

PANEL ESTIMATION FOR THE RELATIONSHIP BETWEEN EDUCATION EXPENDITURE AND ECONOMIC GROWTH FOR OECD COUNTRIES¹

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ABSTRACT

Abstract. Education, which is one of the important dynamics of human capital along with health, plays an important role in this context. Increasing the level of success comes through higher standards of education, recruitment of qualified workers, better employment opportunities and increased earnings which are significant contributors to growth and prosperity in OECD countries. In this study, the relationship between educational expenditures and economic growth for 19 selected OECD countries is analysed using the panel data method.

KEY WORDS

Educational expenditures, growth, panel data analysis.

DOI: 10.23762/FSO_VOL6NO2_18_1

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Introduction

The concept of education is defined as the process of creating changes in the behaviour and thought structure and skills of the individual. Education is also expressed as processes in which the individual acquires behavioural patterns such as ability in and attitude towards society (Çalýtkan et al. 2013: 31). Education determines the value of countries in the global marketplace with the available skills on the labour market and the price of these skills.

The main problem of the human capital theory is the contribution of the increase in

the amount of labour to economic growth. In the context of this problem, two important conferences were held in 1961 on how investment in human beings influenced the extent of economic growth. One of them concentrated on education, the other on health. The structure of human capital is largely shaped by education and health. Thanks to investments in the education and health of the same individual, said individual is more productive both as a producer and as a consumer in society (Mushkin 1962: 129). As service and pro-

¹ This article is an extended version of the presentation at the Dubrovnik International Economic Meeting 2017 entitled "Relationship between education expenditure and economic growth in OECD countries: a panel data analysis".

duction systems become more complex, workers with higher education levels are highly sought-after. In order to attract and retain skilled workers, societies must provide a balance between promoting general equality and providing strong economic incentives. Increased levels of success among the population, better employment opportunities and higher standards of education contribute to growth and prosperity in OECD countries. In this context, the growth of labour income in GDP, in some of the education categories, demonstrates its impact on high levels of skills and economic growth (OECD 2012: 26). Individuals want to learn more because more training means a better job and higher earnings. For many, education means more schooling and a source of social mobility. Similarly, nation states and regions are concerned with raising the average level of education among their population, as it is thought that raising the efficiency of labour will increase the quality of business in the economy and trigger economic growth.

The interest of researchers in the mutual relationship between economic growth and educational expenditure, in particular in terms of Inner Growth Theories, is in line with the foreground of human capital. In this study, which attempts to show the effect of economic growth on educational expenditures, 19 OECD countries were analysed using data for the period of 1998-2012. The panel data method was used as the research method.

1. Theoretical background

The purpose of the economic activities which individuals undertake in social life is to fulfil their basic needs; yet while doing so, it is necessary to struggle with the limitations encountered. Looking at the economy as a whole, basic economic policy is aimed at increasing and maintaining the levels of prosperity within a society.

Economic growth is defined as the number and volume of changes in such a way that the basic size of the national economy sustains per capita income growth. The realisation of economic growth depends mostly on the efficient use of the human and physical capital that the country has (Afşar 2009: 87). Nowadays, while the share of arm strength in production is greatly reduced, the role of brain power and machines is increasing. This structural change in production, while reducing the physical role of people in the production process, gives people more time for activities such as R&D. This can only be achieved by making the necessary investments in human capital.

The question of the effect of education on economic growth has begun with the emergence of the concept of human capital. Until the 1960s, the concept of human capital, which had not previously been covered in much detail, gained importance along with theories of endogenous growth. Education plays an important role in the development of human capital, which is the key to scientific and technological progress. Education is also seen as a sustainable path to economic prosperity and is of the utmost importance in the fight against unemployment, ensuring social equality, solid foundations, awareness and cultural vitality (Mekdad et al. 2014: 56).

Raising the level of equipment for growth and prosperity in OECD countries can increase earnings through better employment opportunities and higher standards of education. On average, about half of the economic growth is related to the increase in labour income at the tertiary level of education. In France, Norway, Switzerland and the UK, 60% or more of the GDP is produced by people with tertiary education (OECD 2012: 38).

