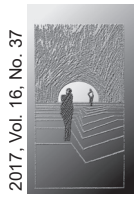

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Agnieszka Głodowska
Cracow University of Economics
Faculty of Economics and International Relations
Department of Foreign Trade
agnieszka.glodowska@uek.krakow.pl

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Level of Education and Economic Growth in the Member States of the European Union: A Comparative Analysis[1]

ABSTRACT

RESEARCH OBJECTIVE: The aim of the article is to present the results of the analysis of the education level in the European Union countries and to verify the relationship between the education and the economic growth of the studied countries.

THE RESEARCH PROBLEM AND METHODS: The basic problem of this publication is quantitative and comparative analysis of the level of education in the European Union countries (EU27). Research methods used in the paper are the analysis and synthesis of the literature on the subject as well as quantitative analysis of the education using statistical and taxonomic tools (descriptive statistics, cluster analysis, taxonomic measure of education [TME]). An analysis of regression and correlation is also conducted to investigate the relationship between education and economic growth.

THE PROCESS OF ARGUMENTATION: The line of reasoning consists of three essential elements. The first part presents the issues of education and economic growth in the light of the theory. This is a selective review of literature. The second part contains a comprehensive description of the research tools and methods. Part three of the article presents the results of the investigation in the field of education and its relationship with economic growth. The level of education was determined on the basis of an aggregated measure constructed from diagnostics variables. GDP per capita was used to estimate economic growth. The papers ends with conclusion and recommendations for future research.

RESEARCH RESULTS: On the basis of theoretical considerations, the influence of knowledge and education on economic growth has been confirmed,

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particularly in the models of endogenous growth. In empirical research, a great part of the research also indicates a positive relationship between education and economic growth. There are also elaborations that do not confirm this correlation. This study provides two important information on education and economic growth in the Member States of the European Union. Firstly, the area of the European Union is very differentiated taking into account the two criteria indicated. Over the years, a gradual reduction in disparities is observed both in GDP per capita and in TME. Secondly, quantitative analysis has confirmed the emerging relationship between education and economic growth.

CONCLUSIONS, INNOVATIONS AND RECOMMENDATIONS: The issue of relationship between education and economic growth is very important and timely. There is lack of papers in the literature that use taxonomic methods to evaluate education. These tools give great opportunity to present the problem in a multidimensional and comprehensive manner, taking into account a large number of variables. The research should be treated as a preliminary study in this field, which requires further in-depth investigation. It is recommended to include more diagnostic variables related to education, as well as, more advanced research techniques in the fields of statistics, econometrics and taxonomy.

→ **KEYWORDS:** EDUCATION, LEVEL OF EDUCATION, ECONOMIC GROWTH, EUROPEAN UNION, TAXONOMIC METHODS

Introduction

The role of education in economic growth at the declarative level is quite definitive. As far as theory is concerned, there is a widespread agreement that education are decisive for many economic areas and thus generate long-term changes in the economy. Empirical studies do not confirm unequivocal positive relationships between these categories. Evaluating education is a rather difficult task given the multidimensional nature of the problem. It is difficult to find a single indicator reflecting the state of education, especially at the country level. In addition, there is no current study on the level of education in the European Union, especially in the context of economic growth.

The purpose of the study is to present the results of the analysis of the education level in the European Union countries and to verify the relationship between the level of education and the economic growth of the examined countries. This is a comparative analysis of 27 European Union countries between the years 2000 and 2014. The research methodology used in the work is primarily quantitative research using

taxonomic methods, descriptive statistics, cluster analysis as well as regression and correlation analysis. In addition, in the theoretical part one uses the analysis and synthesis of literature on education and economic growth.

