

**STOCHASTIC LINKAGE ANALYSIS AND STRUCTURAL CHANGES
THAT INFLUENCE THE EDUCATIONAL SYSTEM IN THE
EUROPEAN UNION IN ACCORDANCE WITH THE "EUROPE 2020
STRATEGY"**

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Abstract

At European level of education and training plays a crucial role in the development strategies. "Strategy Europe 2020" is a key tool for the modernization of the education and training not only to the general level the European Parliament but this document pays a special attention to each Member State of the European Union. In the conditions under which the most Europeans significantly spend much time in the process of education, reflect through no fault of their own to join in higher education, as well as the participation in the initiatives of learning throughout the life cycle for the purpose of retraining or a change of his political career. The manifestation of this phenomenon is due to the diversity of opportunities that it provides its citizens to study and work in order to improve the economic performance of the European Union.

Key words: strategy, higher education public funds, European funds, macroeconomic indicators, quality education

JEL Classification: A23,C52,I28

1. The introductory aspects on higher education at European Union level

The role of higher education in the knowledge-based society is recognized both at the level of the European Union and to the Member States. From this level of education expects an important contribution in the

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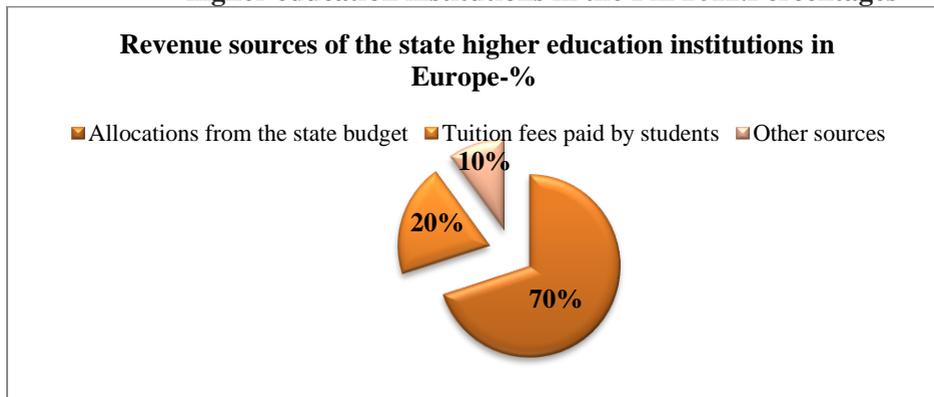
attainment of the objectives listed in the Lisbon agenda, in respect of growth, prosperity and social cohesion. These requirements were included in the work program of the European Union to be known as the "Education and training for 2010", which underlined clearly, the importance of the modernisation of higher education institutions and of the reforms encouraged by the Bologna process, all with the aim of creating a European area for higher education".

The objective of the European Parliament for higher education, that was supposed to reach a higher level of quality in order to pass the test of comparing its internationally. Parallel, higher education in the EU had to enhance its leadership and responsibility, increase their financing and to diversify the sources of financing.

The sources of the constitution of the incomes of higher education institutions of the state are structured, at a European level, on three lines, namely:

- The allocations from the state budget of the Member States; they represent the main source of financing of higher education institutions by the state with a weighted, at a European level, between 50-90 percent of the total revenues;
- Study fees paid by the students, whose value directly depends on the policy funding of higher education, promoted at national level;
- Other sources - contracts for scientific research, the provision of services in various fields, European funds and other extrabudgetary sources; this budget line providing, in some countries of the European Union, up to 10 % of the total value of the incomes for higher education (see figure 1).

Figure 1. Sources of funding for activities like taking in the higher education institutions in the I in 2012. Percentages



Source: The European Commission - DG education and culture. 2008. " The Government in higher education in Europe. Policies, structures, financing and academic body/ Higher Education Governance in Europe. Policies, funding structures and academic staff";

[Http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/091RO.pdf](http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/091RO.pdf)

Of the actions, respectively projects in the "Strategy Europe 2020" connection elements with the future developments of the system for the university education have all seven (The Innovation; Youth in motion; the Digital Agenda for Europe; efficient resources for Europe; an industrial policy suitable for the globalization age; Agenda for the new qualification and places of work; European Platform against poverty and social exclusion). In this context, it is to be mentioned that the involvement of each project in future developments of the system for the university education is different, and by the national programs and those of the support of the EU integration of young people, including the graduates of higher education, in the labor market is and will be a constant preoccupation.

