	0,031	0,515	100,000

Figure 5 shows the scree plot for the eigenvalues. It has a distinct break between the factors with large and small eigenvalues. It indicates the number of factors by the point at which the line first begins to become horizontal. Based on the scree analysis two factors were chosen.

Fig.5 Scree plot



Table 5 shows the factor matrix after the extraction of two factors and associated eigenvalues and proportions of variance. It can be noticed, that the initial factor matrix was difficult to interpret.

Table 5 Initial factor matrix, eigenvalues and total proportion of variance for two extracted factors

Variable	Factor 1	Factor 2
GDPpc	-0,810222	-0,505297
prod	-0,789308	-0,593203
empl	-0,779177	0,523539
emplold	-0,516227	0,789357
price	-0,901713	-0,202543
unempl	0,727270	-0,336657

Eigenvalues	3,495083	1,658754
Proportion of variance	0,582514	0,276459

Since the initial factor matrix was not produced satisfactory results, the varimax rotation was used. Table 6 shows the rotated factor matrix and associated eigenvalues and proportions of variance. It is apparent that factor interpretation had become simplified by using the varimax rotation.

Table 6 Rotated factor matrix, eigenvalues and total proportion of variance for two extracted factors

Variable	Factor 1	Factor 2
GDPpc	0,947325	0,119836
prod	0,986619	0,038468
empl	0,273563	0,897983
emplold	-0,098184	0,938049
price	0,827083	0,412364
unempl	-0,351327	-0,720298
Eigenvalues	2,798019	2,355818
Proportion of variance	0,466336	0,392636

It can be noticed, that the eigenvalues have changed but their sum is still the same, 5,15837. Furthermore, the first factor accounts for 46,63% of the total variance and the second factor for 39,26%. The first and the second factor together account for 85,90% of the total variance, the same percentage as percentage given by the initial extraction.

The first factor has significant loadings on the following variables: GDP per capita, productivity of national economies expressed in relation to the European Union (EU-27) average and comparative price levels. The second factor has significant loadings on the following variables: total employment rate, employment rate of older workers and long term unemployment.

Finally, the factor scores were calculated for two extracted factors. Calculated factor scores were used in hierarchical and non-hierarchical cluster analysis.

3.6 Hierarchical cluster analysis for selected European countries on calculated factor scores

The hierarchical cluster analysis was run using the previously calculated factor scores. Again, various methods of hierarchical cluster analysis were provided to find out the number of clusters and the four-cluster solution given by the Ward's method with squared Euclidean distances was chosen as the best solution.

Figure 6 shows the dendrogram obtained by Ward's method with Squared Euclidean distances. The analysed countries are listed along the left vertical axis of the dendrogram. On the basis of the dendrogram in Figure 6 and the previous results the four-cluster solution was chosen.

Fig.6 Dendrogram (Ward's method, Squared Euclidean distances)



According to dendrogram the first cluster comprises nine countries (Belgium, Italy, France, Germany, Spain, Austria, Greece, Slovenia and Luxembourg), the second cluster five (Hungary, Poland, Slovakia, Croatia and Malta), the third cluster eight (Bulgaria, Romania, Czech Republic, Portugal, Estonia, Latvia, Lithuania and Cyprus) and the fourth cluster six (Denmark, Sweden, Ireland, Netherlands, United Kingdom and Finland).

It can be seen that on the basis of the factor scores for two extracted factors and Ward's method with Squared Euclidean distances Croatia was classified in the group of countries that have similar historical and political background: Hungary, Poland, Slovakia and Malta.

3.7 Non-hierarchical cluster analysis for selected European countries on calculated factor scores

The non-hierarchical cluster analysis was used to improve the previously mentioned four-cluster solution given by the hierarchical cluster analysis on factor scores. K-means method of nonhierarchical cluster analysis with Euclidean distances was provided on factor scores.

