Review of the Relation between Education and Sustainable Socio-Economic Development in the EU through Canonical Correlation Analysis

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Abstract

The aim of this paper is to reveal the importance of education in achieving sustainable socio-economic development. For this purpose, the relation between education and socio-economic development indicators in the European Union was investigated. The method used was canonical correlation, one of the multivariate analysis techniques. The reason why this method was chosen is that it enables simultaneous review of two different variable sets and testing of the significance of correlations between data sets. The reason why this study is important and original is that while most of the studies focus on the impact of education on growth, this paper will mainly analyse the relation between "economic, social, political, cultural and educational socio – economic development" and "education". Analysis results show that there is a strong and statistically significant relation between variable sets both before and after expansion. It can be said that education is a good criterion with regards to socio-economic development indicators for the European Union.

Keywords: European Union, Education, Sustainable-Socio Economic Development, Canonical Correlation, Canonical Variable.

1. Introduction

One of the factors that determine the economic and social development level of countries is the developments in human capital. There are two main components of human capital being education and health. Education influences individuals and the society and the development level of a country as a result of positive externalities it creates. The formation of human capital requires education in the first place. Be it for economic growth and the formation of human capital required by economic development or to raise inquisitive and creative human resources that information society requires, education ranks on top of things to be prioritized by any country. Today, it is commonly believed that it is necessary to place education into a central role for economic development and that long term and regular investment in human capital will have positive effects on economic and social development.

There are many studies that analyze the relation between education and economic development and growth. It is possible to date the views that suggest manpower is an active capital in economic growth back to Mercantilism and Classical school. As Bowman (1966) suggested, Mercantilists gave importance to manpower. They stated that education is the key element of development and drew attention to the importance of educated merchants for countries. A. Smith (1776), the founder of economics, introduced some statements that formed the basis of the relation between education and economic development. He suggested that the primary element and the source of wellbeing of nations is quality labour. He emphasized the relation between capital formation and savings as important determiners of economic development. How educational resources will be provided and utilized has been discussed by all Classical economists and all the following economic schools. Nesterova and Sabirianova (1998) stated in their studies that Classical economists underlined the importance of labour and acquisitions within the definition of capital. R.Malthus, D.Ricardo, N.W. Senior and A.Marshall among classical economists focused especially on the relation between education and economic development.

With the 18th century and onwards, the fact that it is possible to develop and own new technologies only through labour that can produce and use this technology led to attaching more importance to the relation between education and economic development. The ideas and studies on education at that time suggest that education is one of the most influential factors in economic development. As Rao (1996) states, this is the reason why spending on and innovations in education are always included in development plans and policies.

As suggested by Osmonkovic et. al (2011), especially with the 20th century many people started to think that human force is also an element of capital in the economic development process in line with the development of economic development theory. This period has been a milestone in terms of treating economic development

concept as a separate discipline within the science of economy. The first modern theories and models put forward on this issue are like a follow-up of classical economic theory in which development is regarded as an equivalent of growth and industrialization.

Studies that explain the relation between economic development and human resources with quantity indicators or theoretically within the framework of education agree on the fact that education contributes to economic development. On the other hand, studies that approach the issue systematically and that analyze the issue in detail with growth theories stand out with endogenous growth models in the middle of 20th century. In those empirical studies covering the relation between education and growth, following items were used for proxy variable of human capital: the number of students registered for a variety of education levels, schooling rate, literacy rate, the rate of university graduates, and expenditures for education. These studies show that education stands out within human capital among the resources of growth. Some of these studies reported that education has positive impact upon growth. These include; Lucas, 1988; Barro, 1991; Cullison, 1993; Lee and Lee, 1995 ; Zhang and Casagrande, 1998; Asteriou and Agiomirgianakis, 2001; Webber, 2002; Keller, 2006; Pradhan, 2009; Tsamadias and Prontzas, 2012; Paradiso et.al., 2013; Mhere et.al., 2013.

While recent studies assess the effect of education on growth; in this paper only the relation between economic, social, political, cultural and educational "socio-economic development" and "education" will be analyzed. Therefore, this research is expected to be original in this respect. Rest of the paper is organized as follows: next section is the importance given to sustainable socio-economic development, education and their policies in the European Union (EU), while the third section presents methodological framework used and test results. The last section concludes the paper.

