

# Multivariate Analysis of Life-long Learning in European Countries

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**Abstract:** EUROSTAT official data for 2006 and 2011 were analyzed for 33 European countries (EU-27 and six countries) using exploratory data analysis methods, linear regression models and cluster analysis with the goal of both discovering dependence of life-long learning on certain economic variables, and making cross-country comparisons, focusing on clusters of similar countries. Life-long learning variable, expressed as % of persons aged 25 to 64 who recently received education or training, is positively correlated with variable Gross Domestic Product per capita in Purchasing Power Standards, which is expressed in relation to the European Union (EU-27) average set to equal 100. Also, life-long learning is positively correlated on employment rate given by three variables defined as highest level of education attained, % of age group 20-64 years. The indicator of employment rate considered is based on the *EU Labour Force Survey*, according to which there are three compressed levels of education coded according to the *International Standard Classification of Education*. Descriptive analysis of data shows outliers appearing for each of variables in certain countries. Using Ward linkage and Euclidean distance on all variables considered distinct clusters of similar countries appear clearly in the dendrogram. Comparison of life-long learning data for 2011 and past 2006 indicates different moving directions over each of the countries under study.

**Key Words:** Cluster analysis, dendrogram, life-long learning, linear regression model,

## 1. Introduction

The purpose of the research is to get insight into way selected variables impact the life-long learning as the dependent variable in European countries. For that purpose five independent variables are considered: GDP per capita in PPS, three variables for employment rate, by highest level of education attained for three different levels (primary, secondary, tertiary), and net earnings base index. EUROSTAT official data for 33 countries (EU-27 and six countries) are used for 2006 and 2011.

Data are analysed using statistical descriptive, bivariate and multivariate methods. So, after data description, a multiple regression analysis, correlation analysis and simple linear regression analysis were applied. Cluster analysis was conducted for the purpose of recognising possible clusters of countries considering all the variables under study.

Several papers refer to similar researches. So, Jenkins et al. (2002) investigate the effect of the different qualifications acquired via lifelong learning on individuals' economic outcomes, namely wages and the likelihood of being employed in UK. The results provide strong evidence that there is employment effects associated with life-long learning. Egerton (2000a) analyses the pay differentials between men who obtained a degree at the conventional age, and men who obtained their degrees as mature students. Mature male graduates earned more than those with A-levels but less than early graduates, over most of their graduate careers. Egerton and Parry (2001) utilise the GHS to obtain estimates of rates of return for both male and female mature graduates. For men, the return was not sufficient to compensate for loan repayments and for women, on average, the return on their investment was estimated to be just

sufficient to repay the costs of loans and tuition fees. Blundell et al., (1997) used data from the National Child Development Study (NCDS) to examine the economic benefits of higher education in Britain. Generally, large returns to higher education were found, of around 12 to 14 per cent for men and 22 to 34 per cent for women.

A paper by Leigh and Gill (1997) investigated the returns for American adults taking two or four-year college courses after the age of 25, in comparison to those who did the courses at a younger age. The results obtained showed that, for males, two-year college programs gave higher returns to adults than to continuing students, although this result was significant only at the 10 per cent level. A study by Hill (2001) focuses more specifically on the outcomes associated with learning by mature students. In general, Hill's results show that on-the-job training was strongly associated with higher wages and wage growth, while there was also some evidence for a positive relationship between adult education and wages. A review of the literature on the economic benefits of vocational training was done by Barrett and Hovels (1998). Generally, vocational training was found to have positive effects on wages and on productivity in most of the research surveyed, and there was some evidence that, for those employees changing jobs, training received from one employer increased productivity and wages with another employer also.

## 2. Variables and results

The main variable under consideration is life-long learning which refers to persons aged 25 to 64 who stated that they received education or training in the four weeks preceding the survey. This statement is the numerator of the indicator studied. The denominator consists of the total population of the same age group, excluding those who did not answer to the question 'participation to education and training'. Both the numerator and the denominator come from the EU Labour Force Survey. The information collected relates to all education or training whether or not relevant to the respondent's current or possible future job. Life-long learning is the dependent variable. All dependent and selected five independent variables are described as follows in table 1.