The entire policy of coordination of MS through their actions, respectively projects in the "Strategy Europe 2020" must take into account the following: changes of a general nature which will appear in the Society; the globalization process and intensify the commercial relations between Member States; changes in the field of labor productivity generated by the

development of computer science, of communications and the technology; pressures on the natural resources and the role of climate change. All these will have to be included in the training programs of the future graduates of higher education because this is the only way he will be able to improve their competitiveness and profitability of human performance and will be able to record an economic growth intelligence, sustainable and inclusive.

2. Research Methodology

The source of the data was based on statistical data taken from Eurostat. Such data have affected the main macroeconomic indicators of measurement status and financial efforts of MS of the European Union in the field of education in the "Strategy Europe 2020". Main methods of research used in the case of the series of time have been total research for macroeconomic indicators characterizing the education. The study on the state of the educational system in the European Union, at present, was based on data and information on the EUROSTAT such as: the number of children and the students; the percentage of the population on the levels of education; graduates of university education in the total and depending on the gender; etc.

Acceptance of data from Eurostat have enabled the use of simple method (basic) characterisation of education as for example: graphics method that shows the evolution of macroeconomic indicators of the status of education at European level, the method of structural changes and simple method of the processing of these indicators determined in this case, as indicators absolute, relative and synthetic (medium) review in an independent manner.

Analysis and modeling data to characterize trends in the education system in the European Union in accordance with the "Europe 2020" took into account, in the second part of the study, correlation analysis can be established following the application of regression methods and methods of correlation parametric between specified indicators and influence factors taken using management programs and database analysis (EViews). (Serban, D., Cristache,S.,Tigu,G,2012)

Regression analysis is the statistical technique that identifies the relationship between two or more quantitative variables a dependent variable, whose value is to be predicted, and an independent or explanatory variable, or variables, about which knowledge is available. The techniques are used to find the equation that represents the relationship between the variables.

3. Characterize the state education system in the European Union based on data volume secundare-evolution, correlation

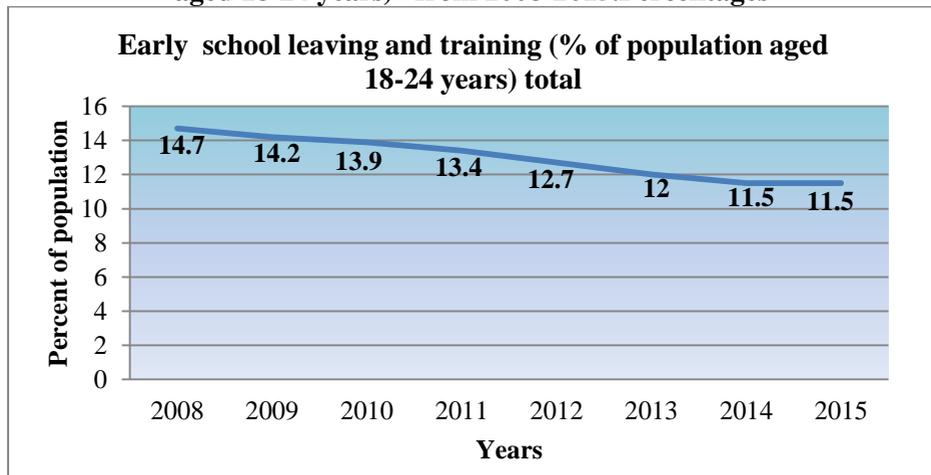
3.1. The analysis of the evolution and the structural modifications of main macroeconomic indicators characterizing the condition of the educational system in the European Union in accordance with the "Strategy Europe 2020"

The main indicators on the state of the education system of the "Strategy Europe 2020" are in a first classification those relating to: Leaving the early school and training (by weight of the population in the age of 18-24 years) for total and by gender; school population; the percentage of the total number of university graduates (total; by gender), learning mobility of students in Europe; total number of student;etc.

- ***Leaving the early school and training***

In Figure 2 we can see a descending trend in early school leaving and training which corresponds with a decrease in the annual average 0,54 percentage points. The decrease of the early leaving of school and training in the period 2008-2014 was 4%. In the same time this macroeconomic indicator which characterizes the condition of the educational system in the EU in accordance with the strategy of Europe 2020 registered a decreasing trend, with an annual average of 13,2 percentage points /year which indicates a positive evolution of system status of education in the EU.

