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### MEDZINÁRODNÝ VEDECKÝ ČASOPIS MLADÁ VEDA / YOUNG SCIENCE

Číslo 1, ročník 9., vydané v marci 2021

ISSN 1339-3189

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Slovenská republika

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# VPLYV VÝDAVKOV NA VÝCHOVU NA HOSPODÁRSKY RAST: ANALÝZA PANELOVEJ REGRESIE V KRAJINÁCH EÚ

THE EFFECT OF EDUCATION EXPENDITURES ON ECONOMIC GROWTH:  
A PANEL REGRESSION ANALYSIS ON EU COUNTRIES

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## **Abstract**

In realizing the socio-economic development of countries, the factor that will provide growth and structural change is human capital rather than physical capital. One of the most important components of human capital is; is education. Education transforms the inexperienced and unskilled person into a more productive human capital by equipping them with the skills necessary for both the traditional economy and the modern economy. For this reason, education is an important variable that ensures the realization of the economic growth of developing countries as well as developed countries and the continuity of this growth. The aim of this study is to econometrically examine the short and long-term relationship between education expenditures and economic growth in EU countries in the 2000-2019 period. For

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this; short and long-term relationships between education expenditures and economic growth in EU countries are discussed within the scope of the panel co-integration and error correction model. The existence of a short-term relationship, with Pooled Mean Group Regression; the existence of a long-term relationship was investigated with the Pedroni Panel Cointegration Test. According to the results, it has been seen that the short and long term relationships between education expenditures and economic growth are positive and meaningful. While a 1% increase in education expenditures in the long term increases the economic growth by 0.29 %, it increases it by 0.23 % in the short term.

Key words: education expenditures, economic growth, European union countries, panel cointegration

### **Abstrakt**

Ľudský kapitál je výrobným faktorom, ktorý výrazne prispieva k sociálno-ekonomickému rozvoju krajiny a realizácii štrukturálnych zmien. Vzdelanie v tomto smere má dôležitú úlohu. Vďaka vzdelaniu sa dá odstrániť neskúsenosť a nekvalifikovanosť a naopak zvyšovať kvalitu a produktivitu ľudského kapitálu, tak potrebnú pre tradičné ako i pre moderné ekonomiky. Z tohto dôvodu je vzdelávanie dôležitou premennou umožňujúcou uskutočnenie hospodárskeho rastu rozvojových i rozvinutých krajín ako i kontinuitu tohto rastu. Cieľom tohto príspevku je poskytnúť výsledky ekonometrického merania krátkodobých a dlhodobých vzťahov medzi výdavkami na vzdelávanie a hospodárskym rastom v krajinách EÚ v období 2000 - 2019. Vysvetlenie ponúkame pomocou regresných modelov založených na kontingenčných vzťahoch v panelových dátach. Existencia krátkodobého vzťahu bola analyzovaná so združenou strednou skupinovou regresiou: existencia dlhodobého vzťahu bola skúmaná pomocou Pedroni kointegračného testu. Podľa výsledkov sa ukázalo, že krátkodobé a dlhodobé vzťahy medzi výdavkami na vzdelanie a hospodárskym rastom sú kladné a významné. Zatiaľ čo 1 % nárast výdavkov na vzdelanie v dlhom období prispieva k ekonomickému rastu o 0,29 %, v krátkom období je to 0,23 % nárast.

Kľúčové slová: výdavky na vzdelávanie, hospodársky rast, krajiny Európskej únie, panelová kointegrácia

### **Introduction**

Having sustainable economic growth is the primary priority of developed and developing countries. In this context, education status, which is the most important human capital component, is of great importance in improving and maintaining economic growth. When considered in the context of human capital investment and development, allocating more resources for education services and increasing these services increases the productivity of individuals. Individuals with increased productivity contribute more to the increase in the level of output production, which in turn contributes to increased economic growth.