In most OECD countries, all students complete at least the high school level of education, and attempts are being made to increase the minimum level of education still higher. The policies which are applied with the goal of raising the minimum level of education vary from country to country. The economic conditions and financing structures which countries have directly affect their education expenditures (Altundemir 2008: 52). All government spending on education (except for international sources) is classified into three categories: central, regional and local. In some countries education financing is centralised, while in other countries funds are centralised after regional and local allocations. For example, education expenditures in France, Ireland, the Netherlands, Spain, Luxembourg, Italy, Greece and Portugal are mainly covered by the central government on a general budget, as in Turkey. In Germany, Austria, Belgium and the UK, it is covered by local governments. In Sweden, Denmark and Finland, education expenditure has been covered by public and local

governments, but responsibility has been passed on to local governments (Egeli and Hayrullahođlu 2014: 99).

The ways in which public revenue is used for education in OECD countries are different. Public funds can flow directly to institutions or can be directed to institutions through state programs or economic actors. Public expenditure on education supports educational institutions and the living expenses of students and other private spending outside institutions. Public and private spending in educational institutions accounts for less than 10 % of OECD countries' total GDP (Temple 2002: 58).

2. Literature review

There are many studies that examine the relationship between education and economic growth. In some of these studies, there was a positive and significant relationship between education and economic growth, and the result was that economic growth positively affected education. The relevant literature is summarised in Table 1.

Table 1. Literature summary

Study	Country	Period and data	Methodology	Empirical findings
Schultz 1963				Found that raising the education level of the labour force was a major contribution to growth both in developing and developed countries.
Uzawa 1965; Lucas 1988				In these models, the output level is defined as a function of human capital.
Romer 1990				Concludes that, with the contribution to endogenous growth models based on research and development analysis, the stable growth rate is partly due to the level of human capital.
Hicks 1980	83 developing countries	1960-1977	Some simple statistical manipulations; multiple regression	Investment in human resources has led to increased growth.
Barro and Lee 1993	100 countries	1960-1985 Used training data for the population aged 25 years		They found that the increase in productivity is due to the change in overall years of education.

Benhabib and Spiegel 1994	cross-country	1965-1985 Various variables such as education; literacy rates; secondary education enrolment rates	Standard growth accounting regressions	Regardless of the education variable selected, the coefficients are negligible or negative.
Weiss 1995				Those who are better educated and who have more work experience receive higher wages. This increases the productivity of employees.
Devarajan et al., 1996	43 developing countries	1970-1990 Government expenditure; Economic growth	Regression analysis	Education spending within public spending has been negatively associated with economic growth and is not significant.
Engelbrecht 1997	20 OECD countries	1971-1985	Unit root tests; Error Correction Model	Argues that human capital is not only considered as a factor in the study, but is also an important input of new growth theories.
Quiggin 1999	Australia			Asserts that education has particularly non-monetary benefits.
Sylwester 2000	cross-section of countries	1970-1985	Least Square Regressions; Robustness Checks	Found that public education expenditures positively affect future economic growth.
Psacharopoulos and Patrinos 2002				In Africa, Asia, and Latin America, the incidence of investments in primary education is high, but this ratio is low in OECD countries.
Çoban 2004	Turkey	1980-1997 Gross National Income; Primary school schooling rate; Middle school schooling rate; College schooling rate; Education expenditure by the public as a share of total expenditure	Augmented Dickey Fuller Unit Root Test; Johansen Cointegration Test; Granger Causality Test	The increase in primary school enrolment rate is due to the increase in economic growth, which is attributed to the increase in high school enrolment rate.
Blankenau et al. 2007	23 developed countries	1960-2000		A positive relationship was found between public education expenditure and long-term growth when the government's budget constraint was taken into consideration.
Timtekin and Kadyar 2010	Turkey	1960-2014 Real GDP; Real export; High school enrolment rate		Found that long-term economic growth and the increase in GDP increased the human capital accumulation.
Chandra 2011	India	1951-2009	Granger Causality Test	Indicates that economic growth affects government spending on education.
Kakar et al., 2011	Pakistan	1980-2009 GDP; Government expenditure on education; Labour; Gross fixed capital formation	Cointegration test; Vector Error Correction Model	Found that education has a long-term relationship with economic growth.