The structure of the study assumes three interrelated parts. The first part presents the issues of education and economic growth in the light of theory. This is a selective overview of the current literature on the subject. The second part contains a comprehensive description of the research tools and methods used. The third part of the paper presents the results of own research in the field of education and its links with economic growth. The level of education was determined on the basis of an aggregate measure constructed from partial variables. GDP per capita was used to estimate economic growth. The entire study is concluded with summary notes, which outline the most important conclusions of the analysis, as well as research limitations and recommendations for future research.

Education and economic growth: Theoretical approach

The importance of education for economic growth is quite obvious. In literature, there is widespread agreement that education and gaining knowledge are becoming the most important forces of long-term economic change today (Rządziński & Swarowska, 2016). Dynamic changes in the world economy have led to the emergence of a new development paradigm known as the knowledge-based economy. Education, however, may have different dimensions. First of all, it means education as human education. This is related to the intellectual, psychological and moral aspect. It aims at adapting to society, logical thinking, shaping free and personal judgment (Skubiak, 2013). In economics, education is understood as a human capital that is narrowly understood. The knowledge, the level of education and the competences of employees that enable them to perform their work and achieve their social goals, according to Bontis (2004), determine the level of human capital. It has the same impact on many areas of socio-economic life.

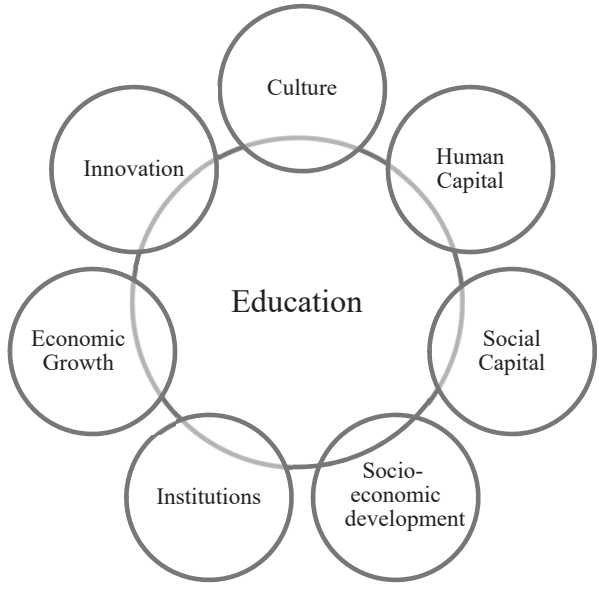

Figure 1. The impact of education on economy.
Source: own study based on Skubiak (2013, p. 197).

In the field of economic growth theory, education appeared with the emergence and development of endogenous growth models. In previous models, it was not a special feature. From the theory of neoclassical growth, it appears that the output per worker is determined by the accumulation of capital rather than intangible assets. The productivity of workers and its differentiation in the international cross section, in line with the neoclassical concept, resulted primarily from the technical equipment of labor (Jabłoński, 2012). Treating scientific and technical knowledge as a factor of exogenous economic growth in neoclassical models has contributed to research into its endogenization and thus the emergence and evolution of endogenous growth theory in which knowledge and education are key growth factors (Wojtyna, 1995). According to the Romer (1986) model, the creation of new knowledge in the enterprise creates positive externalities for the economy as a whole through the production capabilities in other companies. Knowledge as a factor of production is characterized by growing scale benefits as a result of the penetration of knowledge. In the next model, Romer (1990)

introduces human capital as an important factor of production alongside capital, labor and technology. In addition, he introduces three sectors into the model: (i) producing final goods, (ii) producing intermediate goods, (iii) research and development and four factors of production: (i) capital, (ii) labor, (iii) human capital, (iv) technology. There is a strong correlation between the individual factors of production and the sectors. Human capital used by the R&D sector produces new technologies that are in turn exploited by the intermediate goods sector. Intermediate goods are used for the production of final goods. Production growth, and therefore GDP growth, is therefore dependent on human capital and R&D expenditures (Romer, 1990).