**Table 1 Dependent and independent variables**

<p><b>DEPENDENT VARIABLE:</b>  <math>Y_{LLL}</math> = Life-long learning: % of persons aged 25 to 64 who recently received education or training in 2006 and 2011</p>
<p><b>INDEPENDENT VARIABLE:</b>  <math>X_{GDP\_PPS}</math> = GDP per capita in PPS, Index (EU-27 = 100)            Employment rate, by highest level of education attained % of age group 20-64 years  <math>X_{EMPL\_L0\_2}</math> = Pre-primary, primary and lower secondary education (levels 0-2)  <math>X_{EMPL\_L3\_4}</math> = Upper-secondary and post-secondary non-tertiary education (levels 3 and 4)  <math>X_{EMPL\_L5\_6}</math> = First and second stage of tertiary education (levels 5 and 6)  <math>I_{EARN\_2011}</math> = Net earnings base index; base = mean of net earnings in 2011 for 22 countries.</p>

In more details, Gross Domestic Product (GDP) is a measure for the economic activity. 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. As EUROSTAT states, if the index of a country is higher than 100, this country's level of GDP per head is higher than the EU average and vice versa. Basic figures of GDP pc 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. This index, calculated from PPS

figures and expressed with respect to EU27 = 100, is intended for cross-country comparisons rather than for temporal comparisons."

*Employment rate*, by highest level of education attained, is an indicator that is calculated by dividing the number of employed people within age group 20-64 years having attained a specific level of education, by the total population of the same age group. Level is coded according to the International Standard Classification of Education (ISCED, 1997):

1. Pre-primary, primary and lower secondary education: levels 0-2;
2. Upper secondary and post-secondary non-tertiary education: levels 3-4;
3. Tertiary education: levels 5-6.

The indicator is based on the EU Labour Force Survey (LFS), covering the entire population living in private households and excluding those in collective households such as boarding houses, halls of residence and hospitals. The data refers to the second quarter of each year, except FR and AT (quarter 1 all years) and IT (quarter 4 in 1992).

Further, *Net earnings base index*, base = mean of net earnings in 2011 are given only for 22 countries: Belgium, Czech Republic, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Hungary, Netherlands, Austria, Poland, Portugal, Slovenia, Finland, Sweden, United Kingdom, Iceland, Norway, Switzerland, and Turkey. Other countries did not supply data until the research deadline.

Descriptive statistical analysis gives the insight into the data for life-long learning in European countries in last five years, see Figure 1. In some countries this indicator increased, but in some did not.

**Figure 1 Life-long learning: % of persons aged 25 to 64 who recently received education or training in European countries 2006 and 2011**

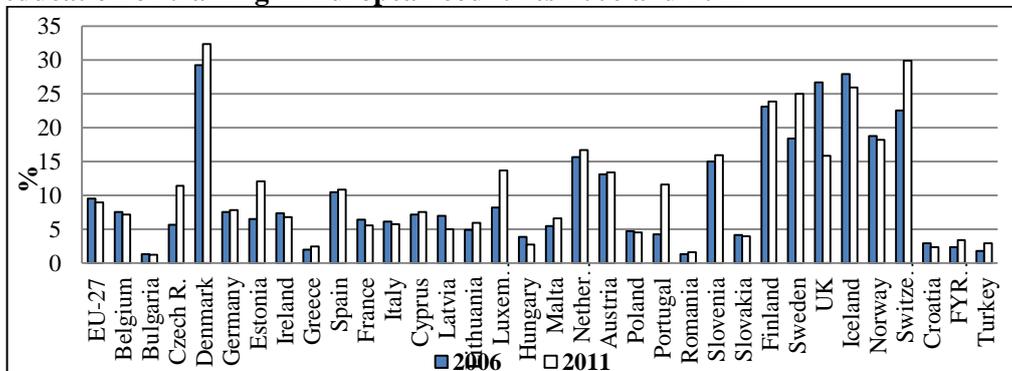
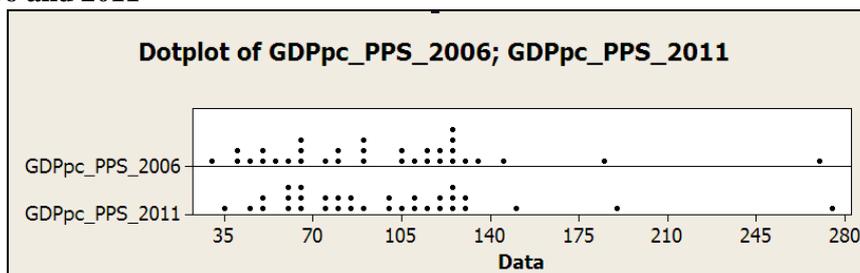