Figure 2. Evolution of early school leaving and training (% of population aged 18-24 years) –from 2008-2015.Percentages



Source: Eurostat, from the section web: Europe 2020 headline indicators
The estimated data to 2015

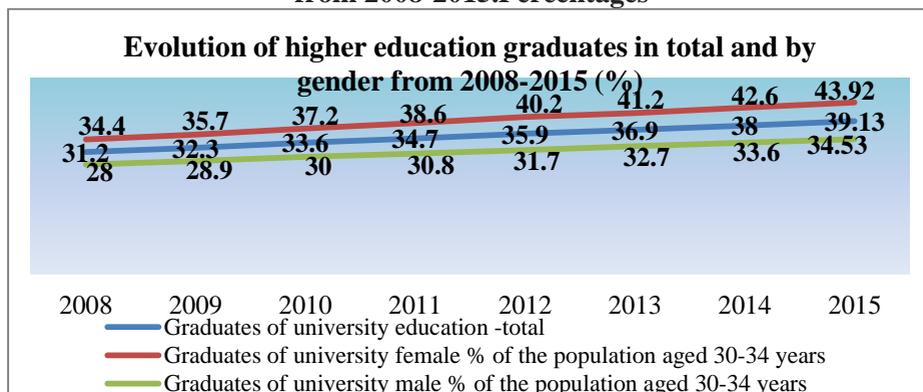
The positive results of this indicator (the abandonment of school) at the level of EU, are complex and multiple as for example: the favorable economic situation, reduction of external migration, the conditions of the positive family, etc.

- **Graduates of academic education-** represents the second macroeconomic indicator of the characterisation of the status of the educational system in the European Union (see figure 3).

The graduates from the university education - total were recorded in this period (2008-2014) an ascending evolution with an annual average of about 35 percent and an average annual increase of 3,08 %. Salary the annual average of the number of graduates of higher education institutions was 0,93 percentage points. the average annual growth rate of the graduates of higher education institutions of gender Female was 3.62% ,better than the gender Male with 0.28 percentage points (see Figure 3).

In conclusion, for this were taken into account the main indicators on the "Early school leaving and training", because in the light of the evolution of the numeric school population, we can reach or not the parameters proposed in "Strategy Europe 2020" for the graduates of higher educational establishments.

Figure 3. Evolution of higher education graduates in total and by gender from 2008-2015. Percentages



Source: Eurostat, from the section web: Europe 2020 headline

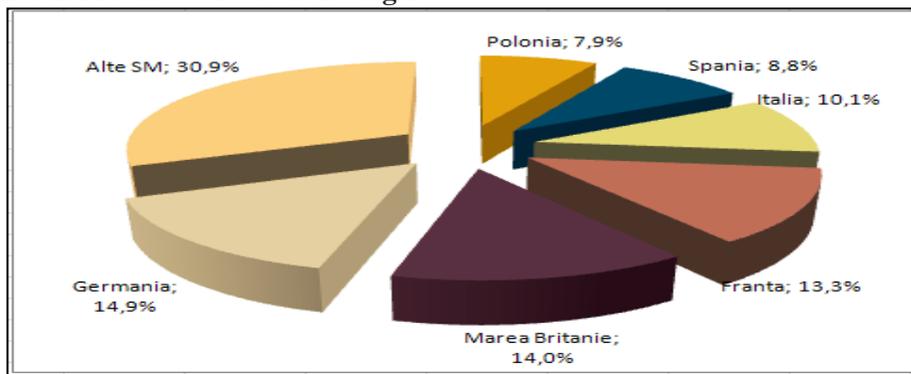
indicators

The estimated data to 2015

- ***The student population***

The student population in 2012 was 93,2 million children and students. Over 50 % of the number of children and students (52.4%, respectively 48.835,9 thousands of children and students were in Italy (9407,6 thousand children and students, respectively 10.1% of the total), France (12.418,6 thousands, i.e. 13,3 %), Great Britain 13.093,6 thousands, respectively 14,0%) and in Germany (13.916,1 thousand children and students, i.e. 14,9 %). Romania with 3.315,4 thousands of children and students represented 3,6 % of the total number, coming close to the Netherlands (3.698,1 thousands of children and students, i.e. 4,0 % of the total number) (see Figure 4).