Education is recognized as an important element of economic and technological development, especially in developing countries. The close relationship between education and development is an issue emphasized by modernist educational theorists, popular since the 1950s. Education makes significant contributions to economic development and increasing social welfare with

the increases in knowledge and abilities and thus productivity of the labor factor. In parallel with the development of the human capital theory that emerged in the late 1950s, studies on the return of education expenditures are being carried out. With globalization in the 1990s, the contribution of education in the formation of human capital has become the focus of attention of educational scientists and economists, as the inequalities between personal earnings have increased against unqualified labor force [1].

In the literature, the assumptions made regarding the function and importance of human capital in socio-economic development are expressed with different approaches in terms of the methods used and the findings obtained. According to Schultz, one of the economists who first theoretically contributed to human capital theory, human beings acquire useful knowledge and skills throughout their lives. However, it is not clear that these acquired knowledge and skills are a capital element that can be used in production. Human capital; in western societies, it leads to a growth that is not peculiar to humans, that is, faster and more than capital in the classical sense. In other words, a significant part of the growth rate in developed countries is explained by the increases in human capital [2].

What are the determinants of economic growth has always been one of the discussed topics in the literature. There have been many theoretical studies linking economic growth with education. These studies carried out for years have revealed the importance of human capital in explaining long-term economic growth. According to Lucas (1988), sustainable growth is the result of human capital accumulation. However, education is the main factor that determines human capital accumulation. Lucas digitized education by the time devoted to training. Romer (1986), on the other hand, argued that growth depends on the existence of human capital that can create innovations [3]. Human capital theory, education; It accepts it as the main source of human capital and the most effective factor affecting the lifetime income of the individual positively and directly, reducing the risk of unemployment [4]. Again, as the level of education increases, the risk of being unemployed in the labor market decreases is accepted as an important return of education [5]. On the other hand, education; it contributes significantly to the welfare of the society by causing positive externalities on the individual at the micro dimension and on the society and the country in the macro dimension.

The aim of the EU education policy is to create a European awareness among citizens, to train students and teachers through exchange, and to ensure the participation of member countries in R&D [6]. On the one hand, the Union attaches importance to the principle of respect for diversity in education among countries with different education systems; On the other hand, for the future of Europe, it foresees the regulation of the education systems of the member countries in line with certain principles. Because, the most rational way to reduce the possible negative effects of the diversity in the education policies and systems of the member countries is to cooperate in the field of education among the member countries [7]. Therefore, it can be said that the regulations made and the programs prepared will play an important role in both strengthening Europe economically and accelerating its social and cultural integration.

The main purpose of this study is to analyze the short and long-term relationship between education expenditures (EDU) and economic growth (GDP) in EU countries in the 2000-2019 period, unlike other studies in the literature, using panel data. For this purpose, in this study, whether there is a long-term relationship between these two variables was examined and using an error correction model, it was investigated to what extent education expenditures affect economic growth in the short and long term. Therefore, in this study, it is tried to contribute to the literature by examining the effect of education expenditures on economic growth in EU countries with panel data analysis, both in cross-section and time dimensions, which were not previously discussed in the literature. The following sections of this study are organized as follows. In the second part, there is a literature research on the subject. Methodology is included in the third chapter. In the fourth section where the application takes place, the data and variables used and the findings obtained from the analysis are presented. The fifth section consists of the conclusion section.

## **Literature**

When the literature is examined, it is seen that the relationship between education expenditures and economic growth is examined in the context of many applied studies. Particularly, some of the studies conducted in recent years are presented below.

Slywester (2000), for the period 1970-1985; He examined the relationship between economic growth and human capital in African, Latin American and East Asian countries. It is concluded that while the simultaneous effect of public education expenditures on economic growth is negative, its long-term effect is positive [8]. In his research, Nunes (2003) examined the relationship between economic growth and education expenditure for Portugal between 1852-1993 and found a positive relationship as a result [9]. Musila and Belassi (2004) examined the effect of education expenditures on real GDP in the period 1965-1999 for Uganda using the Cointegration and Error Correction Method. As a result; they found that education expenditures had a positive effect on economic growth [10].