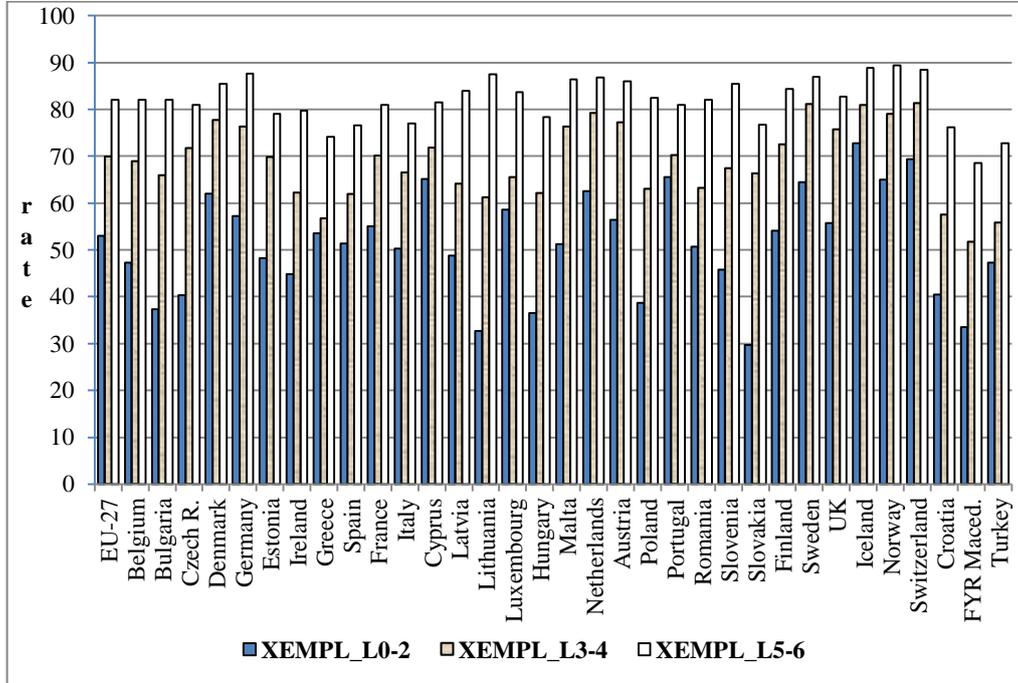
Figure 2 shows distributions of GDPpc in PPS, Index (EU-27=100) in European countries in 2006 and 2011. These distributions are both very skewed to the right, meaning that there are some large outliers, such as Luxembourg data.

**Figure 2 Dot Plots for GDP pc in PPS, Index (EU-27=100) in European countries in 2006 and 2011**



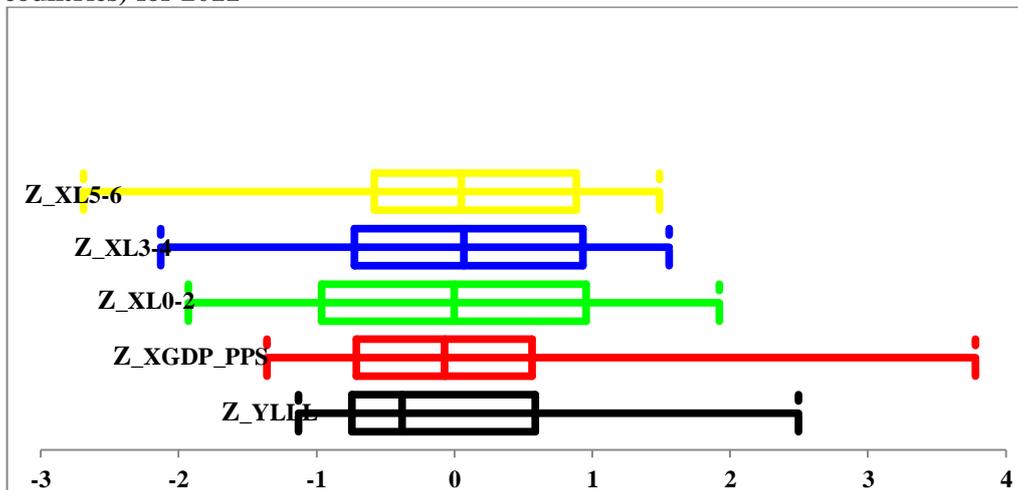
Further, employment rate, by highest level of education in European countries in 2011 is shown in Figure 3.

**Figure 3 Employment rate, by highest level of education attained % of age group 20-64 years in 33 European countries (EU-27 and six countries) in 2011 – by three levels**