2. Sustainable Socio-Economic Development and Education in the EU

Socio-economic development is the basic element of the EU's Sustainable Development Strategy. Socio-economic development aims to promote an innovative, competitive and efficient economy that provides high quality employment with high living standards and that is rich in terms of knowledge. While doing this, it aims to bring the three main elements of sustainable development, economic development, protection of the environment and ensuring social justice into conformity with each other (http://epp.eurostat.ec.europa.eu).

The concept of sustainable development was first introduced to the world in 'Our Common Future Report', also known as Brundtland Report, published by United Nations World Commission on Environment and Development (1987). Sustainable development is defined in the report as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development was first introduced as an objective of the integration process in the Single European Act in 1987. The necessity to include the notion of sustainable development in all community policies was stated in 1992 Maastricht Treaty. Starting with Maastricht, the EU has devoted itself to the development concept related to long term goals. The EU developed its own sustainability strategy, EU Sustainable Development Strategy in 2001 to achieve such a development level. This strategy presents a unique and compatible application that shows how EU can perform long lasting responsibility more effectively to overcome the difficulties of sustainable development. Most importantly, it is a comprehensive strategy for all EU policies that show how to meet the needs of the present without compromising the ability of future generations to meet their own needs (http://epp.eurostat.ec.europa.eu ; http://www.eesc.europa.eu).

The EU is an integration that places utmost importance to human capital and education in terms of sustainable development. Education is a significant factor that improves people's skills and skilled labour supply, the ability to adapt, quality and productivity of workers. With this notion in mind, EU education and training policies has gotten stronger after the adoption of Lisbon Strategy, an important EU program that focuses on growth and creation of job opportunities in 2000. This strategy accepts that knowledge and innovation it promotes are the most valuable assets of EU when we see it in terms of gradually intensifying global competition environment. The long-term strategic goals of EU education and training policies are; making lifelong learning and mobility a reality, improving the quality and efficiency of education and training, promoting equity, social cohesion and active citizenship and enhancing creativity and innovation, including entrepreneurship at all levels of education and training (http://ec.europa.eu). The EU does not only aim for growth and development for sustainability but social inclusion and conscious use of available resources as well. The EU is an integration that is highly aware of the importance of education for its sustainability goals.

3.   Methodology

Canonical Correlation analysis was utilized in the study to reveal the relation between education and socio-economic development. The reason why canonical correlation was chosen as the statistical method to be used in this paper is that it enables simultaneous review of two different variable sets and testing of the significance of correlations between data sets.

Developed by Hotelling (1936), canonical correlation analysis, a multivariate statistical technique analyzes the relation between two data sets provided each data set includes at least two variables. The main idea behind it is first to determine the linear combination of highest correlation. Then, the linear correlation pair with the highest correlation among all the combinations irrelevant to each other is determined with the initial combination and the process goes on in this order. Linear combination pairs are called canonical variables and the correlations of canonical variables are called canonical correlations. Canonical correlations explain to what extent the variables in two sets are related (Levine, 1977; Xia, 2008; Ebenezer and Joseph; 2012).

The data used in the study about the 28 EU member countries belong to 2011. For some indicators, data from 2010 and 2009 were used as 2011 data was not available. All of the data are taken from the website of European Community Statistical Office. Canonical correlation analysis was applied to the variables in "Education" (U) and "Socio-Economic Development Indicators" (V) sets. In this study, a data matrix sized (6+5)x28=11x28 was analyzed and the relation between indicators were examined. In "Education" indicators set; X_1: public expenditure on education (% of GDP), X_2: private expenditure on education (% of GDP), X_3: education participation ratio, X_4: life long learning rate , X_5: ratio of students to teachers; X_6: persons with tertiary education attainment ratio (25 years and over) variables were used. In "Socio-economic development set" determined as the second set, Y_1: dispersion of regional GDP per inhabitant (% of the national GDP per inhabitant) , Y_2: net national income (% of GDP) , Y_3: total employment ratio , Y_4: total research and development expenditure (% of GDP) , Y_5: total investment (business, government, households) (% of GDP) variables were used.

4.   Results

The eigenvalues and canonical correlations of the analysis done on sets being "education" and "socio-economic development indicators" are demonstrated in Table 1.

