The Effect of Education as a Component of Human Capital on Economic Growth: A Panel VAR Analysis*

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A R T I C L E I N F O	A B S T R A C T
	Purpose: Studies of human capital and economic growth were initially focused on labour and physical capital, but it was later recognised that factors such as education, health, and technology also affected this relationship. The present study aims to examine the effects of education, health, and innovation/technology, as the components of human capital, on economic growth. **Method:** This study brings together different indicators of education, health, and innovation/technology to calculate index values for the 1999–2015 period, using data on 31 developed and developing economies. It prefers to adopt a holistic approach, making use of an index that brings together multiple variables used in the literature rather than the 'best/most appropriate' proxy variable, in order to avoid a 'narrowing' of the human capital goals. These values were used to examine the relationship between human capital and economic growth. **Findings:** It was found that

education, health, and innovation/technology, in that order, made the biggest contribution to economic growth in developed and developing economies; education and health made a bigger contribution to growth in developing economies; and innovation/technology made a bigger contribution in developed economies. **Implications for Research and Practice**: These findings have implications for countries trying to achieve stable economic growth, their efforts should be directed to improve the quality of education, and to implement projects with high short-term returns.

Introduction

Economic growth is considered to be one of the most important indicators of the increase in social welfare, which is identified with the fact that life becomes simpler and more liveable (Barro & Lee, 1993a, 1993b; Caselli, Esquivel, & Lefort, 1996). Therefore, the determination of the sources of economic growth has been the subject of many studies. International organisations such as Organisation for Economic Cooperation and Development (OECD), International Monetary Fund (IMF), and World Bank (WB) have the purpose of increasing global cooperation in monetary issues, ensuring financial stability, promoting high employment and sustainable economic growth, and reducing poverty. These organisations' provide a number of economic indicators and make predictions in terms of development levels of the countries.

Given the fact that the birth rates in developing countries are higher than the developed ones, the labour force in these countries is increasing faster than the developed countries (Smith, 1991). However, if growth only depended on the increase in the labour force, developing countries would have grown faster than developed countries and would have had a higher Gross National Product (GNP). Therefore, since the size of the labour force alone is insufficient, the size and the accumulation of the capital need to be considered while examining the factors determining economic growth (Easterly & Wetzel, 1989; Lucas, 1988). Jorgenson, Gollop, and Fraumeni (1990) concluded that the share of capital accumulation in the growth rates of five developed countries between 1950 and 1985 (France, Germany, Japan, the UK, and the USA) was around 70%. Additionally, in the study conducted by Barro and Sala-i-Martin (2003), the share of capital accumulation in economic growth of the seven most developed countries in the world (G7) between 1960 and 1990, was found to be 50%.

Contrary to those who have good values in economic growth indicators, it is known that the countries identified as being 'underdeveloped' have some basic challenges unlike those that score well on economic growth indicators. Based on criteria identified by the United Nations (UN, 2014), countries with a low national income, weak human resources, and an undiversified economy suffer from problems with predictability and stability, low life expectancy, low schooling rates, and high stillbirth rates. It is thought that this situation is due to reasons such as inadequate and unhealthy nutrition and brain drain (Akca, 2014; Easterly & Wetzel, 1989). Thus, it was realised that the labour qualifications required for the effectiveness and efficiency of physical capital were acquired through human capital (Herndon, 2008; Jung, 1990; Langelett, 2000).

The human capital, seen as the main source of economic growth, not only increases the productivity of labour and physical capital, but also contributes to the development and implementation of technological inventions and innovations and to the economic growth processes (Van den Berg, 2001). Moreover, as the level of investment in humans increases, in terms of human capital, individuals have the opportunity to produce high income. Similarly, as the level of education increases, national income also proportionately increases (Carnoy, 1995; Castelló-Climent & Hidalgo-Cabrillana, 2012; Mincer, 1995). The contribution of an individual to the national economy is directly proportional to the individual's production and use of

knowledge. If the individual is healthier and more educated, their contribution to themselves and the country they live in will be higher. In some OECD countries such as Denmark and New Zealand, it is observed that the income of university graduates' is 25% higher than secondary school graduates. In these countries it is also observed that the expenditures of individuals on education lead to a production increase between 3% and 6% in economies each year (Bal, 2011). It is unlikely to have modern technologies or international economic power without educated manpower. It is noteworthy that almost all of the studies in relevant literature were conducted by researchers specialising in such fields as economics, econometrics, banking, public administration, and statistics. The present study is conducted by researchers specialising in the field of education, lending additional significance to its contribution to the body of literature.

Literature Review

Studies into the relationship between education as a component of human capital and economic growth have adopted different perspectives in different historical periods. Economic growth literature, prior to Adam Smith, rarely used the word 'education'. In 1959, Aukrust and Bjerke argued that domestic production in a country would increase by the same amount as the increase in real capital, emphasising that human capital is just as important as physical capital for economic growth, and sought to measure the contribution of factors of production such as labour and capital to total the production. In the 1950–1970 period, the presence of a third factor in addition to labour and capital was proposed to explain the rapid growth in production, especially in studies of developed capitalist economies that adopted Neoclassical and Post-Keynesian theories of growth. This factor largely overlapped with the contribution of education to the production process, and so resources allocated to education started to be perceived as revenue-generating investments, similar to physical capital investments. In the pioneering studies of Schultz (1961), education expenses were analysed as a form of investment related to economic output, given that they improved labour skills in the creation of the physical product. Similarly, Denison (1962a) argued that education made an important contribution to growth rates by increasing the skills and productivity of labour.

In his 1964 book "Human Capital", Becker analysed the return on education, finding that investment in education is similar to physical capital investments. Hansen (1963) and Blaug and Hanoch (1967) also conducted research and got similar findings. In the 1970s, with the Theory of Human Capital, a great increase was noted in the number of registered students and education expenses. It was later realised, however, that education consumed a significant proportion of the national income but failed to generate a corresponding level of economic growth. The phenomenon of graduate unemployment had shaken the confidence in the return on human capital investments. Quantitative indicators such as schooling, and enrolment rates were found to be insufficient. Researchers like Carnoy (1995) focused on 'how much' and 'how', rather than 'whether', education contributes to economic growth. The relationship between income and education is affected by many factors. Societies with high levels of

education have undeniably greater social and political strengths when compared to other societies. On its own, however, education cannot serve as an engine of economic growth and/or development, as factors such as health and technology/innovation have also been recognised as significant influences in this context.