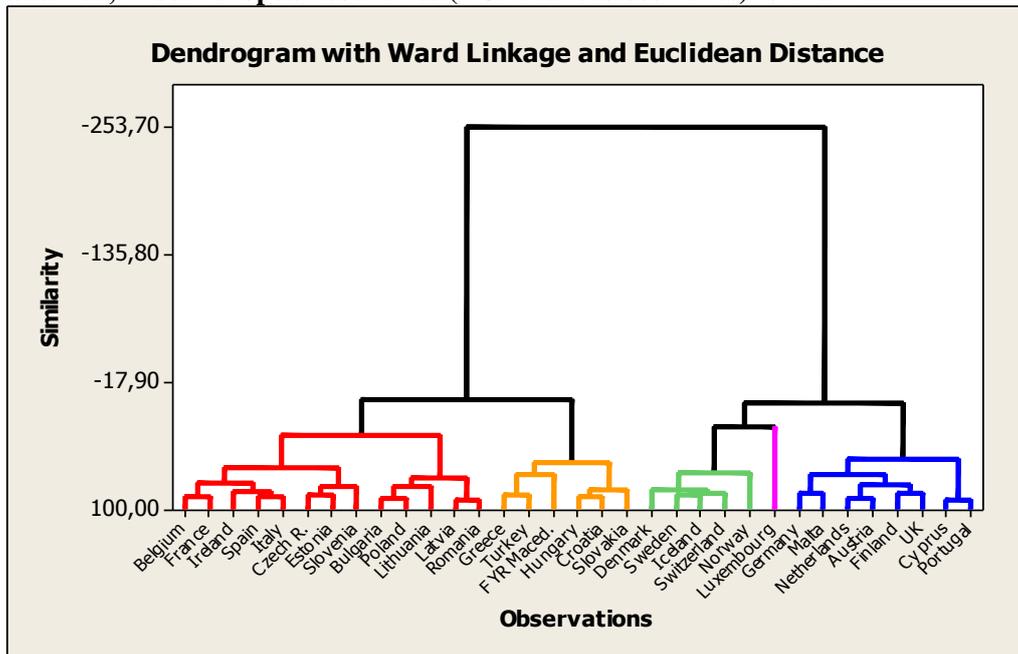
Comparison of distributions on five variables over 33 European countries in 2011 is given in Figure 4.

**Figure 4 BP for standardized data on LLL, GDPpc and employment rate, by highest level of education attained, in 33 European countries (EU-27 and 6 countries) for 2011**



Dendrogram resulted from cluster analysis of data for five variables and 33 European countries (EU-27 and six countries) in 2011 is given below in Figure 5. Five groups are remarkable. It is evident that developed countries are grouped together in three different groups, depending on similarity, and those transition ones are grouped, more or less, too. South-East European countries tend to be together, too. Luxembourg seems to be “a group of its own”.

**Figure 5 Dendrogram for standardized data on Life-long Learning, GDPpc in PPS (Index, EU-27=100), and employment rate, by highest level of education attained, in 33 European countries (EU-27 and 6 countries) for 2011**



Multiple linear regression analysis using OLS estimators was followed, but all the models created were not statistically founded, because basic assumptions of the models were violated.

Only three simple linear regression models estimated were both statistically significant, and with all model assumptions fulfilled. The analysis results are given in Tables 2, 3 and 4.

**Table 2 First simple linear regression model:**

Dependent variable = $Y_{LLL}$ ; Independent variable = $X_{EMPL\_L0\_2}$ ; n=33 countries	
$\hat{y} = -16.16 + 0.53X_{EMPL\_L0\_2}$	$R^2 = 0.4734$
(5.24) (0.10)	$r = 0.69$
	$DW = 1.60$
	n=33

One unit increase in level on tertiary education will increase the proportion of people who received education or training in age between 25 and 64 through life-long learning, on average, for 0.53. The model explains 47.34% of all variations in dependent variable. In this model all assumptions of the regression model are also met.

**Table 3 Second simple linear regression model:**

Dependent variable = $Y_{LLL}$ ; Independent variable = $X_{EMPL\_L3\_4}$ ; n=33 countries	
$\hat{y} = -44.61 + 0.81X_{EMPL\_L3\_4}$	$R^2 = 0.5700$
(8.71) (0.81)	$r = 0.75$
	$DW = 2.15$
	n=33

One unit increase in level on pre-primary, primary and lower secondary education will increase the proportion of people who received education or training in age between 25 and 64 through life-long learning, on average, for 0.54. The coefficient of determination equals 0.5700, which mean that the model explains 57% of all variations in dependent variable. In this model all assumptions of the regression model are also met.

Further variable was introduced as an independent one and that is net earnings as a base index. Since, 11 countries did not supply official data, only 22 countries are analysed.

**Table 4 Third simple linear regression model:**

Dependent variable = $Y_{LLL}$ ; Independent variable = $I_{EARN\_2011}$ ; n=22 countries	
$\hat{y} = -2.73 + 0.09 \cdot I_{Earn\_2011}$	$R^2 = 0.4495$
(2.76) (0.02)	$r = 0.6704$
	$DW = 1.78$
	n=22

One unit increase in net earning index (base=average for 22 countries) will increase, the proportion of people who received education or training in age between 25 and 64 through life-long learning, on average, for 0.09. The coefficient of determination shows that the model explains 67.04% of all variations in dependent variable. In this model all assumptions of the regression model are also met.

### 3. Conclusion

In European countries life-long learning depends on net earnings positively, and on primary and tertiary levels of education, which influences the employment rate. These linear relations are positive and moderately strong.

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