Education and human capital have been explored in the economic model of Lucas (1988). According to the author, the growth of the economy is due to the increasing rate of accumulation of human capital. It influences the increase of labor productivity and contributes to the better use of other factors of production. The process of accumulation of human capital takes place through the process of education and learning by doing. Moreover, the so-called spillover effect of knowledge occurs, i.e. its flow between businesses and economies (Lucas, 2010).

From the endogenous theory of economic growth, it is clear that the performance of workers is a reflection of their equipment in knowledge, qualifications and skills, or broadly understood education. The empirical study did not clearly confirm these relationships, but the excellent number of papers positively verified the assumptions of endogenous models. The positive influence of education on economic growth was confirmed by Landau (1983), Mankiw, Romer & Weil (1992), Tallman & Wang (1994), Chi (2008). Kyriacou (1991), Islam (1995), Shaihani, Harisb, Ismaila & Saida (2011) did not confirm the positive impact of education on economic growth in their works.

Methods and research framework

The availability of statistical data and the development of quantitative methods have significantly influenced the way education is estimated at country level. Consequently, quantitative tools in the field of descriptive statistics and taxonomy dominate in the article.

The following diagnostic variables were used to assess the level of education in the EU countries: (i) population between 25-64 with tertiary educational attainment – level 5-8 (% of total), (ii) early leavers from education and training (% of total population), (iii) participation rate in

education and training – people between 24-64 (% of total), (iv) unemployment rate with tertiary education (%), (v) expenditure on education as a % of GDP. The analysis period covers the years 2000-2014 and is primarily driven by the availability of exhaustive data for the 27 EU Member States (EU27). The study did not include Croatia due to the significant shortage of statistical material for this country.

The study was conducted with the use of taxonomic measure of development proposed by Hellwig (1967) and implemented in many research papers (Wydymus, 1984; Zeliaś, 2000; Malina, 2004; Łuczak & Wysocki, 2015). In this case the measure is known as a taxonomic measure of education (TME). This concept allows to build an aggregated indicator of education on the basis of diagnostic variables indicated above. Preserving the information value of individual diagnostic variables, there was constructed an aggregate value of education (TME). The measurement algorithms of TME are presented in Table 1.

Table 1
Formulas used to create TME

Standarization formula	Pattern model and Euclidean distance formula
$z_{ijt} = \frac{x_{ijt} - \bar{x}_{jt}}{s_{jt}}$,	$z_{0jt} = max\{z_{jt}\}$ *for stimulant* $z_{0jt} = min\{z_{jt}\}$ *for destimulant* $d_{0it} = \sqrt{\sum_{j=1}(z_{ijt} - z_{0jt})^2}$
Where:	
z_{ijt} – *value of standardized variable* x_{ijt} – *value of j variable of i country in t year* $\bar{x}_{jt}$ – *arithmetic mean* s_{jt} – *standard deviation*	z_{0jt} – *value of j standardised variable of the pattern model* d_{0it} – *Euclidean distance of i country from the pattern model*
Taxonomic measure of education (TME)	
$TME_{it} = 1 - \frac{d_{0it}}{d_{0t}}$ $d_{0t} = \bar{d}_{0it} + 2s_{dt}$	

Where:
TME_{it} – *taxonomic measure of education for i country*
$\overline{d}_{0it}$ – *arithmetic mean of Euclidean distance*
S_{dt} – *standard deviation of Euclidean distance*
$TME_{it} \in [0; 1]$

Source: own study based on Hellwig (1967), Zeliaś (2004), Wydymus (1984).

Taxonomic measure of education values from 0 to 1. The value closer to the 1 provide a higher level of education of the country. The grouping of the EU states was made according to level of education, using cluster analysis. An analysis of linear regression and correlation was used to analyze the relationship between education level (TME) and economic growth (GDP per capita).

The second research tool used in the paper is reduced to a qualitative instrument consisting of the analysis and synthesis of the subject literature on the issues of education and economic growth.