Table 1. Eigenvalues and Canonical Correlations

Function	Eigenvalue	Variance Extracted	Total Variance Extracted	Canonical Correlation	Wilks L.	p
1	3,565	55,979	55,979	0,884	0,031	0,000*
2	1,469	23,073	79,051	0,771	0,143	0,004*
3	0,790	12,410	91,461	0,664	0,352	0,038*
4	0,450	7,061	98,521	0,557	0,630	0,138
5	0,094	1,479	100,000	0,293	0,914	0,389

*p<0.05

The eigenvalue calculated for the canonical correlation pair according to Table 1 is an indicator of total variability. As eigenvalues go up, canonical correlation coefficients increase as well. It is observed that the biggest eigenvalue among five canonical correlation pairs calculated is in the 1st function. When the significance of canonical correlations between canonical variable pairs obtained is tested with Wilks Lamda statistics, it is seen that three canonical variable pairs are significant at 0.05 margin of error of canonical correlation coefficients. The canonical correlation coefficient of the first of canonical variable pairs is calculated as 0.884; the second as 0.771; and the third as 0.664.

The raw canonical coefficients and standardized canonical coefficients of these three significant canonical variable pairs are demonstrated in Table 2 for education indicators.

Standardized coefficients show the change score in canonical deviation in terms of standard deviation. In that way, it displays the effect level of the original variant in the formation of canonical variable. By looking at the

strength and direction of correlations between canonical variables among themselves and the canonical variables of sets, which variables play a predominantly determining role in which canonical variables and how they affect each other can be seen (Sharma, 1996; Özdamar, 2009).

Table 2. Raw and Standardized Canonical Coefficients for Education Indicators

U	Raw Canonical Correlation Coefficients			Standardized Canonical Correlation Coefficients		
	1	2	3	1	2	3
x1	0,169	0,637	-0,642	0,220	0,829	-0,836
x2	-0,264	1,374	1,642	-0,112	0,584	0,698
x3	0,009	0,016	-0,034	0,075	0,129	-0,270
x4	0,090	-0,092	0,093	0,689	-0,703	0,710
x5	0,085	0,037	-0,232	0,219	0,095	-0,595
x6	0,020	0,003	0,043	0,151	0,026	0,327

The equations of these three significant variable pairs will be as follows.

$U_1 = 0,220 X_1 - 0,112 X_2 + 0,075 X_3 + 0,689 X_4 + 0,219 X_5 + 0,151 X_6$

$U_2 = 0,829 X_1 + 0,584 X_2 + 0,129 X_3 - 0,703 X_4 + 0,095 X_5 + 0,026 X_6$

$U_3 = -0,836 X_1 + 0,698 X_2 - 0,270 X_3 + 0,710 X_4 - 0,595 X_5 + 0,327 X_6$

Contribution level of X4 variable in the formation of U1 canonical variable is the highest with a value of 0,689. The value of X1 variable is the highest with 0,829 in the formation of U2 canonical variable. The variable that contributed the most to U3 canonical variable is X1.

The raw canonical coefficients and standardized canonical coefficients of these three significant canonical variable pairs are demonstrated in Table 3 for socio-economic development indicators.

Table 3. Raw and Standardized Canonical Coefficients for Socio-economic Development Indicators

V	Raw Canonical Correlation Coefficients			Stardized Canonical Correlation Coefficients		
	1	2	3	1	2	3
y1	-0,009	0,017	-0,063	-0,073	0,136	-0,509
y2	0,009	0,110	-0,104	0,063	0,731	-0,693
y3	0,061	0,072	0,171	0,368	0,433	1,027
y4	0,656	-0,676	-1,158	0,622	-0,642	-1,098
y5	-0,057	-0,184	-0,079	-0,172	-0,557	-0,240

According to Table 3, the equations of V1, V2 and V3 canonical variables will be as follows.

$V_1 = -0,073 Y_1 + 0,063 Y_2 + 0,368 Y_3 + 0,622 Y_4 - 0.172 Y_5$

$V_2 = 0,136 Y_1 + 0,731 Y_2 + 0,433 Y_3 - 0,642 Y_4 - 0.557 Y_5$

$V_3 = -0,509 Y_1 - 0,693 Y_2 + 1,027 Y_3 - 1.098 Y_4 - 0,240 Y_5$

The variable that contributed the most to the formation of V1 canonical variable is Y4 with a contribution value of 0,622. The variable that contributed the most to the formation of V2 canonical variable is Y2. The variable that contributed the most to the formation of V3 canonical variable is observed to be Y4.

Canonical loadings could be considered as they offer a chance to determine which canonical variables

predominantly represent the variables. Canonical loadings ensure the determination of how strong the contribution of the relevant variable to its own and therefore to the canonical correlation coefficient is (Thompson,1984; Sharma,1996).