Solow, who conducted the first studies showing that economic growth requires long-term analysis, stated in his 1956 neoclassical growth model that the main determinants of economic growth are the external variables of the population and technological progress (Solow, 1956). According to this model, sustainable growth in per capita income is only possible with long-term technological progress. Mankiw, Romer, and Weil (MRW, 1992) argued that the expanded Solow model was also successful in explaining the income differences and similarities between countries and used the middle-school enrolment rates as an indicator of human capital. However, these models fall short of explaining how technological progress emerges in the first place.

Countries are confident that education contributes to economic growth, but there are different findings regarding which quantifiable indicators actually contribute to it, and to what extent. For example, Denison's (1962b) study covering the 1929–1957 period in the United States reported that the share of education was 23 percent and that of physical capital was 15 percent in the approximately 3 percent annual growth achieved in the period in question. Psacharopoulos' (1981) study based on data from 45 countries, on the other hand, found that (1) elementary education was the level of education with the biggest return, both individually and socially, (2) the return on higher education was more individual than social, (3) the return on education investments, whether individual or social, exceeded the opportunity cost by 10 percent, and (4) education had a greater return, in both individual and social terms, in less developed countries than in developed countries. In another study, Psacharopoulos (1995) found that health issues among the labour force decreased potential income by 2.1 percent to 6.5 percent in developing economies, and by about 2 percent in developed economies. This was attributed to healthy individuals being able to receive a better education and having the opportunity to make use of educational investments for a longer period of time, which shows that attention must be paid to health in addition to education.

A long-life expectancy, on the other hand, has a positive impact on capital accumulation decisions, as people expect returns on their investments throughout their lives, which in turn contributes to economic growth (Glomm & Ravikumar, 1997). The quality of a country's healthcare services also contribute to increasing the stock of human capital (Lim, 1996). Healthcare conditions are better in countries with low infant mortality rates and long-life expectancies, and this has a positive impact on economic growth as it allows the labour force to work more efficiently, thus contributing to human capital (Herrin, 2000). According to Hanushek and Woessmann (2015), studies into the causal relationship between long-term economic growth, the information capital, and skills of a country make it possible to predict how education policies will affect economic performances.

An important issue that needs to be considered when examining education, which plays a very important role in economic growth and development, is to identify the financial and physical features of the human capital stock. In relevant literature, variables such as schooling rates, enrolment rates, and education participation (Coe, Helpman, & Hoffmaister, 1997; Do, 2009; Mankiw et al., 1992; Whiteley, 2000), public, private, and household spending on education (Hartwig, 2012; Meinagh, 2011; Pelinescu, 2015), the numbers and ratios of students and teachers (Asik, 2007; Barro, 1991; Dasdemir, 2008; Kahilogulları, 2010; Kalyoncu, 2008; Ozutler, 2009; Sanli, 2016), and the educational attainment and mean years of schooling (Apergis, Filippidis, & Economidou, 2007; He, 2011; Patrinos, 2016; Teixeiraa & Queirós, 2016) are used as proxy variables for education. The proxy variables used for health include alcohol consumption (Brenner, 1987; Esser & Jernigan, 2018), healthcare spending (Bedir, 2016; Hartwig, 2012; Pradhan, 2011), numbers of patients, hospitals, beds, and/or doctors (German, Miña, Alfonso, & Yang, 2018; Peran, 2005), life expectancy at birth and average life expectancy (Barro & Lee, 1993b; McDonald & Roberts, 2002), and infant mortality rates (Soubbotina, 2004); whereas variables such as entrepreneurship (Saygin, 2012), R&D spending (Do, 2009; Meinagh, 2011), and number of patents (Pelinescu, 2015) are used as proxy variables for innovation/technology. There is a lack of consensus on a standard measure of human capital in these studies, most of which are based on a panel data analysis. They report that the indirect effects of human capital on economic growth are larger than its direct effects, and that education is more effective than other components of human capital such as health, technology, nutrition, and migration. That being said, authors such as Komatsu and Rappleye (2017) found that the relationship between PISA test scores and growth is neither strong nor consistent. The present study prefers to adopt a holistic approach, making use of an index that brings together multiple variables used in literature rather than the 'best/most appropriate' proxy variable, in order to avoid a 'narrowing' of the goals of human capital (education, health, innovation/technology) (Gorur, 2016; Morris, 2016).

The present study aims to examine the effects of education, health, and innovation/technology, as the components of human capital on economic growth. To this end, education, health, and innovation/technology indexes were created for 31 countries, covering the 16 years for which data was available. Panel data for developed and developing economies for the 1999–2015 period was used to obtain index values for each country and each year, and the results of the causality tests and variance decompositions from the panel vector autoregression (PVAR) analysis conducted with this data were evaluated. Therefore, the aim of the study is to examine the impact of education on economic growth as a human capital component. In order to achieve this aim, the following sub-problems will try to be answered;

For the VAR analysis of panel data of developed and developing countries in the period between 1999 and 2015;

1. What are the causality test results for the effect of education, health, and innovation/technology indexes on economic growth?

2. What are the results of the variance decompositions of education, health, and innovation/technology indexes on economic growth?

Answering the research questions will make it possible (a) to make linear evaluations of index values based on the labour and capital capacities of countries and (b) to advise policymakers on how the selected education, health, and innovation/technology indicators affect economic growth, and to make recommendations on how they should be shaped.

Method

Research Model

This study makes use of a causal comparative model. Causal comparative studies aim to identify the causes of an existing situation or event and the variables that affect these causes, or the consequences that follow on from a cause (Patten & Newhart, 2018). In empirical research models, the production function represents the relationship between inputs and outputs, although including all of the inputs involved in the production process of the function is both unnecessary and makes it difficult to create and estimate the function. Accordingly, in practice, inputs are classified and aggregated into categories that are more general, and these are then included in the production function in this format. Macro-level studies in literature divide all inputs into the two general categories of 'capital' and 'labour' (Sahlgren, 2014). Following the same approach, the present study examines the effects of the independent variables of capital (physical and human) and labour on the dependent variable of economic growth, in developed and developing economies.

Data and Variables

The study makes use of data from developed and developing countries. No data was obtained for the least developed countries, as they are not expected to prioritise policies and strategies that contribute to economic growth when using their already limited resources (Reinert, 2009). Thus, the initial plan was to obtain data for 189 countries worldwide, where 35 of them were developed and 154 were developing countries, based on the IMF classification. During the data collection process, it was found that there was no data available on some variables of interest in the case of 158 countries, 19 of them were developed and 139 were developing countries. Thus, the study was limited to the 31 countries (16 developed and 15 developing countries) for which the necessary data was available. The dataset was formatted as panel data, with the 'id' variable representing cross sections (N), and the 'year' variable representing time (T), for N=31 countries and T=16 years. The time period covered was 1999–2015. The countries included in the study are presented in Table 1 below. It shows that about half of the data came from developed countries and the other half from developing countries.