Tamang 2011	India	1980-2008 GDP; Expenditure on education; Labour	Johansen Cointegration Test; Vector Error Correction Model	Found that a long-term relationship exists between education expenditure and economic growth.
Çalýtkan et al., 2013	Turkey	1923-2011 GDP; Primary education; high school and vocational high school; higher education levels	ADF Unit Root Test; Cointegration Test	The increased resources allocated especially to higher education in Turkey will support the development process.
Eriçok and Yılcı 2013	Turkey	1968-2005 GDP; Educational expenditure	Boundary test approach	Found that the effect of educational expenditure on economic growth is temporary.
Idrees and Siddiqi 2013	Developed (UK, US, Canada, Germany, France, Italy and Japan) and Developing (Pakistan, India, China, Turkey, Poland, Russia and South Africa)	1990-2006 GDP; Total Public Expenditure in Education Sector	Panel Cointegration Test	Showed the existence of a long-term relationship between public education expenditure and GDP.
Mercan 2013	Turkey	1980:Q1-2012:Q4 Real GDP; Total expenditure on education	Granger Causality Test	Found a two-way relationship determined between education expenditure and economic growth.
Kýran 2014	18 Latin American Countries	1970-2009 Gross National Income (GNI); Educational expenditure per capita (EDU)	Cointegration test	Found a cointegration relationship between economic growth and educational spending, excluding seven countries.
Kýzýlkaya and Koçak 2014	11 Selected OECD Countries	1990-2009 Per Capita Income; Public Education Expenditure; Fixed Capital Investments	Panel Unit Root Test; Panel Cointegration Test	Shows that expenditure on education positively affects economic growth.
Mekdad et al., 2014	Algeria	1974-2012 GDP; Labour; Capital; Expenditure on Education	Ordinary Least Squares; Johansen Cointegration Test; Causality Test	Found that public spending on education positively affects economic growth.
Mercan and Sezer 2014	Turkey	1970-2012 Real GDP; Total expenditure on education	Cointegration Analysis; Bound Testing ARDL Models	Showed that education expenditure in Turkey had a positive effect on economic growth.
Pamuk and Bektaş 2014	Turkey	1988:01-2013:02 Real GDP; Real Educational expenditure	Unit Root Tests; Delayed Distributed Autoregressive Bound Test; Granger Causality Test	Found a long-term relationship between GDP and education expenditure. Showed a unilateral causality relationship from GDP to growth in education expenditure.
Selim et al., 2014	G-20 Countries	2000-2011 GDP; Expenditure on education	Panel Cointegration Test; Vector Error Correction Model	Found a positive relationship between education expenditure and economic growth.

Mallyck and Dash 2015	India	1951-2012 GDP; Expenditure on education	Bivariate VAR model; Co-integration; Granger causality; variance Decomposition; impulse response	They point out that in the long run, a one-sided causality relationship runs from expenditure on education to economic growth.
Mariana 2015	Romania	1980-2013 GDP per capita; Public education expenditure; The number of students enrolled in tertiary education	Vector Error Correction Model; Granger Causality Test	Showed that there is no cointegration equation between GDP per capita, higher education and public education expenditure.
Nantwi2015	Ghana	1970-2012 Real Gross Domestic Product; Education Expenditure; Gross Capital Formation; Labour Force Participation	Vector Error Correction; Cointegration Analysis	A positive and significant long-term relationship between education expenditure and economic growth has been identified.
Mallyck et al., 2016	14 Major Asian Countries	1973-2012 GDP; Education expenditure	Panel Data Analysis	According to Pedroni's cointegration result, there is a long-term balance between economic growth and education expenditure in all countries.
Uçan and Yeşilyurt2016	Turkey	2006:Q1-2015:Q4 Education expenditure; GDP	Granger Causality Test	Found that the relationship between education expenditure and GDP used for growth is bidirectional causality.
Ali et al., 2017	Pakistan	1980-2014 Gross Fixed capital formation; GDP; Public spending on education	Johansen Cointegration Test; Granger Causality Test	Found a bidirectional relationship between government spending on education and GDP.
Frank 2017	179 countries	1970-2017 Education and healthcare expenditure; Real GDP; Human Capital Index; Population; Share of gross capital formation; Share of merchandise exports	General Least Squares Equation	Found that overall education expenditure positively affects economic growth.
Rankaduwa et al., 2017	Sri Lanka	1960-2015 Government education expenditure; Economic growth		Found a negative direct effect and a positive indirect effect of education expenditure on economic growth.
Sunde2017	Mauritius	1976-2016 Economic growth; Education expenditure	ARDL Bound Test; Granger Causality Test	Found that education expenditure causes economic growth in the short run based on the Granger Causality Test.
Ozatac et al., 2018	France	1970-2012 Capital; Labour; Government expenditure on education; GDP	Johansen Cointegration Test	Showed that capital, labour and government expenditure on education are long-term determinants of GDP. Found that long-term unidirectional causalities run from expenditure on education to GDP.