Level of education and economic growth: Empirical approach

The value of taxonomic measure of education for EU countries between 2000 and 2014 is presented in Table 2, while simultaneously displaying descriptive statistics for this measure.

Table 2
The value of TME and descriptive statistics for the EU countries in years 2004-2014 (selected years are presented)

Country\year	2000	2002	2004	2006	2008	2010	2012	2014
Austria	0.324	0.362	0.451	0.461	0.464	0.461	0.469	0.497
Belgium	0.496	0.523	0.514	0.485	0.485	0.475	0.477	0.493
Bulgaria	0.177	0.140	0.214	0.218	0.266	0.208	0.218	0.234
Cypr	0.400	0.518	0.540	0.519	0.558	0.511	0.465	0.456
Czech Republic	0.252	0.300	0.265	0.289	0.267	0.280	0.369	0.297
Dennmark	0.731	0.820	0.818	0.843	0.820	0.780	0.815	0.806
Estonia	0.450	0.427	0.347	0.401	0.493	0.342	0.468	0.430
Finland	0.615	0.675	0.653	0.678	0.681	0.682	0.761	0.701

France	0.383	0.397	0.366	0.360	0.384	0.378	0.409	0.539
Germany	0.347	0.381	0.331	0.297	0.359	0.380	0.406	0.359
Greece	0.174	0.146	0.143	0.124	0.165	0.195	0.075	0.098
Hungary	0.278	0.364	0.360	0.361	0.320	0.270	0.256	0.258
Irleand	0.308	0.379	0.391	0.428	0.456	0.403	0.445	0.380
Italy	0.240	0.219	0.215	0.197	0.193	0.186	0.196	0.288
Latvia	0.344	0.433	0.372	0.357	0.362	0.187	0.361	0.352
Lithuania	0.203	0.365	0.356	0.394	0.395	0.327	0.401	0.358
Luxembourg	0.326	0.328	0.335	0.280	0.273	0.308	0.488	0.301
Malta	0.047	0.059	0.114	0.241	0.240	0.262	0.273	0.234
Netherland	0.499	0.576	0.563	0.584	0.610	0.575	0.597	0.575
Poland	0.299	0.312	0.287	0.290	0.335	0.340	0.355	0.376
Portugal	0.013	0.156	0.153	0.047	0.008	0.137	0.198	0.281
Romania	0.243	0.137	0.103	0.115	0.157	0.087	0.070	0.009
Slovakia	0.415	0.327	0.216	0.229	0.179	0.213	0.192	0.229
Slovenia	0.305	0.482	0.535	0.541	0.476	0.499	0.496	0.436
Spain	0.116	0.182	0.134	0.197	0.136	0.120	0.109	0.056
Sweden	0.542	0.802	0.683	0.636	0.714	0.711	0.801	0.754
United Kingdom	0.626	0.582	0.596	0.656	0.568	0.580	0.562	0.559
Descriptive statistics								
Min	0.013	0.059	0.103	0.047	0.008	0.087	0.070	0.009
Max	0.731	0.820	0.818	0.843	0.820	0.780	0.815	0.806
Mean average	0.339	0.385	0.372	0.379	0.384	0.367	0.397	0.384
Coefficient of variation	52.0	51.9	51.8	51.8	51.8	51.7	51.8	51.6
Coefficient of skewness	0.313	0.527	0.513	0.496	0.324	0.592	0.370	0.285

Source: own study based on Eurostat (2000-2014).

Taking into account the spread of TME values and the coefficient of variation, it can be said that the level of education in the European Union area is quit differentiated or moderately differentiated. Over the years covered by the study, a slight reduction in this discrepancy can be seen. The arithmetic mean of TME values for EU countries has increased from 0.339 in 2000 to 0.384 in 2014, which is a gradual but very slow increase in the level of education in the EU Member States. The asymmetry coefficient is positive throughout the period considered, although the intensity of the asymmetry is changing. Positive asymmetry demonstrates that

most of the surveyed countries have a TME below the EU average. The asymmetry force is greater in the initial period of analysis, i.e. by 2010, the value of the asymmetry measure decreases, which means that the distribution becomes more symmetrical.