Table 1

Countries Included within the Scope of the Study

Developed countries			
1. Austria	5. Finland	9. New Zealand	13. Spain
2. Southern Cyprus	6. France	10. Portugal	14. Sweden
3. Czech Republic	7. Japan	11. Slovakia	15. UK
4. Estonia	8. South Korea	12. Slovenia	16. USA
Developing countries			
17. Brazil	21. Hungary	25. Moldova	29. Tunisia
18. Bulgaria	22. Latvia	26. Philippines	30. Turkey
19. Chile	23. Malaysia	27. Poland	31. Uruguay
20. Colombia	24. Mexico	28. Romania	
Source: IMF - World Economic Outlook Report and Database, October 2014.			

Data Collection and Analysis

The criterion, most commonly used for the classification of countries into developed and developing categories, is GDP per capita. Differences in levels of development are expressed in terms of per capita income using the same currency, which adds to the importance of this criterion when it comes to international comparisons. GDP is further preferred by many researchers as a practical and suitable proxy variable (Barro & Lee, 1993a, 1993b; Baumol, 1986; Bils & Klenow, 2000; Hartwig, 2012; McDonald & Roberts, 2002; Nonneman & Vandhoult, 1996; Pelinescu, 2015; Soubbotina, 2004; Teixeiraa & Queirós, 2016). In the present study, real GDP per capita (in US dollars) is used as the proxy variable for economic growth.

In the relevant literature, labour force is used as a proxy variable for labour, relating to the subject of human capital (Cobb & Douglas, 1928; Denison, 1962a; Lucas, 1988; Mankiw et al., 1992; Nonneman & Vandhoult, 1996; Romer, 1990; Schultz, 1961; Soubbotina, 2004). In the present study, the total labour force is used as the proxy variable for the component of labour. In literature on physical capital, different proxy variables are used as a result of the lack of direct observations. Psacharopoulos (1973) used estimations of increasing capital output ratios multiplied by GDP; Lau, Jamison, Liu, and Rivkin (1993) used industrial electricity usage; and Benhabib and Spiegel (1994) used investment flow data for their analyses of physical capital. In the present study, the selected proxy variable for physical capital was (per capita) electricity usage. Based on the literature review provided in the first section, education, health, and innovation/technology were identified as indicators of human capital. The observable explanatory variables associated with unobservable variables were added as proxies. Table 2 below reports the abbreviations, units, and sources of the proxy variables.

Table 2

Abbreviations, Units, and Sources for the Proxy Variables Used in the Study

Category	Name of the variable	Abbreviation	Unit	Source
Economic growth	Real Gross Domestic Product Per Capita	rgdppc	$	WB
Labour	Labour force (employed and unemployed population above the age of 15)	labour	number of people	WB
Physical capital	Electricity usage (annual per capita usage in industry, motorised transport, and urban areas)	capital	kWh	WB
Education	Gross primary school enrolment	e1	%	WB
	Gross secondary school enrolment	e2	%	WB
	Gross tertiary enrolment	e3	%	WB
	Public spending on education (% of GDP)	e4	%	WB
	Mean years of schooling	e5	number of years	HDI
	Student-teacher ratio in primary schools	e6	%	WB
	Student-teacher ratio in middle schools	e7	%	WB
	Student-teacher ratio in high schools	e8	%	WB
	Student-teacher ratio in higher education	e9	%	WB
Health	Alcohol consumption (per person aged 15 years or older)	h1	litres	WHO
	Healthcare spending (public and private, % of GDP)	h2	%	WB
	Hospital beds (per 1,000 people)	h3	%	WB
	Life expectancy at birth	h4	number of years	WB
	Infant mortality rate (per 1,000 live births)	h5	%	WB
	Number of physicians (per 1,000 people)	h6	%	WB
Innovation/ technology	Gross domestic spending on R&D (% of GDP)	i1	%	UNESCO
	Exports of ICT products (% of total exports of goods)	i2	%	WB
	Patent applications	i3	number of patent applications	WB
	R&D employees (per million people)	i4	%	WB

The data used in the study was obtained from the web databases of the World Bank (WB), the Human Development Index (HDI), the World Health Organisation (WHO), and the United Nations Educational, Scientific, and Cultural Organisation (UNESCO). EViews 9, Microsoft Excel, and STATA 13 statistical software packages were used in the analysis of the data. In the data inspection process prior to the analysis, the data was examined to check for any missing data in the variables. The missing data in the datasets was identified and estimated through interpolation with the help of the EViews 9 software package. The interpolation procedure requires filling in the missing values (NAs) in a series by interpolating them from the available values (EViews, 2016).

The relevant literature was first consulted to calculate the human capital indices. Then, a principal component analysis was carried out to create an index using the nine

proxy variables for education, the six proxy variables for health, and the four proxy variables for innovation/technology, as reported in Table 2 above. The need for calculation arose given the absence of this data in an existing database for the countries and time periods under examination. Indices were created following the procedure put forward by Krishnan (2010) to create the Socioeconomic Status Index. To generally understand the steps involved in constructing the index, the processes are highlighted in Figure 1 below.
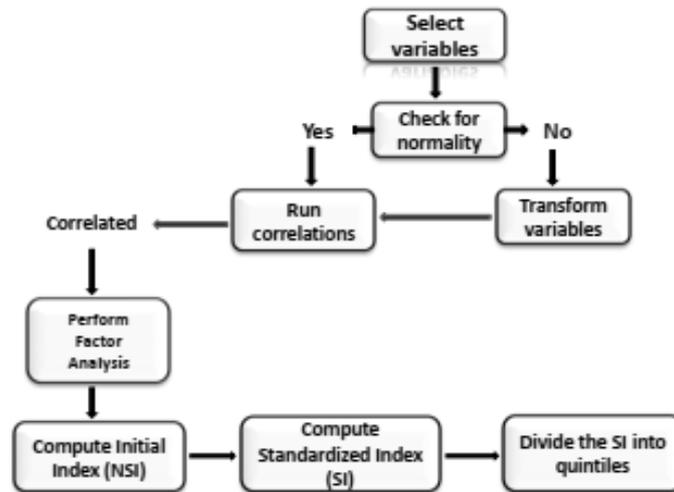

Figure 1. *The Procedure Used in the Creation of the Human Capital Index*

In this analysis, 'p' variables with 'n' measurements are transformed into new 'k' variables (k<p) that are linear, vertical, and independent from one another (Johnson & Wichern, 2007). Prior to the principal component analysis, the dataset is required to be checked to ensure its suitability for the analysis. To this end, a correlation matrix was created and the Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity tests were evaluated. The lower threshold for an acceptable KMO value is considered to be .50, with KMO values larger than .50 indicating that the dataset is suitable for a factor analysis (Field, 2000). Detailed findings are in the results section.