Source: Own elaboration.

3. Methods and data

In this study, the relationship between education expenditure and economic growth was examined for 19 selected OECD member countries (Australia, Belgium, Canada, Denmark, Finland, France, Iceland, Ireland, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the UK) using panel data models based on annual data for the period of 1998-2012.

Cross-sectional data, time series and panel data consisting of time series or the combination of cross-sectional data and time series were used for analysing the relationship between economic variables, statistically and econometrically. The functional form of panel data econometrics is as follows:

$$\begin{aligned} Y_{it} &= \alpha + \beta_{it} X_{it} + \mu_i + \gamma_t + e_{it} \\ i &= 1, 2, \dots, N \\ t &= 1, 2, \dots, T \end{aligned} \quad (1)$$

As can be seen in the functional form of panel data econometrics, t shows the time and i shows the sections. In this equation, an individual effect exists. This effect cannot be observed by independent variables, nor does it change depending on time, but includes characteristics peculiar to sections (Baltagi 2005).

In panel data econometrics, the next step - after converting cross-sectional data and time series data to the panel system - is to determine if the cross-section and period effects can be explained by the fixed effects model or the random-effects model. The fixed effects model creates a different fixed value for each cross-sectional unit. In the fixed effects model, it is assumed that the slope coefficients which are shown

with “\$” do not change, but fixed coefficients show differences only among cross-sectional data or time data, or among both types of data. If the differentiation occurs depending only on time, these types of models are labelled as one-way time dependent fixed effect models. If a differentiation occurs in panel data depending on both time and section, these models are labelled as two-way fixed effects models. However, because the cross-sectional effect is generally investigated more in panel data studies, panel data models are generally considered one-way models (Hsiao, 2002). One-way and two-way fixed effects models can be seen in Eq. (2) and (3) given below:

$$Y_{it} = (a_{it} + \mu_i) + \beta_{1it} X_{1it} + \dots + \beta_{kit} X_{kit} + e_{it} \quad (2)$$

$$Y_{it} = (a_{it} + \mu_i + \lambda_t) + \beta_{1it} X_{1it} + \dots + \beta_{kit} X_{kit} + e_{it} \quad (3)$$

In this equation, the error terms are considered to have been distributed independently and identically in a manner such that their variances equal zero. In the fixed effects model, the fixed effects estimator

allows the fixed constant to differ across cross-section units by estimating different constants for each cross-section (Baltagi 2005).

The changes that occur depending on cross-sections or both cross-sections and time are observed when they are integrated into the model as a component of the error terms. The advantage of the random effects model over the fixed effects model

is that, without any loss of degree of freedom, the random effects model allows for the inclusion of the effects outside the sample to the model. The functional relation for the models mentioned can be demonstrated as follows:

$$Y_{it} = \alpha_i + \beta_{1it} + X_{1it} + \dots + \beta_{kit} X_{kit} + (\mu_i + v_{it}) \quad (4)$$

$$Y_{it} = \alpha_i + \beta_{1it} + X_{1it} + \dots + \beta_{kit} X_{kit} + (\mu_i + v_{it} + \lambda_t) \quad (5)$$

Here, Eq. (4) shows the one-way random-effects model and Eq. (5) shows the two-way random-effects model. The error terms in random effects have two components, the first of which is the: i value of the cross-section $\mu_i = 1, 2, \dots, N$, which does not vary over time, and the v_{it} value which signifies the rest of the cross-sections where the values are correlated over time. In this model, the i value, which signifies the cross-section effect, and the v_{it} value, which includes the remaining error terms, are independent from each other. In addition, these two components of the error term are independent from an observed value of each independent variable. For this reason, the ordinary least squares estimators are consistent and unbiased estimators of the error term components

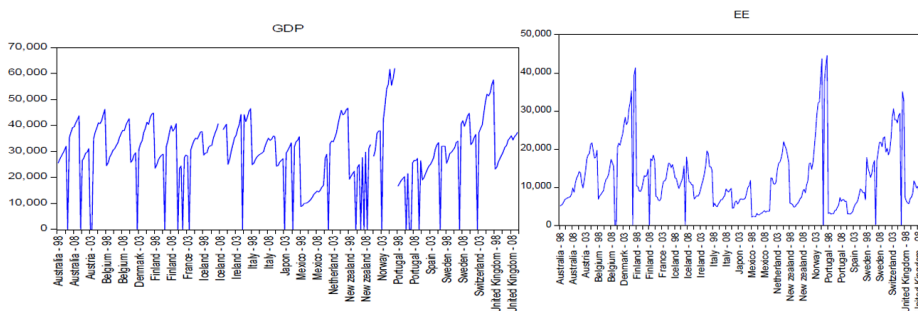
(μ_i and v_{it}) shown in Eq. (4) and (5) which explain the random effects model (Özer and Çiftçi 2008).