Figure 4. Population structure represented by school children and students in 2012. Percentages



The analysis of the dynamics of school population in the period 2007-2012 indicates on the EU-28 a decreasing trend (from almost 94 million children and students in the year 2007 to 93,2 million children and students in 2012; out with 0.8 percentage points). At the level of each SM developments were differentiated, as follows:

- In 12 SM the *number of school population* has increased with values between 1 and 16 percentage points (France; Luxembourg). The largest increases were registered in Ireland (by 5.7 percentage points), Spain (8,2 percentage points), the Netherlands (10.5 percentage points), Denmark (12.7 percentage points) and Luxembourg (16.0 percentage points);
- In Sweden the *number of children and students* from the year 2012 has remained at the level of 2007 (2.061,5 thousands of children and students);
- In the other 15 ms *number of school population* was reduced with values between 1 and 22.2 percentage points (Italy; Latvia). The largest price declines of the number of children and students in 2012 compared to 2007 were registered in Latvia (22.2 percentage points), Lithuania (19,1 percentage points), Romania (13.6 percentage points), Poland (12.0 percentage points), Slovakia (11.6 percentage points) and in Estonia (11.5 percentage points).

At the level of the MS, in 2014, the lowest weightings of the level of the *university education* (ISCED 8), to the population of 25-54 years, has

been registered in Italy and in Romania (18,3 % in each SM). In a situation relatively close to Romania in terms of university education (ISCED 8), in the year 2014, to the population of 25-54 years, have located the following MS: Slovakia (22.3 % of the total population of the category of age of reference); Malta (23,0 %); Rep. of Czech Republic (23.5 percent); Croatia (23,7 %); Portugal (24,4 %); Hungary (25,6%).

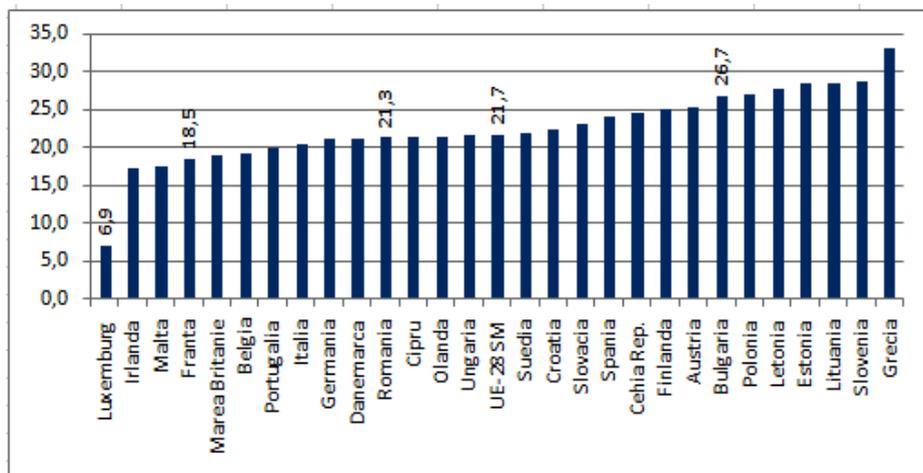
At the opposite pole, over 40 percent of the population to the category of the age of 24-54 years, the year 2014, were situated: Belgium (40,1%); Sweden (41.3%); Great Britain (42.6%); Cyprus (44.0%); Finland (44,5 %); Ireland (45.1%); Luxembourg (49.4%). The category of the age of 55-74 years the population with highest share at the *university education* has been recorded in the following MS: Great Britain (31,0 % of the total population of the age group reference); Finland (31.8%); Estonia (35,3%). To the population in the age of 55-74 years the smallest weightings of the level of the University Education (Isced 5-8) were registered in Romania (7.7 percent of the population of this category of age). To this indicator at a level close to Romania was located and Malta (8.6%).

The highest weightings of the level of the university education (ISCED 8), in the year 2014, were registered in Belgium and the Netherlands (with 24,0 % each); Germany (24,0 %); Lithuania (24,3%); Denmark (21,6 %); Sweden (28,2 %); Luxembourg (28,5 %); Great Britain (31,0 %); Finland (31.8%); Estonia (35,3).