Results

Calculation of Human Capital Indices

Separate correlation matrices were created for each year (as the time dimension is not taken into account in a principal component analysis) and values lower than 0.30 were omitted from the analysis. As it is not practical to report the correlation matrices in question, only the results of the KMO and Bartlett's Sphericity tests are reported.

Table 3

Results of the KMO and Bartlett's Sphericity Tests for the Proxy Variables of Education

Year	KMO value	Bartlett's Sphericity Test		
		Chi-square	Chi-square degrees of freedom	Probability value
1999	.6521	132.20	28	.0000*
2000	.6294	148.27	36	.0000*
2001	.6402	144.77	36	.0000*
2002	.7192	131.02	28	.0000*
2003	.7356	124.92	28	.0000*
2004	.7953	128.45	28	.0000*
2005	.8099	145.70	28	.0000*
2006	.8087	144.94	28	.0000*
2007	.7380	144.53	28	.0000*
2008	.7498	147.23	28	.0000*
2009	.7151	146.91	28	.0000*
2010	.7084	145.39	28	.0000*
2011	.7388	137.32	28	.0000*
2012	.7599	134.16	28	.0000*
2013	.6124	140.05	28	.0000*
2014	.5890	134.36	28	.0000*
2015	.6142	135.74	36	.0000*

p< .01

Table 3 above shows that the KMO values for the proxy variables of education varied between .5890 and .8099 (KMO≥ .50), and that the probability values for Bartlett's Sphericity Test were significant (*p*< .01). In other words, the dataset for the proxy variables of education can be considered suitable for a principal component analysis. Table 4 shows that the KMO values for the proxy variables of health varied between .6398 and .7339 (KMO≥ .50), and that the probability values for Bartlett's Sphericity Test were significant (p< .01). In other words, the dataset for the proxy variables of health can be considered suitable for a principal component analysis. Also, Table 5 below shows that the KMO values for the proxy variables of innovation/technology varied between .5018 and .6226 (KMO≥ .50), and that the probability values for Bartlett's Sphericity Test were significant (*p*< .01). In other

words, the dataset for the proxy variables of innovation/technology can be considered suitable for a principal component analysis.

Table 4

Results of the KMO and Bartlett's Sphericity Tests for the Proxy Variables of Health

Year	KMO value	Bartlett's Sphericity Test		
		Chi-square	Chi-square degrees of freedom	Probability value
1999	.6811	89.33	15	.0000*
2000	.6731	88.34	15	.0000*
2001	.7014	89.91	15	.0000*
2002	.7339	88.56	15	.0000*
2003	.7276	89.79	15	.0000*
2004	.6817	85.83	15	.0000*
2005	.6774	89.35	15	.0000*
2006	.6827	82.77	15	.0000*
2007	.6581	79.83	15	.0000*
2008	.6584	80.81	15	.0000*
2009	.6816	82.17	15	.0000*
2010	.6974	80.47	15	.0000*
2011	.6945	85.09	15	.0000*
2012	.6658	85.33	15	.0000*
2013	.6592	88.96	15	.0000*
2014	.6667	88.63	15	.0000*
2015	.6398	75.62	15	.0000*

*p< .01

After clarifying that the dataset is suitable for a principal component analysis, the second stage of the data analysis was initiated. In this stage, various methods were adopted, such as the eigenvalue statistic, scree plot, and percentage of variance explained to obtain the smallest number of components that best represent the relationships between variables (Johnson & Wichern, 2007).

Table 5

Results of the KMO and Bartlett's Sphericity Tests for the Proxy Variables of Innovation/Technology

Year	KMO value	Bartlett's Sphericity Test		
		Chi-square	Chi-square degrees of freedom	Probability value
1999	.6226	66.71	6	.0000*
2000	.6172	66.57	6	.0000*
2001	.6048	65.01	6	.0000*
2002	.5764	65.96	6	.0000*
2003	.5836	65.59	6	.0000*
2004	.5689	66.12	6	.0000*
2005	.5405	71.69	6	.0000*
2006	.5254	72.53	6	.0000*
2007	.5430	67.82	6	.0000*
2008	.5178	67.30	6	.0000*
2009	.5343	66.57	6	.0000*
2010	.5168	70.30	6	.0000*
2011	.5305	69.32	6	.0000*
2012	.5297	68.72	6	.0000*
2013	.5072	72.13	6	.0000*
2014	.5040	74.48	6	.0000*
2015	.5018	73.72	6	.0000*

p< .01

In the present study, the number of principal components was decided using the criterion 'eigenvalues above 1'. The first principal component calculated (PC_1) explains the maximum variance between the original variables; the second principal component (PC_2) explains the maximum remaining variance, and is unrelated to the first one, and the calculation proceeds in this manner. The 'a' coefficient, representing the weight of the variables in the principal component, add up to 1 (Vyas & Kumaranayake, 2006).

$$PC_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n$$
$$\vdots$$

$$PC_m = a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n$$

$PC_1, PC_2, \ldots, PC_m$ represent 'm' principal components, and a_{mj} represents the weight of the jth variable in the mth principal component.

Table 6

Variance Explained by Principal Components of Education Variables with Eigenvalues Above 1

Year	PC_1	Variance explained	PC_2	Variance explained	PC_3	Variance explained	Total variance explained
1999	3.72731	.4659	1.45075	.1813	1.20718	.1509	.7982
2000	3.82920	.4255	1.57145	.1746	1.34274	.1492	.7493
2001	3.86793	.4298	1.57118	.1746	1.23317	.1370	.7414
2002	3.89496	.4869	1.27274	.1591	1.16218	.1453	.7912
2003	3.89874	.4873	1.26294	.1579	1.10248	.1378	.7830
2004	4.20815	.5260	1.13764	.1422	-	-	.6682
2005	4.33801	.5423	1.23818	.1548	-	-	.6970
2006	4.32925	.5412	1.19306	.1491	1.02741	.1284	.8187
2007	4.21611	.5270	1.14850	.1436	1.09475	.1368	.8074
2008	4.15112	.5189	1.17692	.1471	1.12233	.1403	.8063
2009	4.04265	.5053	1.25210	.1565	1.17492	.1469	.8087
2010	3.94862	.4936	1.24982	.1562	1.17902	.1474	.7972
2011	3.91846	.4898	1.26554	.1582	1.20736	.1509	.7989
2012	3.93479	.4918	1.23824	.1548	1.14699	.1434	.7900
2013	3.76762	.4710	1.37543	.1719	1.19711	.1496	.7925
2014	3.62181	.4527	1.42781	.1785	1.25982	.1575	.7887
2015	3.62583	.4029	1.56320	.1737	1.44466	.1605	.7371

Table 6 above shows that the principal components of education variables explain 77.49 percent of the total variance. In other words, about 77 percent of the relationships between the proxy variables of education are explained by a maximum of 3 factors. Also, Table 7 above shows that the principal components of health variables together explain 62.66 percent of the total variance. In other words, about 63 percent of the relationships between the proxy variables of health are explained by a maximum of 2 factors.