4. Results and discussion

The data used in the study was taken from the official OECD database on an annual basis for 19 selected OECD member countries including Australia, Belgium, Canada, Denmark, Finland, France, Iceland, Ireland, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the UK.

In the study, the simple interaction between education expenditure and economic growth in 19 OECD member countries for the years between 1998 and 2012 can be seen in Figure 1. It is remarkable that there is an increasing trend in both graphics.

Figure 1. The course of GDP – EE in 19 OECD member countries (1998-2012)



Source: Own elaboration.

However, before proceeding to the analysis, it is necessary for the data to be made suitable for analysis, through subjecting it to several tests. In this sense, the graphics of the variable will be closely examined, then a decision on the suitable form will be made, and the issue of whether or not they include a unit root will be tested.

According to Granger and Newbold (1974), a regression analysis between the variables does not provide reliable results if non-stationary data is used. For this reason, stationarity should be checked before performing the regression analysis.

Studies conducted by Levin and Lin (1992, 1993), Breitung and Meyer (1994), Quah (1994), Maddala and Wu (1999), Hadri (2000) and Im et al. (2003) suggest the use of unit root tests in panel data models. Recently, the most commonly used unit root tests in studies in which panel data unit root tests were performed on a sectoral basis are Levin-Lin and Im-Pesaran Shin Tests. Unit root tests of Levin, Lin & Chu (LLC), Breitung, Im, Pesaran and Shin (IPS), Augmented Dickey-Fuller (ADF), PP (Phillips Peron) and Hadri were used in our study.

Table 2. Unit Root Test results for GDP and EE

Method	GDP		EE	
	Test Statistics	Probability	Test Statistics	Probability
Levin, Lin & Chu t^*	-3.71350	0.0001	-1.76326	0.0389
Breitung t-stat	-1.17572	0.1199	2.38516	0.9915
Im, Pesaran and Shin W-stat	-0.99435	0.1600	-0.00377	0.4985
ADF - Fisher Chi-square	48.9858	0.1092	42.8407	0.2712
PP - Fisher Chi-square	107.075	0.0000	78.0820	0.0001
Hadri Z-stat	4.01816	0.0000	10.2063	0.0000
Heteroscedastic Consistent Z-stat	9.67807	0.0000	10.5376	0.0000

Source: Own elaboration.

The panel data unit root test results for gross domestic product and education expenditure are given in Table 2. According to the unit root test results, Breitung t-stat, Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square, Hadri Z-stat, Heteroscedastic Consistent Z-stat unit root tests indicated that the GDP variable had a unit root, while Levin, Lin & Chu, PP - Fisher Chi-square unit root tests indicated that the GDP variable did not have a unit root. Table 2 also reveals that the EE variable had a unit root according to all of the results except the PP

- Fisher Chi-square unit root test.

The existence of a unit root in both series was detected as the result of the findings obtained from unit root tests, and the conclusion that the series was nonstationary was drawn. For this reason, Pedroni, Kao and Johansen Fisher Cointegration Tests were used in the remainder of the study. The next step, after detecting the existence of a panel unit root in the series, was to investigate the presence of cointegration as shown in Table 3.

Table 3. Pedroni Cointegration Test results for GDP and EE

Method	Test Statistics	Probability
Panel v- Statistic	0.049849	0.4801
Panel rho- Statistic	-4.932418	0.0000
Panel PP- Statistic	-7.913372	0.0000

Panel ADF-Statistic	-8.169209	0.0000
Group rho-Statistic	-1.524287	0.0637
Group PP-Statistic	-8.620864	0.0000
Group ADF-Statistic	-8.094477	0.0000

Source: Own elaboration.

It is possible to prepare the hypothesis to be used in this analysis in such a way:

Ho: There is no cointegration between the variables;

H1: There is cointegration between the variables.