The results of grouping of countries in terms of similarity of education levels are presented selectively for the years 2000 and 2014.

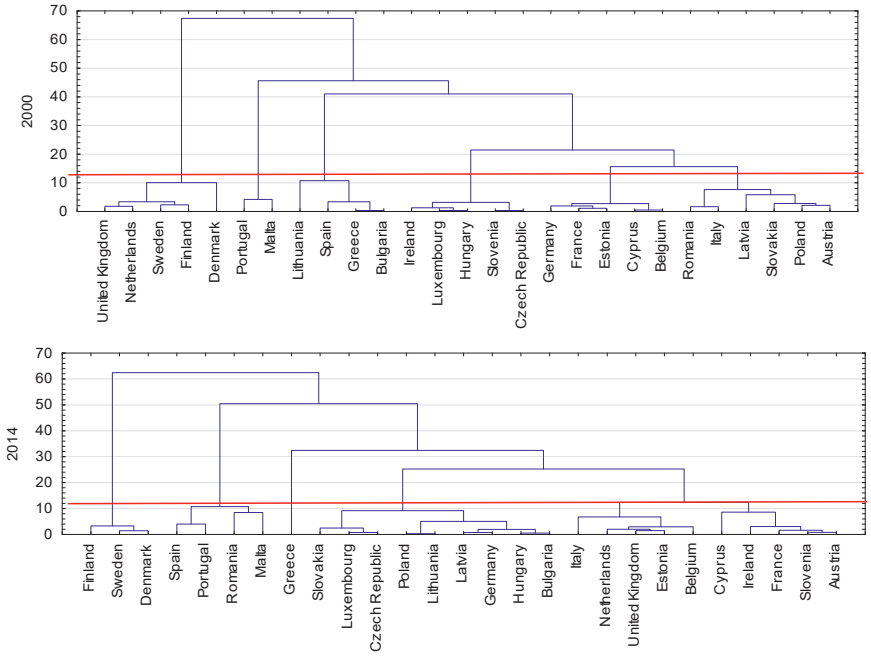

Figure 2. The grouping of the EU countries according to the level of education in years 2000 and 2014.
Source: own study based on Eurostat (2000, 2014).

On the basis of figure 2 it can be indicated 6 groups of countries according to level of education in 2000. These groups are:

Group I: Denmark, Finland, Sweden, Netherland, United Kingdom.
Group II: Portugal, Malta.
Group III: Lithuania, Greece, Spain, Bulgaria.
Group IV: Ireland, Luxemburg, Hungary, Slovenia, Czech Republic.
Group V: Germany, France, Estonia, Cyprus, Belgium.
Group VI: Romania, Italy, Latvia, Poland, Slovakia, Austria.

In 2014, 6 groups of countries with similar level of education can also be identified:

Group I: Finland, Sweden, Denmark.

Group II: Spain, Portugal, Romania, Malta.

Group III: Greece.

Group IV: Slovakia, Luxemburg, Czech Republic, Poland, Lithuania, Latvia, Germany, Hungary, Bulgaria.

Group V: Italy, Netherland, United Kingdom, Belgium.

Group VI: Cyprus, Ireland, France, Slovenia, Austria.

Compositions of groups from the beginning and the end of the analysis are not identical. There are some changes in the education level of the European Union countries during the period under review. Scandinavian countries with the highest level of education are the evident leaders of the countries being compared. The growth rate of education index in these countries is also the highest. The second group of countries with a relatively high level of education are the countries of Western Europe: the United Kingdom, the Netherlands, France, Belgium, Austria and Ireland. Subsequently, the "new – adopted" countries of Slovenia, Cyprus and Portugal have a relatively high level of education. These countries are among the Western European economies (France, Austria, Ireland) in the last year of comparison. The Baltic countries, Poland and Hungary show a high dynamics of changes in the level of education and a significant increase in TME in analyzed period. Romania and Bulgaria are the countries with the lowest level of education.