Gyimah-Brempong et al. (2006) investigated the effect of education on economic growth in 34 African countries using the panel data method, based on the period 1960-2000. In the study, they emphasized that the increase in expenditures for higher education in Sub-Saharan Africa will contribute to economic growth by accelerating the technological capture process [11]. Baldacci et al. (2008) analyzed the relationship between human capital and economic growth on 120 developing countries, based on the period 1975-2000. They used the Panel data method in their studies. As a result; They found that education expenditures have a direct positive effect on human capital accumulation [12].

The study by Beraldo et al. (2009) covering the years 1971-1998 was based on 19 OECD countries. As a result; It has been found that public education expenditures are more effective on economic growth [13]. Digdowiseiso (2009), in his study on Indonesia covering the years 1996-2005, states that the increase in the rate of participation in higher education significantly affects the economic growth [14].

Riasat et al. (2011) investigated the effect of education expenditures on Pakistan's economic growth in their studies. ARDL technique was used in the analysis part of the study. As a result; while education expenditures do not have an effect on economic growth in the short run; it has been found to be effective in the long term [15]. Tamang (2011) investigated the relationship between economic growth and education expenditures for the period between 1980-2008. As a result, he found a positive relationship between education expenditures and economic growth in his study using the cointegration analysis and Error Correction model [16]. Ding and Knight (2011) showed that the contribution of especially high school and higher education to economic growth is higher than primary education. Also; increasing the enrollment rates in higher education by 1% will create an increase of 2.8% on GDP per capita [17].

Hussin et al. (2012), in Malaysia between 1970-2010; It tested growth, education expenditures, capital formation and labor force variables with VAR Analysis. After all; growth has a positive long-term relationship with capital formation, labor force participation and education expenditure [18]. Tchantchane et al. (2013), in their study using the ARDL model for the Philippines, in the period 1992-2011, found that education expenditures indirectly affected growth [19]. Pamuk and Bektas (2014), have studied the period from 1998 to 2013 with the analysis of time series relationship between education and economic growth in Turkey and as a result, they concluded that there is a cointegration relationship between the two variables [20].

Ucan and Yesilyurt (2016), the relationship between education spending and economic growth in Turkey were examined for the period 2006-2015. As a result of the application, a long-term relationship was found between the two variables. However, they stated that there was a bidirectional relationship as a result of the Granger Causality test [21]. Balci (2019), based on the years between 1985-2015, analyzes Turkey, France, South Korea, has applied to the Netherlands and Portugal. In the analyzes, Toda-Yamamoto used the ARDL Boundary Test and Error Correction Model to examine the short and long-term relationship between variables with causality analysis. Turkey, although no causality between growth and spending on education in the Netherlands and France, was seen negatively correlated in the short and long term. In Portugal and South Korea; In contrast to the negative effect of education expenditures on growth in the short run, a positive effect was observed in the long run [22].

## **Methodology**

### *Panel Unit Root Tests*

In the panel data method, there are two dimensions, both the horizontal section (N) and the time series (T) dimension. In other words, panel data models include N units and T observations. Computing panel data estimators is more complex than computing cross-section data alone or time series alone. However, the presence of panel data can simplify this calculation and reaching a conclusion [23].

Panel data regression model can be shown as follows [24]:

$$y_{it} = \alpha + \beta X_{it} + u_{it} \quad (1)$$

$i$  represents the section with  $i = 1, 2, \dots, N$ , and  $t$  represents the time period with  $t = 1, 2, \dots, T$ .  $\alpha$  in the equation shows the number of observations of the amount of data,  $\beta$  is  $K \times 1$ .  $X_{it}$  is the  $it$ 'th observation number regarding  $K$  explanatory variables. The  $T$  observation for the first household follows the  $T$  observation for the second household and continues in this way until the  $N$ th household [24].