Table 7

Variance Explained by Principal Components of Health Variables with Eigenvalues Above 1

Year	PC_1	Variance explained	PC_2	Variance explained	Total variance explained
1999	3.19409	.5323	1.25542	.2092	.7416
2000	3.28193	.5470	1.13884	.1898	.7368
2001	3.35355	.5589	1.11284	.1855	.7444
2002	3.41657	.5694	-	-	.5694
2003	3.40623	.5677	1.01026	.1684	.7361
2004	3.24335	.5406	1.02685	.1711	.7117
2005	3.28980	.5483	-	-	.5483
2006	3.21824	.5364	-	-	.5364
2007	3.12592	.5210	1.00754	.1679	.6889
2008	3.13919	.5232	-	-	.5232
2009	3.22834	.5381	-	-	.5381
2010	3.25293	.5422	-	-	.5422
2011	3.28746	.5479	-	-	.5479
2012	3.24875	.5415	-	-	.5415
2013	3.27222	.5454	1.02270	.1704	.7158

| 2014 | 3.28739 | .5479 | - | - | .5479 |
| 2015 | 3.06438 | .5107 | 1.02686 | .1711 | .6819 |

Table 8

Variance Explained by Principal Components of Innovation/Technology Variables with Eigenvalues Above 1

Year	PC_1	Variance explained	PC_2	Variance explained	Total variance explained
1999	2.41093	.6027	-	-	.6027
2000	2.41117	.6028	-	-	.6028
2001	2.34751	.5869	-	-	.5869
2002	2.33670	.5842	-	-	.5842
2003	2.35479	.5887	-	-	.5887
2004	2.33908	.5848	-	-	.5848
2005	2.32193	.5805	-	-	.5805
2006	2.31619	.5790	-	-	.5790
2007	2.34145	.5854	-	-	.5854
2008	2.30378	.5759	-	-	.5759
2009	2.26613	.5665	1.03951	.2599	.8264
2010	2.26132	.5653	1.02957	.2574	.8227
2011	2.27514	.5688	1.00806	.2520	.8208
2012	2.26233	.5656	1.02210	.2555	.8211
2013	2.28291	.5707	1.01699	.2542	.8250
2014	2.30524	.5763	1.01967	.2549	.8312
2015	2.30111	.5753	1.02718	.2568	.8321

Table 8 above shows that the principal components of innovation/technology variables together explain 68.53 percent of the total variance. In other words, about 69 percent of the relationships between the proxy variables of innovation/technology are explained by a maximum of 2 factors. Scree plots of the education, health, and innovation/technology variables for 2015, based on eigenvalues obtained from the principal component analysis, are shown in the following as an example, as it would not be practical to reproduce the scree plots for all years. Figure 2 below shows that there are 3 factors with eigenvalues above 1 for the education variable, and 2 factors each for the health and innovation/technology variables.

The next step, following this procedure, was to calculate the indices using the selected variables. PC_1, PC_2,..., PC_m obtained for all countries, variables, and years represent the m principal components; and σ_i^2 represents the variance explained by the principal component in question. The first principal component makes the biggest contribution to the total variance explained, followed by the other components in decreasing order.

$$NSI = \left(\sigma_i^2\right).(PC_1) + \left(\sigma_i^2\right).(PC_2) + \left(\sigma_i^2\right).(PC_3)$$

If we were to place the relevant variance and principal component values in the equation above for the education variables of Turkey in 2015 as an example, the result would be as follows;

$$NSI = (0.4029)x(2.381753)+(0.1737)x(2.493165)+(0.1605)x(-2.032766)$$

$$= 1,066412$$

$$SI = \frac{(NSI-NSI_{\min})}{(NSI_{\max}-NSI_{\min})}\ x\ 100 \qquad = \frac{(1.066412-(-1.0642))}{(2.6320-(-1.0642))}\ x\ 100 = 57,64$$

The human capital index is created following the same method for other countries, years, and variables.
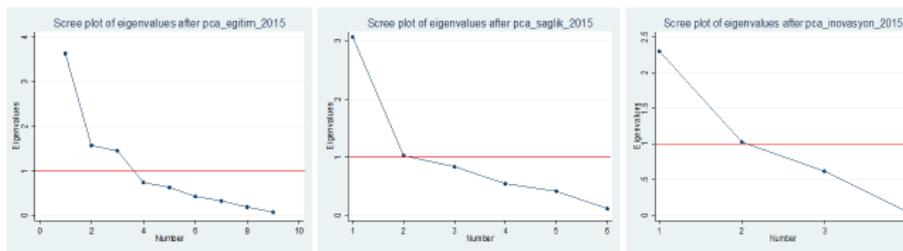
Figure 2. *Scree plots of the Education, Health, and Innovation/Technology Variables for 2015*

Results from the PVAR Analysis

The logarithms of all variables were taken and a PVAR analysis was conducted. Prior to the PVAR analysis, the data was inspected. First, the logarithms of the variables rgdppc, labour, capital, ind_edu, ind_health, and ind_inno were taken, represented by adding 'l' before the codenames of the new variables. For reasons of practicality, the variables expressing the logarithms of the index values were named ledu, lhealth, and linno. Hausman's (1978) test was then conducted on the developed and developing country groups separately to decide upon the estimation method for the panel data model. In other words, it was found that labour force, physical capital, education, health, and innovation/technology are significant predictors of real GDP in developing countries.

After identifying the predictors for developed and developing economies, a Granger causality analysis was conducted. VAR models conducted only with time series have emerged as an alternative to multivariate simultaneous equations models in macroeconomics literature (Sims, 1980). VAR models can uncover dynamic relationships between variables without forcing any limitations on the structural model, and so are frequently preferred for time series (Charemza & Deadman, 1997). The present analysis makes use of the PVAR data analysis technique due to the

advantages it offers over both VAR analyses, cross-sectional, and time series analyses of panel data.