The variation in economic growth of the European Union countries in the years 2000-2014 was presented on the basis of GDP per capita. The GDP per capita value and descriptive statistics are shown in Table 3.

Table 3

The value of GDP per capita and descriptive statistics for the European Union countries in years 2000-2014 (selected years are presented)

Country\ years	**2000**	**2002**	**2004**	**2006**	**2008**	**2010**	**2012**	**2014**
Austria	25700	26700	28500	31000	32500	32000	34900	35700
Belgium	24500	26200	27300	29300	30100	30700	32200	33000
Bulgaria	5600	6600	7700	9400	11300	11400	12200	12800
Cyprus	18700	20200	21900	24800	27500	25400	24100	22400
Czech Republic	14100	15600	17600	19600	21900	21000	21900	23800
Denmark	25100	26300	27900	30900	32600	32900	33900	35100
Estonia	8200	9900	12200	15900	17900	16500	19600	20900

Finland	23400	24500	26300	28400	31600	29600	30700	30500
France	23000	24600	24700	26900	27800	27500	28500	29500
Germany	24100	25500	26900	28800	30600	30500	32900	34600
Greece	17100	19400	21500	23600	24400	21500	19100	19400
Hungary	10400	12500	13700	15100	16300	16400	17400	18700
Ireland	26400	30200	32700	36600	34900	33000	35100	37700
Italy	23700	24600	24800	26600	27800	26500	27000	26600
Latvia	7000	8600	10300	13000	15400	13400	16100	17500
Lithuania	7400	9000	11000	13600	16400	15400	18600	20700
Luxemburg	46500	49000	54500	63800	65800	64000	67100	72474
Malta	16000	16800	18100	19200	20700	21300	22200	24800
Netherlands	27700	29200	30000	33600	36200	34100	35300	36000
Poland	9300	10100	11300	12500	14500	15900	17800	18600
Portugal	16500	17500	18200	20400	21000	20900	20000	21100
Romania	5200	6200	7700	9700	12900	13100	14300	15300
Slovakia	9900	11400	12800	15600	18600	19000	20100	21300
Slovenia	15800	17400	19300	21300	23400	21200	21800	22800
Spain	18900	20900	22200	25500	26400	24400	24200	24700
Sweden	25600	26300	28400	31000	33100	31800	33800	34100
United Kingdom	22800	24600	26700	28400	28500	27300	28300	29900
Descriptive Statistics								
Min	5200	6200	7700	9400	11300	11400	12200	12800
Max	46500	49000	54500	63800	65800	64000	67100	72474
Mean average	18466.67	19992.59	21637.04	24240.74	25929.63	25062.96	26262.96	27406.43
Coefficient of variation	48.90	46.18	44.87	44.52	40.69	40.74	40.24	40.95
Coefficient of skewness	0.78	0.84	1.18	1.66	1.85	1.94	2.09	2.39

Source: own study based on Eurostat (2000-2014).

The variation in economic growth of the EU Member States should be regarded as high, but it is lower than the level of education (the value of the coefficient of variation is about 49%-42%). Over the years, the disparities in development of the European Union countries have been visible. GDP per capita distribution is asymmetric. There is a very large, growing

right-wing asymmetry, which demonstrates an increase in the number of countries which GDP per capita is lower than its average for the whole of the Union. On the other hand, high peak values of GDP per capita are visible, which value during the period under review is increasing dynamically. This high maximum value is generated by Luxembourg, where GDP per capita is the highest and far exceeds that of all other countries. Statistically, this is outlier. After eliminating Luxembourg from the database, the per capita GDP distribution of the EU countries becomes more symmetrical and the coefficient of variation is on average 30%. Accordingly, Luxembourg will not be presented in the further part of the analysis due to the generated defragmentation.