Panel data analysis, which is created by combining cross-section and time series, also carries with it time series properties and problems seen in time series. Therefore, as in time series data, it should be examined whether the variables contain unit root or not, whether there is cointegration between variables with the same degree unit root. Otherwise, regression estimates to be obtained may be misleading if the data are not stable. For this purpose, panel unit root tests and panel cointegration tests are applied [25]. In order to obtain econometrically significant relationships between variables, the analyzed series should be stationary series. If there is a trend in the time series of the variables; the relationship may appear in the form of spurious regression rather than being real [26]. In the case of spurious regression, it is possible to find very high  $R^2$  values with significant  $t$  and  $F$  statistics. In addition, the effects of temporary shocks become permanent in non-stationary time series [27]. Therefore, whether regression expresses a real relationship or a misleading relationship is related to whether the time series data are stationary or not.

### *Pedroni Cointegration Analysis*

Pedroni Cointegration Analysis, one of the most used panel cointegration tests in the literature, is a test that allows heterogeneity in the cointegration vector. This test not only allows dynamic and fixed effects to be different between sections of the panel, but also allows the co-holistic vector to differ between sections under the alternative hypothesis [28]. In order to cover the within and between effects in the panel, seven different cointegration tests are presented and these tests are divided into two different categories. The first category contains four tests pooled within a [in-section] size. The second category includes three other tests in the between [cross-section] dimension [29].

Hence, the first category; It contains average test statistics for cointegration in time series across the section. The second category is; Instead of average test statistics, it contains test statistics that divide the means into pieces in order to limit the distribution based on piecewise numbers and predecessor terms [30]. The first three of the four tests in the first category are nonparametric tests. The first test is a statistic of variance ratio type. The second test is similar to the Phillips-Peron (PP) ( $\rho$ ) statistic, the third PP ( $t$ ) statistic. The fourth is a parametric statistic similar to the Augmented Dickey Fuller (ADF) ( $t$ ) statistic. In the second category, the first of the three tests is similar to PP ( $\rho$ ) statistics, while the other two are similar to PP ( $t$ ) and ADF ( $t$ ) statistics [28].

### *Panel Error Correction Model*

When there is a long-term relationship between variables as a result of the panel cointegration test, long and short-term relationships can be estimated by various methods. Some of these are Pooled Mean Group Estimator (PMGE) (Pesaran et al. 1999), Mean Group Estimator (MGE) (Pesaran and Smith, 1995) and Dynamic Fixed Effects Estimator (DFE). Pooled Mean Group Estimator (PMGE), Mean Group Estimator (MGE) and Dynamic Fixed Effects Estimator (DFE) estimate both short-term and long-term parameters together by creating an error correction model.

The MG Estimation Method proposed by Pesaran and Smith (1995) obtains the long-term parameter by using the average of long-term parameters of autoregressive distributed lag models (ARDL) created for each unit. Therefore, it allows the evaluation of long-term parameters in terms of units. The PMG Estimation Method proposed by Pesaran, Shin, and Smith (1999) consists of a mixture of MG, which allows both the slope and the constant parameters to vary by units, and the fixed effects estimator, which requires the constant parameter to change but the slope parameter to be constant. Therefore, PMGE allows the evaluation of short-term parameters and error variance in terms of units, while keeping the long-term parameters constant. The dynamic fixed effects estimator, on the other hand, estimates the error correction model with the assumption of fixed effects, it does not make calculations according to units because it keeps all parameters constant [31].

## **Econometric Application**

### *Data Set and Model*

In this study; it is aimed to reveal the short and long term relationships between education expenditures and economic growth in 25 EU member countries in the period of 2000-2019. The data used were obtained from World Development Indicators [32] published by the World Bank. In the models obtained, the economic growth rate (GDP) and the ratio of education expenditures (EDU) as the indicator of human capital are used to represent economic growth. Analyzes are made by taking the logarithms of these variables.

The model in which economic growth is the dependent variable and education expenditures as the independent variable is formed as follows:

$$\ln GDP_{it} = \alpha + \beta_1 \ln EDU_{it} + u_{it} \quad (2)$$

The model defined to analyze the relationship between education expenditures and economic growth will be analyzed using the panel cointegration method. The first step of a cointegration analysis is to examine the unit root properties of the variables. In the second stage, whether the variables have a long-term cointegration relationship is determined by panel cointegration tests and in the third stage, the panel error correction model is made.