Table 9

Results of the Granger Causality Test

Equation	Excluded	Developed countries			Developing countries		
		χ^2	SD	Prob>chi2	χ^2	SD	Prob>chi2
lrgdppc	llabour	23.557	1	.000*	.005	1	.943
	lcapital	19.914	1	.000*	.103	1	.748
	ledu	19.934	1	.000*	7.086	1	.008*
	lhealth	35.590	1	.000*	56.599	1	.000*
	linv	.498	1	.480	.377	1	.539
	Total	360.781	5	.000*	196.402	5	.000*
labour	lrgdppc	36.512	1	.000*	12.433	1	.000*
	lcapital	3.730	1	.053*	6.386	1	.012*
	ledu	4.946	1	.026*	.097	1	.756
	lhealth	60.545	1	.000*	.364	1	.547
	linv	3.736	1	.053*	1.487	1	.223
	Total	577.412	5	.000*	52.765	5	.000*
lcapital	lrgdppc	6.473	1	.011*	1.849	1	.174
	llabour	69.620	1	.000*	.799	1	.371
	ledu	4.439	1	.035*	9.312	1	.002*
	lhealth	35.394	1	.000*	33.311	1	.000*
	linv	.107	1	.744	2.730	1	.098
	Total	245.414	5	.000*	77.473	5	.000*
ledu	lrgdppc	19.728	1	.000*	17.064	1	.000*
	llabour	1.220	1	.269	3.306	1	.069
	lcapital	44.678	1	.000*	28.889	1	.000*
	lhealth	115.312	1	.000*	24.181	1	.000*
	linv	3.144	1	.076	4.408	1	.036*
	Total	175.162	5	.000*	274.734	5	.000*
lhealth	lrgdppc	6.455	1	.011*	63.388	1	.000*
	llabour	31.980	1	.000*	20.178	1	.000*
	lcapital	33.682	1	.000*	10.968	1	.001*
	ledu	2.888	1	.089	60.175	1	.000*
	linv	80.660	1	.000*	2.147	1	.143
	Total	273.204	5	.000*	237.013	5	.000*
linv	lrgdppc	6.074	1	.014*	.016	1	.900
	llabour	14.465	1	.000*	.953	1	.329
	lcapital	15.936	1	.000*	1.468	1	.226
	ledu	15.404	1	.000*	1.451	1	.228
	lhealth	2.094	1	.148	31.727	1	.000*
	Total	69.897	5	.000*	114.724	5	.000*

*$p \leq .05$

PVAR models are used to examine the dynamic effects of random shocks on the system of variables (Abrigo & Love, 2015). In VAR modelling, based on a Granger causality test, relationships between variables are examined through variance decomposition (Kumar, Leona, & Gaskins, 1995). Granger's concept of causality is in fact a bivariate VAR model, and to explain the causality relationship between two variables they are regressed on each other with appropriate lag sizes and limited and unlimited regression logic (Breitung, 2005). The findings of this analysis are presented in the following table. Figure 3 below shows the significant causality relationships between variables given in Table 9 above.
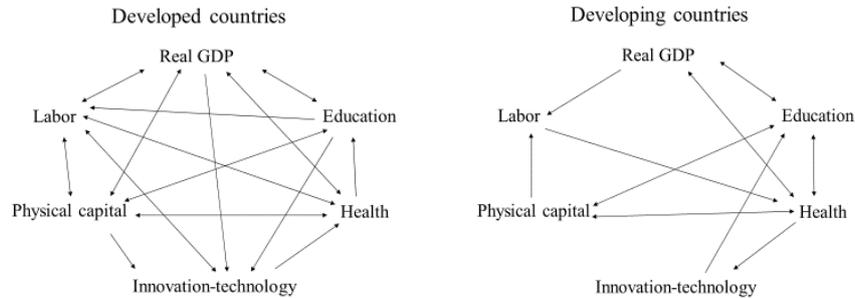
Figure 3. *Relationships between Variables in Developed and Developing Countries, Identified by a Granger Causality Test*

Table 9 and Figure 3 show that two-way causality relationships exist between real GDP and labour, physical capital, education, and health in developed countries. Furthermore, there is a one-way causality relationship from real GDP to innovation/technology; a one-way causality relationships from education to labour and to innovation/technology; a two-way causality relationship between education and physical capital; and a one-way causality relationship from health to education. In other words, real GDP and education are causes of one another in developed countries. In developing countries, on the other hand, two-way causality relationships exist between real GDP and education, and between real GDP and health. Furthermore, there is a one-way causality relationship from real GDP to labour; a two-way causality relationships between education and physical capital, and education and health; and a one-way causality relationship from innovation/technology to education. In other words, real GDP and education are also causes of one another in developing countries.

A variance decomposition analysis was made of the variables used in the study to identify the causes of the changes in series. A variance decomposition analysis helps identify the direct and indirect effects between the variables, assigns percentage values to the sources of the observed shocks in the variables themselves (which are in one of the other variables), and provides information about the strength of the causality relationships between variables (Enders, 2010). It is frequently used to identify the variable with the largest effect on a macroeconomic quantity (Luthepohl, 2005). The results of the analyses carried out for developed and developing countries are presented in Table 10 below.

Table 10

Variance Decomposition Results

Period (year)	Developed countries (logarithms)						Developing countries (logarithms)					
	rgdppc	labour	capital	edu	health	inv	rgdppc	labour	capital	edu	health	inv
1	1	0	0	0	0	0	1	0	0	0	0	0
2	.93	.01	.01	.03	.02	0	.82	.01	0	.02	.15	0
3	.89	.01	.01	.06	.02	.01	.72	.01	0	.09	.17	.01
4	.83	.02	.02	.10	.01	.02	.64	.01	0	.18	.16	.01
5	.78	.02	.02	.15	.01	.02	.59	.01	.01	.24	.14	.01
6	.72	.03	.03	.18	.01	.03	.54	.01	.01	.30	.13	.01
7	.68	.03	.03	.22	.02	.02	.52	.01	.02	.33	.11	.01
8	.64	.04	.03	.25	.02	.02	.49	.01	.04	.35	.10	.01
9	.60	.05	.03	.27	.03	.02	.47	.02	.05	.36	.09	.01
10	.57	.05	.03	.29	.04	.02	.45	.02	.07	.36	.09	.01

Variance decomposition results presented in Table 10 above show that in developed countries, most of the variability in real GDP is caused by its own variance. Moreover, the contribution of education is 29 percent, the contribution of health is 4 percent, and the contribution of innovation/technology is 2 percent over a 10-year period. The variance decomposition analysis results also show that in developing countries, most of the variability in real GDP is caused by its own variance. The contribution of education is 36 percent, the contribution of health is 9 percent, and the contribution of innovation/technology is 1 percent over a 10-year period.

