

# CLUSTERING OF REGIONS OF THE EUROPEAN UNION BY THE LABOUR MARKET STRUCTURE

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## Abstract

This paper will be devoted to the problem of different areas in the European Union. We will distinguish regions of European Union by the characteristics of labour market. Among these characteristics we can mention employment/unemployment rate of different population groups of (divided by the age and gender), economic activity rate in these groups and demographic structure of whole population. We will use the method of cluster analysis to compare different regions by NUTS 2 in the European Union. The aim of the paper is to show differences in the European Union not only at the national but also at the regional level. One can expect that some regions of one country will be more similar to parts of a different country compared with rest of its own regions.

**Key words:** Labour market, cluster analysis, NUTS 2

**JEL Code:** J21, C38

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## Introduction

The Europe consists of many countries with different economic and social situation which is given by the historical events and development, position in The Europe and so on. It is obvious that one country consists of many regions which can be also different to each other region in the country. Our paper is devoted to the characteristics of labour market which can reflect the condition of economy as it is narrowly associated with the output of economy. We use the method of cluster analysis to make different groups of regions in Europe on NUTS 2 level.

We use unemployment rate, participation rate, share of part-time job on total job and the structure of population in each region as a characteristics of the clusters. We further divide these indicators by gender and by the age of population. We also observe the unemployment rate of people in the age from 15 to 24. This group of population is the most threatened by unemployment especially in the South Europe countries. Current economic crisis significantly affected the situation on labour market. We use the date from Eurostat database from the year

2012. The data are influenced by the economic crisis and it is expected that southern Europe countries are consisted in worse clusters.

The remainder of paper is following. The second capture describes briefly the problematic of unemployment. The third part consists of description of cluster analysis method used in our analysis. Next two parts devoted to characteristics description and presentation of results of analysis. Last section is conclusion.

## **1 Theoretical framework**

Unemployment is the theme which is frequently discussed not only in these days as a one of the serious problem associated with current economic condition of the countries in the world. Economic crisis affects the structure and the condition of labour market. Unemployment has cyclical behaviour and is thus narrowly associated with output of economy. The lower output of economy the higher unemployment is. This relationship can be described for example by Okun's law.

Walrasian point of view offers one of the extreme explanations of unemployment. Person who lose their job are indifferent about this situation because they can find identical job. It is expected that vacancies exists. And unemployment occurs as a process of matching of unemployed people and job. But this view on labour market is not accurate description. Workers differ from each other by different skills, experiences, imaginations about possible wages and so on. Workers should not find identical job and it can take much more time to find another job. Economic crisis affected the labour market by decreasing of number of vacancies on the market as many companies had to shut down its business. With respect of these words we can divide unemployment on basic types, see e.g. (Wickens, 2012):

- Involuntary unemployment: area group of people who are willing to work at the going wage but the job is not available. Involuntary unemployment is temporary and disappears in the period of booms. On the other hand it increases in the period of recession.
- Frictional unemployment. This type of unemployment is rather permanent and is associated with flow of the workers between jobs.
- Voluntary unemployment. These unemployed people are not seeking to get job and thus do not supply job. It can be said that they are out of the labour market.

The problem of unemployment is associated with the wages negotiating and wage setting. Search and matching models describes the process of trying to match up preferences, skills and needs of both sides of labour market subjects (supply and demand).

Workers and jobs are highly heterogeneous and it is the reason why the labour market cannot be Walrasian. The process of matching up workers and jobs is not instantaneous and it leads to unemployment, frictional unemployment. But there is also high role of turnovers, especially in some kind of industries, and we can say that significant part of unemployment will not be frictional.

The structure of labour market is different in each country in Europe. The differences are given by historical development, social and culture development. But it is also expected that the differences occur even between regions in one country. The turnovers mentioned above affect regions by the different way. We can use an example of Czech Republic and mining industry in the North Moravia. This region faces higher unemployment due to closing of coal mines.

The impacts of unemployment can be divided on social impacts and economic impacts. Economic impact can be expressed by the Okun law. Lower employment will lead to lower output of economy. Social impacts are associated mainly with long term unemployment. If someone is unemployed for the longer time his skills can deteriorate. He can also adjust his standard of living by restriction of consumption.

Labour force and its structure is significant variable which can affect long-term economic growth of economies. In order to analyse the labour market we can divide some indicators on fractional components. Labour market structure can be distinguished by the age and gender and we can thus observe the situation in one particular group of population.