- ***The total number of students***

The total number of students in the year 2012 was of 20.2 million students and represented 21,7 % of total school population. On SM the share of the total number of students in the school population total, in 2012, has recorded the oscillation between 6,9 % (Luxembourg) and 33,0 % (Greece). Romania with 705,3 thousands students owned the 3,5 % of the total number of students in the EU-28. The weights of the total number of students in total school population close to Romania had the following MS: Germany and Denmark (with 21.1% each); Cyprus (21,4 %); the Netherlands (21.5%); Hungary (21,6%) (see Figure 5).

**Figure 5. The share of students in the school population in 2012.
Percentages**



Source: Processes according

Eurostat, <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tps00062>.

[Http://ec.europa.eu/eurostat/tgm/download.do?tab=table&plugin=1&language=en&pcode=tps00051](http://ec.europa.eu/eurostat/tgm/download.do?tab=table&plugin=1&language=en&pcode=tps00051).

In 2012 compared to that of the year 2007, at the level of EU-28, the total number of students increased by 6,4 percentage points.

- **The total number of graduates of higher educational establishments**

Another indicator which characterizes the condition of higher education in the EU is the *total number of graduates*. Said indicator analysis took into account the share of population in the age group of 30-34 years, which have successfully completed their university education.

Thus in the year 2014, in the EU-28 the level of this indicator was 37,9 % and was dominated by the graduates of female sex (42,3%). Compared with the target set to this indicator by the Strategy Europe 2020 (40,0%) it is found that on the whole Union offset is of only 2 percentage points.

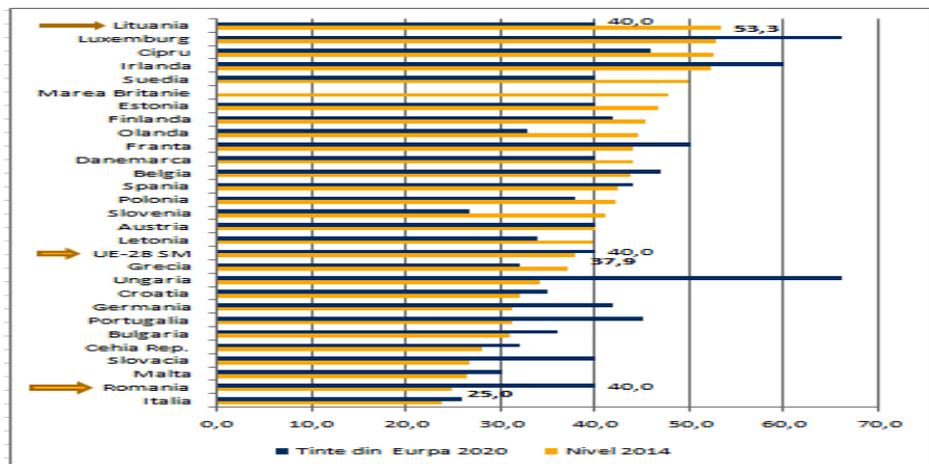
In 2014, the largest share of total number of graduates of higher education has been in Ireland (52,2%), Cyprus (52,5%), Luxembourg (52,7%) and in Lithuania (53,3%). Compared with the targets set for MS referred to by

the Strategy Europe 2020 (40,0%) is found to have recorded the following offsets: Ireland (with a decrease of 7,8 percentage points), Cyprus (with an increase in the percentage 6,5puncte), Luxembourg (with a decrease of 13.3 percentage points p) and in Lithuania (with an increase of 13,3 %) (see figure 6).

- **Mobility in the educational purpose of the students in Europe**

In accordance with the provisions of the community academic mobility means the right of the students and the PhD students to recognize the transferable credits acquired to other institutions of higher education accredited/ provisionally authorized in the country or abroad. A special role in the promotion of mobility in the educational purpose of the students in Europe have funding programs of the European Communities ; they are part of the new multiannual financial framework of the period 2014 to 2020, and shall ensure that at the level of EU-28 the number of beneficiaries of the future program in the field of education and training to be almost doubled (from 400,000 to approximately 700.00 per year).