Table 7 shows the classification of countries in four clusters given by the Ward's method and by the K-means method. It can be noticed that the Kmeans method resulted in similar structure of the clusters as the clusters given by the Ward's method with squared Euclidean distances.

On the basis of K-means method Croatia was grouped along with Hungary, Poland, Slovakia, Malta, Greece and Slovenia. Again Croatia was classified in the group of countries that have similar historical and political background.

Table 7 Classification of countries in four clusters (Ward's method and K-means method)

Country	Ward's	K-means
Country	method	method
Belgium	1	2
Italy	1	2
France	1	2
Germany	1	1
Spain	1	1
Austria	1	1
Greece	1	4
Slovenia	1	4
Luxembourg	1	2
Hungary	2	4
Poland	2	4
Slovakia	2	4
Croatia	2	4
Malta	2	4
Bulgaria	3	3
Romania	3	3
Czech Republic	3	3
Portugal	3	3
Estonia	3	3
Latvia	3	3
Lithuania	3	3
Cyprus	3	1
Denmark	4	1
Sweden	4	1
Ireland	4	1
Netherlands	4	1
United Kingdom	4	1
Finland	4	1

Figure 7 shows the plot of means for four clusters obtained by the K-means method.





Figure 7 shows that in the fourth cluster, in which Croatia was grouped, all variables are below average. The first variable are factor scores for the first factor which has significant loadings on GDP per capita, productivity of national economies expressed in relation to the European Union (EU-27) average and comparative price levels. The second variable are factor scores for the second factor which has significant loadings on total employment rate, employment rate of older workers and long term unemployment.

4 Conclusion

The aim of this paper was to classify Croatia and EU 27 Member States according to the following structural economic indicators: GDP per capita, total employment rate, comparative price levels, employment rate of older workers, long term unemployment and productivity of national economies expressed in relation to the European Union (EU-27) average.

Firstly, the cluster analysis was run on three following variables: GDP per capita, total employment rate and comparative price levels. Because of the measurement differences these three variables were standardized. Various methods of hierarchical cluster analysis were first provided to find out the number of clusters. The best interpretative solution was provided by the Ward's method with the squared Euclidean distances. The four-cluster solution given by the Ward's method with squared Euclidean distances was chosen. According to the results of the Ward's method and three chosen structural economic indicators Croatia was classified along with the following EU Member States: Bulgaria, Hungary, Poland, Romania, Slovakia and Malta

A non-hierarchical cluster analysis was then employed to improve the results of the four-cluster solution given by the hierarchical cluster analysis. The K-means method resulted in similar structure of clusters like the clusters given by the hierarchical cluster analysis. On the basis of three chosen structural economic indicators and K-means method Croatia was classified into the group of the following EU 27 Member States: Bulgaria, Hungary, Poland, Romania, Slovakia, Malta and Lithuania.

The hierarchical cluster analysis and nonhierarchical cluster analysis were run to classify Croatia and 12 European countries that joined the EU during the last two waves of enlargement. Again the Croatia was grouped along with Bulgaria, Hungary, Poland, Romania, Slovakia and Malta.

The factor analysis was also applied. It intended to synthesis the following structural economic indicators: GDP per capita, total employment rate, comparative price levels, employment rate of older workers, long term unemployment and productivity of national economies expressed in relation to the European Union (EU-27) average.

Two factors were extracted by the Kaiser criterion, the percentage of variance criterion and by scree plot. Since the initial factor matrix was difficult to interpret the varimax rotation was used.

The first factor has significant loadings on GDP per capita, productivity of national economies expressed in relation to the European Union (EU-27) average and comparative price levels. The second factor has significant loadings on total employment rate, employment rate of older workers and long term unemployment.

Factor scores were calculated for the extracted factors, respectively for each country. Those factor scores were used in further cluster analysis and again similar results of classification was given.

The results of analysis are quite expected, since Croatia was grouped with the countries that have similar political and historical background. References:

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