Discussion, Conclusion and Recommendations

In the wider literature on human capital, the relationship between human capital and economic growth constitutes an area of overlap between the fields of education and economics. In the literature on economic growth, human capital started to be considered as a third factor of production in the 1960s, alongside labour and capital.

Various growth models have been created to identify the sources of economic growth, but most adopted a quantitative approach to human capital, leaving its qualitative aspects relatively overlooked. This study was conducted to investigate the relationship between economic growth and human capital within the framework of the Mankiw-Romer-Weil model. To this end, a principal component analysis was conducted on nine education variables, six health variables, and four innovation technology/variables, which are thought to represent human capital collectively, and index values were calculated for the education, health, and innovation/technology dimensions of human capital. A Granger causality test and variance decomposition analysis of these values was conducted, which cannot be directly obtained from an existing database, together with the real GDP, labour, and physical capital variables.

Real GDP was found to have a two-way causality relationships with labour, physical capital, education, and health in developed countries, and with education and health in developing countries. That is to say, economic growth on one hand and education and health on the other are the causes of one another in both types of countries. In developed countries, economic growth also maintains a reciprocal causality relationship with labour and physical capital. Given these relationships, it

could be argued that in the absence of a trained workforce, an abundance of natural resources and capital accumulation in a developing country would not allow it to catch up with developed countries, as the human factor is the only element that can combine and utilise all other factors of production. Being home to healthier and better educated individuals, who are also on higher incomes, developed economies are able to mobilise all factors in an efficient manner (Easterly & Wetzel, 1989; Schultz, 1961). Developing countries, on the other hand, with relatively lower incomes, lower schooling ratios, and fewer mean years of schooling, are unable to make use of their already limited resources as efficiently as developed countries. Accordingly, education is in fact a national investment for all countries.

The findings related to health have certain similarities with those of Schultz (for developing countries), who identified a one-way causality relationship from economic growth to health (Schultz, 2003). A relatively high level of income is required for healthy nutrition and access to high-quality healthcare services, and in turn, health is a prerequisite for a high level of income and a good education. In developing countries, negative socio-economic phenomena such as high birth rates, health epidemics, insufficient supplies of consumption goods, a prevalence of communicative diseases, unemployment, and low levels of income result in tension between economic growth and population growth. Accordingly, in developed countries, an interaction between economic growth and the quality of labour and physical capital can be expected.

Another finding of the study is that a one-way causality relationship exists in developed countries from real GDP to innovation/technology, and a one-way causality relationship exists in developing countries from real GDP to labour. New technologies usually originate in developed countries before being transferred to developing countries. While technology transfers would be more preferable than direct R&D, for many developing countries the effects of trade policies on the incentives for technology transfers could have similar implications for growth (Easterly & Wetzel, 1989). Accordingly, economic growth in developing countries affects the labour force (that the country needs) more than it affects technology. In addition, research-oriented education institutions in developed countries make an important contribution to economic development in the form of technological innovation (Langelett, 2000).

The results of the variance decomposition analysis show that in developed countries, most of the variability in real GDP is caused by its own variance. Moreover, the contribution of education is 29 percent, the contribution of health is 4 percent, and the contribution of innovation/technology is 2 percent over a 10-year period. In Lin's (2003) study conducted in Taiwan (a developed country), technological progress was found to account for 37 percent of the growth in output, followed by 25 percent with human capital, 22 percent with labour force, and 16 percent with physical capital, while a one-year increase in the mean years of schooling was found to increase output by about 15 percent. Denison (1962b), on the other hand, found that education accounted for 23 percent of the approximately 3 percent economic growth in the United States, whereas physical capital accounted for 15 percent. According to a study conducted by Schultz (1971) in the United States, 36 percent of the surplus GDP is

explained by primary school-educated labour, 44 percent by middle school-educated labour, and 70 percent by college-educated labour. Countries that achieve high levels of per capita income also make significant progress in educating their labour force (Becker, 1993).

The variance decomposition analysis results also show that in developing countries, most of the variability in real GDP is caused by its own variance. The contribution of education is 36 percent, the contribution of health is 9 percent, and the contribution of innovation/technology is 1 percent over a 10-year period. According to McDonald and Roberts (2002), health is just as important as education for economic growth, and in the long-term, the rate of return on investment in health and education is higher than that of physical capital. That being said, education is more significant for developed countries, and health is more significant for developing countries. In developing countries, physical capital is not viewed as a factor that explains economic growth, which may be attributed to the fact that these countries have relatively younger populations and lower levels of capital accumulation.

In terms of social policy, public sector participation in the provision of basic education and healthcare services is inevitable. It is mainly the responsibility of the government to improve the opportunities in these fields for individuals, who are then expected to contribute to economic growth. Developing countries should recognise the importance of having well-educated, healthy, and technology-literate human capital, and should develop policies to protect and improve these assets. On the other hand, the index creation approach adopted in the present study adds to the empirical evidence collected in the field. Education, in particular, is classified as a consumption in the short-term and as an investment in the long-term. Therefore, to achieve stable economic growth, efforts should be made to improve the quality of education, and to implement projects with high short-term returns.

Future studies conducted with additional proxy variables for the human capital components under examination (such as literacy rates and the number of academic publications for education; obesity and child vaccination rates for health; along with imports of ICT products, and innovation/technology entrepreneurship etc.) would make an important contribution to the body of literature. Moreover, studies should be conducted with a larger number of developed or developing countries and should also include the least developed countries. Part of the model that has a one-way causality relationship from real GDP to innovation/technology, should be investigated in more detail. One limitation of this model is that only those countries with access to healthy data are included in the study. This is the suspicion of reliable data transmission to international organisations from which data is provided, particularly in developing countries. Additionally, there may also be other variables that should be included in the model, that are not included here, which can be considered as another limitation of the model.

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Beşeri Sermaye Bileşenlerinden Eğitimin Ekonomik Büyümeye Etkisi: Panel VAR Analizi

Özet

Problem Durumu: Ekonomik büyüme, toplumsal refah artışının en önemli göstergelerinden biri olarak kabul edilmektedir. Yaşamın daha basit ve yaşanabilir hale gelerek zenginleşmesi ile özdeşleştirilen ekonomik büyümenin kaynaklarının saptanması açısından pek çok araştırmaya konu edilmektedir. Ekonomik büyümeyi sağlayan üretim faktörleri literatürde genellikle sermaye, işgücü, doğal kaynaklar ve teknolojik gelişmeden oluşmaktadır. Ülkelerin ekonomik büyüme ve gelişmesinde, oldukça önemli bir yere sahip olan beşeri sermaye bileşenlerinden eğitim incelenirken üzerinde durulması gereken önemli bir konu, beşeri sermaye stoğunun mali ve fiziki kriterlerinin neler olduğunu belirlemektir. Eğitim alanında gerçekleştirilmiş olan bu araştırmanın sağlık ve inovasyon-teknoloji faktörlerinin de ekonomik büyüme üzerinde doğrudan ve eğitim aracılığıyla dolaylı olarak etkilerinin belirlenmesiyle alana önemli bir katkı sağlayacağı düşünülmektedir. Ayrıca bu çalışmada, beşeri sermayenin göstergelerinin "daraltılmasından" kaçınmak için, literatürde kullanılan genel geçer değişkenlerden "en iyi/en uygun" proxy değişkenini üretebilmek amacıyla bir araya getirilmiş; ülkeler için eğitim, sağlık, inovasyon/teknoloji endeksleri oluşturulmuştur. Bu bütünsel yaklaşımın alana yeni bir veri seti kazandırdığı söylenebilir.