Figure 6. The total number of university graduates in 2014 and targets set by Member MEMBER Europe 2020. Percentages



Source: Processing after:

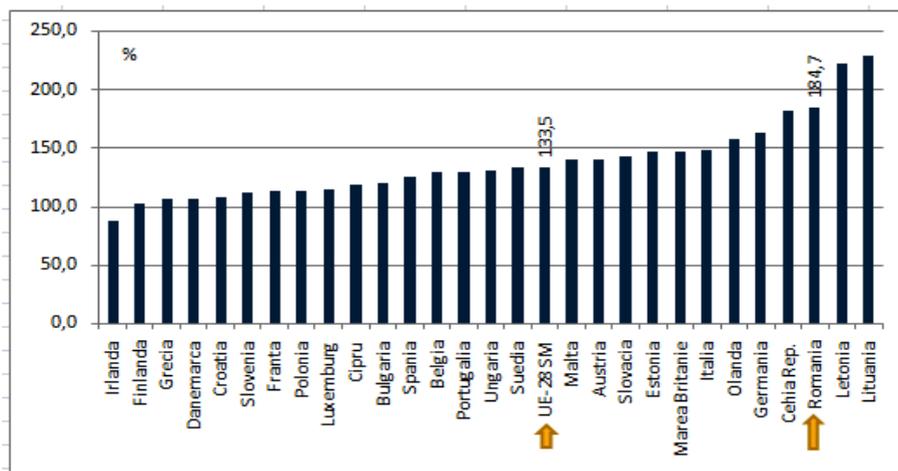
<http://ec.europa.eu/eurostat/documents/2995521/6787423/3-20042015-BP-EN.pdf/b2f295ba-2E15-409c-bulb9-91c4E49c5d32>

Analyze the evolution of the students in mobility on the EU-28, in 2012 compared to that of the year 2007, showed an increase of 33,5 % (from 497,1 thousands students in the mobility in 2007 to 663,7 thousands, in 2012). As a general observation: in all MS of the EU-28, excluding Northern Ireland⁴ has recorded an increase of students in mobility. The highest dynamic of students in mobility has been registered in the following MS: Lithuania (2,3 times); Latvia (2.2 times); Romania (1.85 times); Rep. of Czech Republic (1.83 times); Germany (1.64 times); the Netherlands (1,6 times). We mention that, in 2012, the students of these MS-EU-28 in mobility held 30.1 percent of the total number (199,5 thousands of students in the mobility) (see Figure 7)

A relatively low affluence of students in mobility has been registered in the following MS: Finland (2,2%); Greece (6.7%); Denmark (7,3 %); Croatia (8,7 %); Slovenia (12,5%); France (13,4 %); Poland (14.2%); Luxembourg (14.7%); Cyprus (19,2%).

⁴ In 2012 compared to that of the year 2007, the number of students in mobility decreased by 12,2 percentage points (from 28,8 thousand students at 25,3 thousand).

Figure 7. Dynamics of student mobility in Europe in 2007-2012 . Percentages



Source: Processing after:

<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tps00064;>

[http://ec.europa.eu/geninfo/legal_notices_en.htm.](http://ec.europa.eu/geninfo/legal_notices_en.htm)

It must also be said that in the year 2012, students of these MS-EU-28 in mobility held 33,6 % of the total number (197,6 thousands of students in the mobility).

3.2. The correlation analysis between the macroeconomic indicators characterizing the state education in the European Union during 2008-2015

An accurate analysis concerning the educational levels of a country's population implies the description of the political, economic, social and demographic context. Thus the analysis of complex correlations and interdependence of economic and social phenomena, elementary statistical methods are often inadequate (Andrei and Bourbonnais, 2008). Links to statistical analysis is necessary first to identify correlations, identifying and prioritizing their influence, followed by the analysis of the forms that show causal relations and statistical measurement of the degree of correlation.

Multifactorial ANOVA also allows analysis of the indicators characterizing educational system activity from Romania due to several factors and default comparison typical values in order to determine whether there are significant differences between them.