*Panel Unit Root Tests*

Since the variables are linear on their logarithmic values, the logarithms of all variables were taken before performing the unit root test, and the unit root test was performed using the logarithmic values of the variables. Since the unit root properties of the variables have an important role in performing cointegration analysis, firstly the series, Levin-Lin-Chu; Im-Pesaran-Shin; ADF Fisher and Breitung unit root tests were applied. In these tests, the basic hypothesis that "no unit is stationary" is tested against the alternative hypothesis "at least one of the units is stationary".

Unit root tests were applied for both level and first differences of the series and the results are presented in Table 1 and Table 2.

	<b>Constant Term</b>		<b>Term with Constant and Trend</b>	
<b>Unit Root Tests</b>	<b>Education Expenditures (lnEDU)</b>			
	Test Statistics	Possibility	Test Statistics	Possibility
Levin,Lin&Chu	-8.9240	0.951	-3.7065	0.4752
Im,Pesaran&Shin	-2.2086	0.895	-2.7603	0.5800
ADF Fisher	-3.6758	1.000	-3.8418	0.8523
Breitung	-1.5380	0.062	-3.1481	0.0965
	<b>Economic Growth (lnGDP)</b>			
Levin,Lin&Chu	-5.7906	0.2257	-5.5324	0.3271
Im,Pesaran&Shin	-2.8562	1.950	-3.0113	2.580
ADF Fisher	-8.0526	1.000	-5.3964	0.4717
Breitung	-5.6230	1.024	-5.5168	0.5817

Table 1 - Unit Root Test Results (Level Values)

Source: Author

	<b>Constant Term</b>		<b>Term with Constant and Trend</b>	
<b>Unit Root Tests</b>	<b>Education Expenditures (lnEDU)</b>			
	Test Statistics	Possibility	Test Statistics	Possibility
Levin,Lin&Chu	-19.3903***	0.000	-19.9446***	0.000
Im,Pesaran&Shin	-5.0119***	0.000	-4.9457***	0.000
ADF Fisher	-20.1698***	0.000	-16.9671***	0.000
Breitung	-11.1574***	0.000	-9.6772***	0.000
	<b>Economic Growth (lnGDP)</b>			
Levin,Lin&Chu	-22.1791***	0.000	-22.5324***	0.000

Im,Pesaran&Shin	-4.9212***	0.000	-4.7647***	0.000
ADF Fisher	-19.7517***	0.000	-.16.0429***	0.000
Breitung	-9.1088***	0.000	-10.0708***	0.000
Note: *** indicates statistical significance at the 1% significance level.				

Table 2 - Unit Root Tests Results (1st Difference Values)

Source: Author

According to the panel unit root tests, the series become stationary when the difference from the first order is taken, that is,  $I(1)$ . Therefore, when their first difference is taken, the  $H_0$  hypothesis is rejected and it is seen that the series become stationary.

### *Cointegration Test Results*

Education expenditure (lnEDU) and economic growth (lnGDP) series were stable in their primary differences. The Pedroni Panel Cointegration Test was applied to determine the long-term relationship between the series. Pedroni, his basic hypothesis is "there is no cointegration", the alternative hypothesis is; He established it as "there is cointegration". Table 3 shows the results of the panel cointegration test.

<b>Pedroni Panel Cointegration Test Result</b>		
<b>(Within-Dimension)</b>	t-statistics	Possibility
Panel v-Statistic	-2.8116	0.0225**
Panel rho-Statistic	-7.3816	0.0000*
Panel PP-Statistic	-6.2620	0.0000*
Panel ADF-Statistic	1.7749	0.0380**
<b>(Between-Dimension)</b>		
Group rho-Statistic	-5.4514	0.5659
Group PP-Statistic	-7.4834	0.0000*
Group ADF-Statistic	-6.4845	0.0000*
Note: * and ** indicate statistical significance at 1% and 5% significance level.		