Table 4. Conanical Loadings

| | U | | | | V | | |
	1	2	3		1	2	3
x1	0,710	0,557	-0,127	y1	-0,644	0,129	-0,200
x2	-0,021	0,756	0,558	y2	0,320	0,660	-0,503
x3	0,325	-0,177	-0,417	y3	0,873	0,112	0,255
x4	0,946	-0,139	0,209	y4	0,944	-0,259	-0,201
x5	0,313	0,154	-0,274	y5	-0,146	-0,512	-0,280
x6	0,644	0,247	0,248				

According to Table 4, it can be observed that the highest loading value belongs to X4 variable with a value of 0,946 when the canonical loading of coefficients in the education indicators data set with its own canonical coefficient U1 is considered; the highest loading value in the U2 and U3 canonical variable is in X2 variable. The highest factor loading value of socio-economic development indicators data set variables in their own V1 canonical variable is Y4 with a value of 0,944; while it is Y2 for V2 and V3.

The extracted variance and redundancy coefficients of canonical correlation pairs are displayed in Table 5. For each set, variance extracted reveals to what extent canonical variables explain the variance of observed variable set while redundancy indicates to what extent one variable set is explained compared to another variable set (Özdamar, 2009).

Table 5. Extracted Variance and Redundancy Coefficients

	Extracted Variance	Redundancy
U1	0,336	0,263
U2	0,170	0,101
U3	0,113	0,050
V1	0,438	0,342
V2	0,159	0,094
V3	0,095	0,042

According to Table 5, the contribution of education indicators U1 linear component to variance extracted is 34% and the redundancy coefficient is 0,26. The high value of redundancy coefficient shows the strength of the relation between the two variable sets. The contribution of U2 linear component to variance extracted is 17% while the contribution of U3 linear component to variance extracted is 11%. For the variable set regarding socio-economic development indicators, the contribution of V1 linear component to total variance extracted is found to be 44 % while the redundancy coefficient is 0,34. The contribution of V2 linear component to total variance extracted is 16 % and the contribution of V3 linear component to total variance extracted is 10%. According to variance extracted and redundancy coefficient results, it is found that the first canonical correlation pair is important to explain the relation.

Five different canonical variable pairs were found according to the results of the analysis done for 28 EU countries. The first three of these canonical variable pairs were found significant. The function with the highest canonical correlation coefficients is the first one.

While the relation between education and socio-economic development indicators is being looked into, it is also

important to what extent the expansion of EU affects this relation. To this end, the analysis was carried out again for the first 15 EU member countries. According to the results of the analysis, five different canonical variable pairs were found. Only one of these canonical variable pairs was found to be significant and another high canonical correlation coefficient at a value of 0,973 was obtained. X2 and Y4 variables have the highest contribution to the formation of canonical variables.

5. Conclusion

While sustainable socio-economic development in the EU offers more accessible resources and better conditions for wellbeing of countries, it also enhances the corporate quality that will contribute to a good social environment, economic activities and long term economic growth. Sustainable socio-economic development is a matter of understanding how to maintain a successful strategy in time and how to sustain economic prosperity.

The EU has developed a strategy that ensures economic potential and stability while guaranteeing the feasibility of social and environmental systems. The EU developed the Sustainable Development Strategy in 2001 to achieve a development level devoted to the development concept committed to long term goals and considering the needs of present and future generations. Then, it included the main features of sustainable development in Europe 2020, its own 10 year growth strategy. The effects of ongoing Euro Crisis indicate the importance and necessity of analyzing environmental, economic and social goals with equal care for the EU to sustain its economic potential.

To reveal the importance of education in achieving sustainable socio-economic development, five different canonical variable pairs were found according to the results of canonical correlation significance between "education indicators" and "socio-economic development indicators" of EU countries. The first three of these canonical variable pairs were found significant and it was observed that their canonical correlation coefficient is high. The highest canonical correlation coefficient was found to be 0,884. The second highest correlation coefficient was found to be 0,771 while the third highest canonical coefficient was 0,664.

The EU follows a sound policy in the expansion process in its own way. The EU performed its biggest expansion in 2004 and then went through two more expansion processes. While the relation between education and socio-economic development indicators was being analyzed, to what extent the expansion of EU affected this relation was also tried to be revealed and according to the results of the analysis carried out for the first 15 EU countries, a high correlation coefficient at a value of 0,973 was obtained.

As a result, within the frame of variables determined for 28 EU countries, a high and statistically significant relation has been found between education indicators and socio-economic development indicators. The levels of correlation between education and socio-economic development level show that education is a good criterion with regards to socio-economic development indicators. It is clear that many other studies can be conducted on this issue via several analyses by changing the indicators and time and various conclusions can be reached.

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