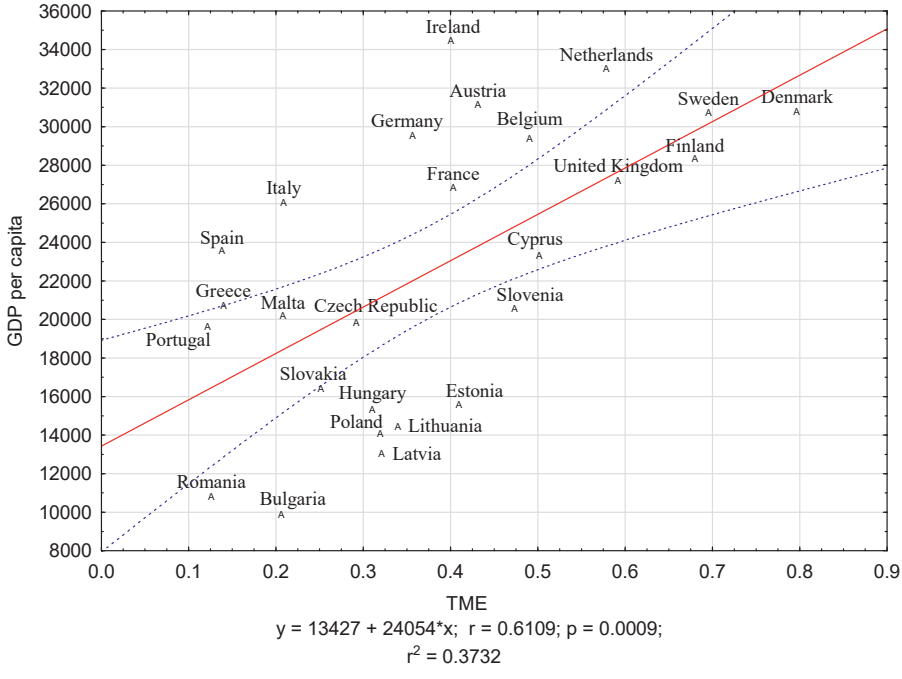

Figure 3. The value of TME versus GDP per capita (average values for the European Union countries in years 2000-2014).
Source: own study based on Eurostat (2000-2014).

Figure 3 summarizes the country-wide average TME and GDP per capita. Countries with the highest education index and at the same time the highest GDP per capita value are: Denmark, Finland and Sweden.

On the other side are Romania and Bulgaria, with the lowest GDP per capita and the lowest level of education. We can talk about the positive, linear relationship between TME values and the level of GDP per capita. The diagnostic variables used in the study transposed into the aggregate value have a positive effect on the economic growth of European Union countries. Doubts are aroused by the quality of model fit. The coefficient of determination of 0.4 indicates the weak and unsatisfactory fit of the model to the real values. Pearson's correlation coefficient above 0.6 indicates that the average correlation coefficient is positive.

Concluding remarks

The issue of education and economic growth is very important and timely. On the basis of theoretical considerations, the influence of knowledge and education on economic growth has been confirmed, particularly in the models of endogenous growth. In empirical research, a great part of the research also indicates a positive relationship between education and economic growth. There are also elaborations that do not confirm this correlation. This study provides two important information on education and economic growth in the Member States of the European Union. Firstly, the area of the European Union is very differentiated taking into account the two criteria indicated. Over the years, a gradual reduction in disparities is observed both in GDP per capita and TME. Secondly, quantitative analysis has confirmed the emerging relationship between education and economic growth. The availability of statistical data was the limitation of the paper. Doubts are aroused by the quality of model fit (coefficient of determination). The research should be treated as a preliminary study on the relationship between education and economic growth, which requires further in-depth investigation. It is recommended to include more diagnostic variables related to education. It is then advisable to use more advanced research techniques in the fields of statistics, econometrics and taxonomy.

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