We use unemployment rate and participation rate of different group of population, long term unemployment, rate of younger and rate of older people on total population and share of part-time job in order to describe the structure of labour market in European countries. Data from Eurostat are used in this paper.

## 2 Method description

In order to create clusters of objects we used hierarchical cluster analysis. Namely we used **Ward method (Ward-Wishart method)** which solves clustering by minimizing of heterogeneity of the clusters. By the other words the method creates cluster by maximization intragroup homogeneity. *The Ward criterion* indicated by  $G_1$  measures homogeneity of the clusters by the intragroup square sum of deviations from cluster average.  $G_1$  is defined by relationship

$$G_1 = \sum_{h=1}^k \sum_{i=1}^{n_h} \sum_{t=1}^m (x_{hit} - \bar{x}_{ht})^2, \quad (1)$$

where  $x_{hit}$  is a value of  $i$ -th object,  $t$ -th variable in  $h$ -th cluster

$\bar{x}_{ht}$  is average value  $t$ -th variable in  $h$ -th cluster

$n_h$  is number of objects in  $h$ -th cluster

$m$  is number of variables, which characterize the objects (EU countries)

$k$  is number of clusters

The criterion for clustering originates from the idea of minimal increase of Ward criterion,  $G_1$ , in each cluster. We can this idea formalize by equation

$$\Delta G_1 = \sum_{i=1}^{n_g} \sum_{t=1}^m (x_{git} - \bar{x}_{gt})^2 - \left( \sum_{i=1}^{n_h} \sum_{t=1}^m (x_{hit} - \bar{x}_{ht})^2 + \sum_{i=1}^{n_{h'}} \sum_{t=1}^m (x_{h'it} - \bar{x}_{h't})^2 \right). \quad (2)$$

Ward method tends to eliminate small clusters and create cluster with approximately similar size. It is used only together with square of Euclidean distance. The calculation of this distance  $D$  between  $i$ -th and  $j$ -th object is based on Pythagoras

$$D_E(\mathbf{x}_i, \mathbf{x}_j) = \sqrt{\sum_{t=1}^m (x_{it} - x_{jt})^2}, \quad (3)$$

where  $\mathbf{x}_i$  represents  $i$ -th object a where  $\mathbf{x}_j$  represents  $j$ -th object.

The first question in our analysis is to set the optimal number of clusters. We have used many criteria to make this decision. We have finally set 4 clusters based on evaluating coefficients, namely CHF coefficient, RMSSTD coefficient and Davies-Bouldin coefficient. These coefficients were set in the SYSTAT system.

Detailed calculation of the evaluating coefficients can be found for example in Gan, G., Mach., and Wu, J.

The two-step cluster analysis was used to create the group of countries. More detail of the problematic of cluster analysis can be seen in textbook devoted to cluster analysis see e.g. (Řezanková, 2009)

### **3 Characteristics description**

We have chosen twelve characteristics which can describe labour market in European countries and which enable us to distinguish regions into 4 clusters

#### **The rate of unemployment**

The rate of unemployment is measured as a share of unemployed people on the economically active population see e.g. (Spěvák, 2010). We observe here unemployment rate of different group of population together with total unemployment in economy. These groups are:

- *Population of 15-24 years old* which are considered as an alumni. This fraction of population the most threatened by the unemployment
- *Men*
- *Women*

The theme of unemployment of different groups of employees can be found in for example in Kieselbach, T. (2003), Elder, S. (2010) or Azmat, G. (2006)

#### **The rate of participation**

The rate of participation is measured as a share of active people in total population [4]. This characteristic describes how many people work or are able to work; this indicator thus eliminates retired people, young people and others who cannot work. Some other research can be seen in Aaronson, S. (2006) or Hotchkiss, J. L. (2009). We distinguish population into 3 groups:

- *Population of 15-24 years*
- *Population of 15-34 years*
- *Women*

#### **Long term unemployment**

The unemployment which lasts for longer time than 12 months is defined as long-term unemployment, see e.g. (Spěvák, 2010). This type of unemployment is very dangerous for the country economy as people can lose the contact with practice and their employability is decreasing. The problem can be associated with hysteresis, see e.g. Romer, D. (2012). Other research devoted to long-term unemployment can be seen in Chapman, B. (1993) or Pavelka, T. (2012).

#### **Part-time**

This characteristic can be considered as a proxy of flexibility of labour market. Countries with higher share of part-time job in total number of jobs have the labour market more flexible.