In this case the regression analysis covers the following stages: developing the regression model and estimating the model parameters, checking the accuracy of results. The following results of multiple regression function using linear regression model of multi-factorial were obtained:

$$Y_{x_1,x_2} = 64.35 - 2.19x_1 - 0.05 x_2$$

The link between the variables of this model is measured by the multiple correlation report of ($R_{y/x_1,x_2}=0.98$). We appreciate that the multiple relationship is in a linear form and very intense. The positive sign of the correlation indicates that our relationship is also direct. (see **Table 1**). The regression coefficient (b_1) is 2.19 which means that a growth in terms of **early school leaving and training (% of population aged 18-24 years-total)** of just one percentage will lead to an average decrease in the annual **percentage of the total number of university graduates** by about 2.19%. Since $t = -4.54$ and $p\text{-value} = 0.006 < 0.05$ the coefficient b_1 is valid for a significance level of 0.05 The regression coefficient (b_2) is 0.05 which means that a growth in terms of **percentage of the student mobility in Europe** of just one percentage will lead to an average decrease in the annual **percentage of the total number of university graduates** by about 0.05%. Since $t = -0.19$ and $p\text{-value} = 0.85 > 0.05$ the coefficient is not valid for a significance level of 0.05.

Checking the accuracy of the multiple regression models and of the multiple correlation ratios, based on "Fisher" criterion, leads to the following conclusion: because the probability Significance F is less than 0.05 the multiple regression models is valid, with a significance threshold of 0.05.

The stochastic relation between variables is a high one. The coefficient of determination shows that 96% of the variation of **the percentage of the total number of university graduates** is explained by the influence of **early school leaving and training (% of population aged 18-24 years-total)** and **percentage of the student mobility in Europe** just pointing and R adjusted, but given the number of degrees of freedom. The difference of 4% representing the influence of other factors. By applying a multiple linear

regression model using Eviews (EViews, User Guide, Version 8.0) software package the following results summarized in **Table 1** were obtained:

Table 1: Multiple correlation between the percentage of the total number of university graduates as redundant variable and early school leaving and training (% of population aged 18-24 years-total) and percentage of the student mobility in Europe as factorial variables

| | | | | |
|---|-------------|----------------------|-------------|----------|
| Dependent Variable: : Percentage of the total number of university graduates | | | | |
| Method: Least Squares | | | | |
| Included observations: 8 | | | | |
| Percentage of the total number of university graduates= C(1) +C(2)* Early school leaving and training (% of population aged 18-24 years-total) +C(3)* Percentage of the student mobility in Europe | | | | |
| | Coefficient | Std. Error | t-Statistic | Prob. |
| C(1) | 64.35410 | 10.02133 | 6.421716 | 0.0014 |
| C(2) | -2.192259 | 0.482172 | -4.546628 | 0.0061 |
| C(3) | -0.058562 | 0.308087 | -0.190083 | 0.8567 |
| R-squared | 0.983692 | Mean dependent var | | 35.21625 |
| Adjusted R-squared | 0.977169 | S.D. dependent var | | 2.774444 |
| Log likelihood | -2.516602 | Hannan-Quinn criter. | | 1.178225 |
| F-statistic | 150.7985 | Durbin-Watson stat | | 1.439975 |
| Prob(F-statistic) | 0.000034 | | | |

From correlation chart we estimate that the points in the network graph (Figure 8.a) are uniformly distributed without gaps between them , so we can conclude that the link between **Early school leaving and training (% of population aged 18-24 years-total** and **Percentage student mobility in Europe** factorial variables and **Percentage of the total number of university graduates** the variable result is linear , direct and significant.

Figure 8.a Actual ,Fitted, Residual Graph

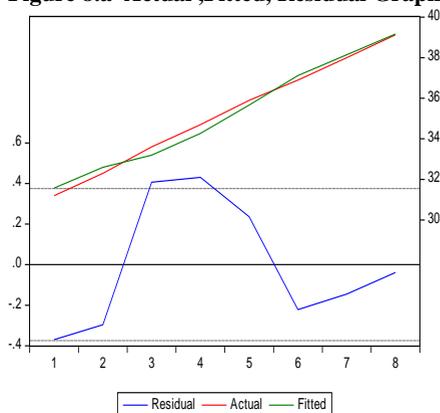
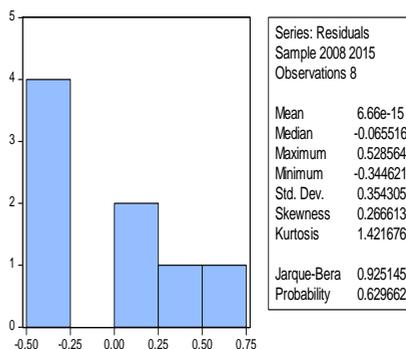