Table 3 - Pedroni Panel Cointegration Test

Source: Author

In Table 3, there are panel tests in the first four rows and group tests in the last three rows. According to the Pedroni Cointegration Test, which investigates the long-term relationship between education expenditures and economic growth, two of the panel statistics are statistically significant at 1% level and two at 5% level. Group statistics; two of them are statistically significant at the 1% level. In general, when the results of all seven tests in the Pedroni cointegration test that constitute both panel and group statistics are evaluated; it can be said that there is a cointegration relationship between series in the long run. Thus, the  $H_0$

hypothesis (no cointegration between series) was rejected. Therefore; the alternative hypothesis,  $H_1$  hypothesis (there is cointegration between series) was accepted.

#### *Panel Error Correction Model Results*

As a panel error correction model, PMGE was applied to examine the short and long-term relationship between education expenditures and economic growth. The outputs obtained as a result of the analysis are presented in Table 4.

<b>Independent Variables</b>	<b>Coefficient</b>	<b>Standart Error</b>	<b>Z Value</b>	<b>Possibility</b>
lnEDU	0,292	0.130	2.24	0.025**
lnEDUt-1	0,236	0.158	1.50	0.034* *
et-1	-0,587	0.045	-12.91	0.000 *
Constant	0,371	0.15	2.46	0.014**
Hausman Test ( $\chi^2$ test statistic)	0,000			
Number of Observations	475			
Number of Groups	25			
Note: * and ** indicate statistical significance at 1% and 5% significance level.				

Table 4 - Pooled Mean Group Regression Model Results

Source: Author

When Table 4 was examined, the error correction parameter was found to be negative and significant. The error correction parameter shows the speed at which short-term deviations resulting from the series are not stationary reach equilibrium in the next period. Accordingly, approximately 58% of the imbalance that occurs in one period will be corrected in the next period and it will be brought closer to the long-term balance. Also, the long-term parameter of education expenditures is about 0.29, which is statistically significant and positive. In other words, a 1% increase in education expenditures in the long term increases GDP by 0.29%. The short-term parameter of education expenditures is 0.23, which is statistically significant and positive. A 1% increase in education expenditures in the short term increases GDP by 0.23%.

#### **Conclusion**

The most important advantage of developed countries; They have a well-educated, qualified workforce that can keep up with the rapid changes in the production process and have a high knowledge generation capacity. Improvements in the education situation positively affect

economic growth by increasing both the productivity of the workforce and the knowledge generation capacity. As the level of education increases, the competitiveness of countries improves and improvements are achieved in many areas in the society. Many economists also drew attention to the necessity and importance of education investments for countries. Considering all these positive effects of education, education expenditures made in this sense are of great importance for the country. From this point of view, to what extent and how much education expenditures made by countries affect economic growth has always been a subject of research.

The aim of this study is to analyze the short and long-term relationship between education expenditures and economic growth in EU countries in the 2000-2019 period using panel data. While education expenditures of countries are taken as an indicator of human capital, GDP variables are evaluated as an indicator of economic growth. First of all, unit root tests were examined by taking the logarithms of the variables. Both variables have become stationary at the first level. To test the long-term relationship between education expenditures and economic growth, the Pedroni panel cointegration test was used. According to the panel cointegration result, there is a long-term relationship between education expenditures and economic growth. In order to determine the direction and extent of this long-term relationship, panel error correction model was applied. According to the Pooled Mean Group Regression; A positive relationship was found between education expenditures and economic growth both in the long run and in the short run. The analyzes obtained have shown that 58% of the short term deviations will be corrected in the next period. In addition, a 1% increase in education expenditures in the long term increases the GDP by 0.29%; In the short term, it increases by 0.23%. These results are consistent with Slywester (2000), Nunes (2003), Baldacci et al. (2008), Tamang (2011) and many more studies.

As a result, in order for societies to grow and develop; education should be given due importance. A person with an increased level of education will contribute to the development and growth of the country by increasing the quality in his field. A country whose economic growth is developing will also increase the importance of education by allocating a higher share to its expenditures on education. Thus, the increase in the economic growth of the country and the increase in education expenditures mutually benefit each other.

*This article was recommended for publication in a scientific journal Young Science by:  
doc. Ing. Emese Tokarčíková, PhD.*

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