Part-time job are arranged in shorter period of time and are easily cancellable, see e.g. Kjeldstad, R. (2012)

### **The structure of population**

Labour force and its structure is significant determinant of long-term economic growth. We can say here that it is better to have higher ratio of younger people to total population in comparison with older/retired people. We recognize here to ratios:

- *Share of younger people to population*
- *Share of older people to population*

## **4 Analysis results**

As it is mentioned above we have divided regions of European countries into four different groups. The characteristics of these groups are concluded in Table 1. We have named the clusters by the colours in order to better presentation of results in Picture 1. It is possible to order clusters from the best to the worst.

The best one is green cluster which consists of the biggest number of regions, namely 162. The cluster is characterized by the highest mean value of participation in each fraction of labour market. The unemployment rate is the lowest if we will compare it with other clusters. The unemployment rate of younger people is here 16%. It is much higher rate in comparison with other rates in green cluster and it is in the line with statement that this part of population in threatened the most by the unemployment rate. We can compare this rate with other clusters and can see that the rate is much lower. This cluster has the highest portion of part-time jobs on total jobs in economy and the labour market can be considered as a most flexible. The black cluster characterizes the regions with the biggest problem on labour market. The participation rate is the lowest one and the unemployment rate is the highest one in comparison with other clusters. It can be seen that black cluster consists of the lowest number regions.

Between these two extreme clusters stand yellow and red cluster. The yellow one is little bit better than the red one and we can say that the yellow cluster is second best in the order.

**Table 1 clusters characteristics**

	Cluster	N	Mean	Cluster	N	Mean	Cluster	N	Mean	Cluster	N	Mean
total participation	GREEN	162	0,50	YELLOW	71	0,47	RED	36	0,45	BLACK	19	0,43
women's participation		162	0,46		71	0,42		36	0,39		19	0,37
participation of 15-34		162	0,69		71	0,64		36	0,60		19	0,59
participation of 15-24		162	0,51		71	0,40		36	0,33		19	0,32
share of elder people		162	0,17		71	0,18		36	0,18		19	0,16
share of young people		162	0,16		71	0,15		36	0,15		19	0,18
share of part-time jobs		162	0,25		71	0,16		36	0,12		19	0,12
Long-term unemployment		162	0,02		71	0,05		36	0,10		19	0,15
unemployment rate		162	0,06		71	0,10		36	0,18		19	0,26
unemployment rate 15-24		162	0,16		71	0,26		36	0,43		19	0,55
unemployment rate men		162	0,09		71	0,12		36	0,20		19	0,24
unemployment rate women		162	0,08		71	0,12		36	0,20		19	0,31

Source: Eurostat, own calculation

The Picture 1 presents decomposition on cluster in regions of European countries. Nordic countries and countries of BENELUX have its regions in the best cluster except two regions of Belgium. If we will move down from north to south, green colour is gradually replaced by yellow and red. The black colour can be seen only on the south of Europe. The worst situation was recognized in Greece. Statement about richer north and poorer south can be confirmed here. We can use this statement even in the case of Italy, where industrial north belongs to green cluster, while south of Italy is belonged to red cluster.

There are not many green areas in Eastern and Central Europe (CEE). The best situation is in the Czech Republic where most of regions belong to green cluster except North Moravia South-West of Czech Republics. These regions were affected by structural changes in economy when mining industry loses its former position in economy. We can also state that countries which belonged to Soviet bloc are in worse situation in comparison with western countries. We don't speak here about South Europe which is specific due to higher effects of current economic crisis.

The case of Germany is in the line with sentences above. We can see that almost whole Germany belongs to green cluster. The exception is former Eastern Germany where we can find Berlin too. These regions were coloured into yellow as the situation on labour market seems to be worse in comparison with other German regions.

Grey coloured countries are those where Eurostat do not offer any data.

**Picture 1 Clusters schema in Europe**



Source: Eurostat, own modification

## **5 Conclusion**

We have used the method of cluster analysis to describe the situation on labour market in the different European regions on the NUTS 2 level. The labour market is observed by the indicators like unemployment rate, participation rate, share of part-time job and the structure of population in different group of population.

The results showed that there is significant difference between north and south of Europe. Whilst the Nordic countries belong to the best cluster, the situation on the south is completely opposite. There is also evident difference between countries from former Soviet bloc and the rest of the Western Europe. We can say that the best situation on labour market in CEE region is in The Czech Republic where most of the clusters belong to the best group of European regions.

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