Figure 8.b Histogram Normally Test



The **Durbin-Watson test**, used in the errors autocorrelation analysis, in the multiply model (see Table 1) has registered a computed value $DW=1.43$, value which was compared with the critical statistic values for $\alpha=0.05$, $p=3$ and $n=6$; $d_1=0.95$ and $d_2=1.54$ don't necessarily imply that the errors are positively auto correlated. Verifying the normality of errors using **Jarque-Bera test** one observes that $JB_{calc}=0.92 < \chi^2_{tabel}=7.81$ which means that the errors are normally distributed (see Figure 8.b). Because errors occur evenly scattered around the environment of the regression line (see figure 4.a), the data shows heteroskedasticity, so the variance is constant.

To detect errors autocorrelation using empirical methods that test Breusch-Godfrey. With this test will analyze the existence of autocorrelation of order k , $k \neq 1$. It is assumed that the error of the regression model is given by the equation:

$$\varepsilon_t = \rho_1 \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + \dots + \rho_k \varepsilon_{t-k} + v_t, \text{ for } t = k, \dots, n, \text{ but } v_t \sim N(0, \sigma_v^2)$$

In order to evaluate the statistical presence of an autocorrelation of the order k to be used the following statistical hypotheses:

$$H_0: \rho_1 = \rho_2 = \dots = \rho_k = 0; \text{ the residuals are not correlated}$$

$$H_1: \rho_1 \neq 0 \text{ or } \rho_2 \neq 0 \text{ or } \rho_s \neq 0, \text{ the residuals are correlated}$$

It is seen by applying statistical software (EViews) statistical probability F is 0.19 (small) model shows autocorrelation of order 2.(see Table 2)

Table 2:Breusch-Godfrey Test for multiple regression model

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|----------|---------------------|--------|
| F-statistic | 3.833268 | Prob. F(2,3) | 0.1497 |
| Obs*R-squared | 5.749972 | Prob. Chi-Square(2) | 0.0569 |

The disadvantage is that regression method does not take into account the relationships between independent variables.

Conclusions

The priorities of the "Europe Strategy 2020" - intelligent economic growth, lasting and more inclusive - are differentiated according to the general level of development of the Member States of the Union, because each actor (member country) has a situation of socio-economic, including the status of higher education different. Therefore at the level of each SM there is a national system of education that uses the different elements of management and quality assurance in the education system.

Improvement of the quality of education, training and lifelong learning throughout the life is one of the main priorities on education and training in the action programs of the European Union - Programs - "Socrates" and "Leonardo da Vinci". At the same time the Council and the European Parliament have argued continuously with the promotion of evaluations of the quality of school and higher education and the quality objective of education has been brought to the foreground, especially in the aspects related to the cooperation (in the field of education) and vocational training. **The Bologna process and Lisbon process** configures the european space of education and quality assurance in education. The Lisbon European Council has established that until 2010, Europe to become the most competitive and dynamic economy in the world, based on knowledge and able to support a fast economic growth with more and better jobs".

All these elements have led to a positive evolution of the macroeconomic indicators characterizing the condition of education in the EU countries such as: the abandonment of school which is decreasing, permanent growth from year to year in the number of graduates from the university education, the development of mobility in the educational purpose of the students in Europe. **In accordance with the "Strategy Europe 2020"** on the increase of quality of the education system, it must be taken into account the centring of the university education of the student, expressing learning outcomes with cognitive skills and functional setting (professional and transverse), as well as by other purchases (values, belief, attitudes in their professional career and in life) are of such a nature as to increase transparency and attractiveness of the study programs, competitiveness and efficiency of these. In conclusion, although Romania is still deficient in the efficiency in higher education, there are some indicators such as average cost per student, and the average cost of labour, both situated a low level, on one side and very high enrolment rate in higher education for high school graduates, can induce a positive change.

Also, higher education has a decisive role in the social development, economic development, cultural development, scientific and political of society, with the role to form basic skills in practicing different forms of work. Finally, everywhere in the EU, the education system is faced with the impact of new technologies for knowledge and communication, as well as to the effect of the globalisation of society, of increasing interdependence between countries and cultures.

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