As shown in Table 3, the null hypothesis was accepted in all tests except the

panel v - statistic in the regression equation formed by the mentioned variables, so the existence of cointegration was rejected.

After confirming cointegration through the Pedroni test, it was also possible to test the existence of cointegration by performing the Kao Test (Table 4).

Table 4. KAO Cointegration Test results for GDP and EE

Method	Test Statistics	Probability
ADF	-2.915927	0.0018
Residual variance	1.73E+08	
HAC variance	42209362	

Source: Own elaboration.

It is possible to prepare the hypothesis to be used in this analysis in such a way:

Ho: There is no cointegration between the variables;

H1: There is cointegration between the variables.

The null hypothesis was rejected based on the results of the Kao Cointegration Test.

That is, the existence of cointegration was confirmed. In the same way, the Johansen Fisher Panel Cointegration Test, which is another technique to check the existence of cointegration, was analysed as shown in Table 5.

Table 5. Johansen Fisher Cointegration Test results for GDP and EE

Hypothesised No. of CE(s)	Fisher Stat (from trace test)	Probability	Fisher Stat (max-eigen test)	Probability
None	95.83	0.0000	93.39	0.0000
At most 1	51.18	0.0749	51.18	0.0749

Source: Own elaboration.

According to the results of the Johansen Fisher Panel Cointegration Test, the null hypothesis that there is no correlation between the two variables was rejected and the alternative hypothesis supporting the existence of cointegration was accepted.

Of the three tests which were conducted in order to determine the existence of

cointegration in the model, the Pedroni, Kao and Johansen Fisher Panel Cointegration Tests indicated the existence of cointegration. However, the Pedroni Cointegration Test (only the Panel v -Statistic) revealed that there was no correlation between the two variables. Since the majority of the tests we performed revealed

the existence of cointegration in the model, it was accepted that there was a correlation between education expenditure and economic growth for the OECD countries in the long run.

In the next stage, panel data regression estimations were undertaken. The Hausman Test was used in order to determine whether the fixed effects model or the

random effects model was valid for the 19 OECD member countries. According to the Hausman Test, the fixed effects model yielded more effective results for all countries which were the subjects of the study. Based on this report, the fixed effects method was used in panel data regression estimation.

Table 6. Fixed effects panel data regression estimation results

	Variable	Coefficient	Std. Error	t-Statistic
C	27866.54	1734.309	16.06780	0.0000
EE	0.163985	0.132060	1.241744	0.2155
R2: 0.527 D-W Stat.: 2.086 F Stat. (Prob): 8.3476 (0.000)				

Source: Own elaboration.

According to Table 6, in the model which was developed based on the fixed effects model, the approximate value of the Durbin Watson (2.086) statistic was found to be below the (2) value which was accepted as significant. As shown in Table 6, based on the results obtained in the present study conducted for 19 OECD member countries, we conclude that education expenditure has not had an effect on GDP, since the probability value is smaller than the table value ($0.2155 > 0.005$).

Conclusions

Economic growth refers to the increase in GDP per capita. In this sense, the factors which enable the curve of production possibilities of any country to move outward also constitute the foundation of economic growth.

In the present study, the economies of 19 OECD member countries were analysed. Accordingly, the panel data system consisting of time series and cross-sectional series was firstly used for analysing the relationship between the variables. In the next step, using the panel data, the existence of a panel unit root in the variables mentioned was investigated. The test results indicated

the presence of a unit root in the variables and the finding was reported.

After this step, a panel cointegration test was conducted, which revealed that a panel cointegration relationship existed among the variables consisting of the data obtained for 19 OECD member countries. Afterwards, it was investigated whether the fixed effects model or the random-effects model would be used in the model by using the Hausman Test statistics. Based on the results of the test statistics, it was reported that the fixed effects model yielded more effective results for all countries subject to the study.

Based on the final model on which structural and diagnostic tests were performed, it was concluded in this study of 19 OECD member countries that education expenditure has not had an effect on GDP.

When viewed from the perspective of the literature, most of the studies on the subject –which overlap with the theory– have reached the conclusion that education expenditure positively affects economic growth. On the other hand, some studies have produced results which are similar to those of this study (Devarajan et al. 1996; Psacharopoulos and Patrinos 2002; Eriçok

and Yýlancý 2013). This difference has basically been caused by the developmental differences between the countries on which the analyses were based. Especially when examined in terms of OECD countries, it may be observed that income from investments is low.

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