Araştırmanın Amacı: Bu araştırmanın amacı, beşeri sermaye bileşenlerinden eğitimin ekonomik büyümeye etkisini incelemektir. Bu amaca ulaşabilmek için aşağıdaki alt problemlere ilişkin cevaplar aranacaktır:

1999-2015 döneminde gelişmiş ve gelişmekte olan ülkelerin panel verilerinin VAR analizi için;

1. Nedensellik testlerinin sonuçları nasıldır?

2. Varyans ayrışmasının sonuçları nasıldır?

Araştırmanın Yöntemi: Araştırma, nedensel karşılaştırma modelindedir. Araştırma modelinde, bağımlı değişken olan ekonomik büyüme üzerinde, bağımsız değişkenler olan emek, fiziki sermaye ve beşeri sermayenin (eğitim, sağlık ve inovasyon/teknoloji) etkileri, gelişmiş ve gelişmekte olan ülkeler açısından ele alınmaktadır. Araştırmanın evrenini, 35'i gelişmiş ve 154'ü gelişmekte olan toplam 189 ülke; örneklemini ise 16'sı gelişmiş ve 15'i gelişmekte olan toplam 31 ülke oluşturmaktadır. Araştırmada kullanılan veriler, WB, HDI, WHO ve UNESCO'nun web veri bankalarından temin

edilmiştir ve 1999-2015 dönemi yıllık panel verileri kapsamaktadır. Verilerin analizinde EViews 9, Microsoft Excel ve STATA 13 istatistik paket programları kullanılmıştır. Her ülke ve yıl için beşeri sermaye indeks değerleri elde edilerek, bu değerlere PVAR analizi uygulanmıştır.

Araştırmanın Bulguları: Araştırmadan elde edilen bulgulara göre, gelişmiş ve gelişmekte olan tüm ülkelerde, ekonomik büyüme ile eğitim ve sağlık karşılıklı birbirlerinin nedeni iken; gelişmiş ülkelerde bunlara ek olarak, ekonomik büyüme ile emek ve fiziki sermaye de karşılıklı birbirlerinin nedenidir. Ayrıca, gelişmiş ülkelerde, eğitim, emek ve inovasyon-teknolojinin nedenidir. Gelişmekte olan ülkelerde ise inovasyon-teknoloji, eğitimin nedenidir. Eğitim ile fiziki sermaye arasında tüm ülkelerde karşılıklı nedensellik söz konusudur. Gelişmiş ülkelerde, ayrıca sağlık, eğitimin nedeni iken; gelişmekte olan ülkelerde eğitim ile sağlık birbirlerinin nedeni durumundadır. Varyans ayrıştırması sonuçlarına göre, gelişmiş ülkelerde ekonomik büyümedeki değişimin, 10 yıllık uzun bir dönemde, yaklaşık üçte ikisi kendisiyle, yaklaşık üçte biri ise eğitim ile açıklanmaktadır. Gelişmekte olan ülkelerde ise ekonomik büyümedeki değişimin, 2 yıllık gibi kısa bir dönemde, diğer değişkenlere kıyasla, en fazla kendisi ve sağlık ile açıklandığı belirlenmiştir. 4 yıllık bir dönemde kendisi ile birlikte, eğitim sağlıktan daha yüksek düzeyde açıklamaya başlamakta; ilerleyen dönemlerde de bu trendler devam etmektedir. 10 yıllık uzun bir dönemde ise ekonomik büyümenin yaklaşık yarısı kendisiyle, yaklaşık üçte biri ise eğitim ile açıklanmaktadır.

Araştırmanın Sonuçları ve Öneriler: Gelişmiş ve gelişmekte olan ülkeler için okullaşma oranları, eğitime yapılan kamu harcamaları ve ortalama eğitim süresindeki artış, ekonomik büyümeyi ancak 10 yıl gibi uzun bir dönemde artırabilmektedir. Sağlıklı bireylere kısa vadede yapılan eğitim harcamalarının, uzun vadede yatırım özelliği kazanarak, ülkelerin ekonomisine olumlu katkılarda bulunması beklenmektedir. Gelişmiş ülkelerden farklı olarak, Türkiye gibi gelişmekte olan ülkelerde, kısa dönemde sağlık, uzun dönemde ise eğitim, ekonomik büyümenin en önemli yordayıcılarındandır. Toplumsal anlamda, temel eğitim ve sağlık hizmetleri, bireylerin yanı sıra hükümet katılımının da vazgeçilmez olduğu alanlardan biridir. Ekonomik büyümeye katkı sağlayacak olan bireylerin bu alanlardaki olanaklarının iyileştirilmesi, öncelikle devletlerin sorumluluğundadır. Gelişmekte olan ülkeler, eğitimli, sağlıklı, teknoloji okur-yazarı olan beşeri sermayelerinin öneminin farkına varmalı ve bu değeri koruyup, geliştirmeye yönelik politikalar üretmelidir. Gelişmekte olan ülkelerin, gelişmiş ülkelerin sahip olduğu refaha ulaşabilmesi için, ekonomik büyüme sürecinde, hizmet, sanayi ve tarım sektörünün işgücü ihtiyaçlarına göre eğitim sistemlerinin, planlı ve programlı bir şekilde düzenlenmesi gerekmektedir. Buna ek olarak, sağlık harcamaları, personel sayısı ve niteliğini artıracak, bireylerin sağlık hizmetlerine ulaşımını kolaylaştıracak politikalar geliştirilmesinin, ortalama yaşam süresi ve kalitesini artıracağı düşünülmektedir. Teknoloji kapsamında ise ar-ge harcamalarına ayrılan payın artması, araştırmacı sayısının ve niteliklerinin artırılması ile yüksek nitelikli teknolojik ürünler üretilip, ekonomik büyüme desteklenebilir. Araştırmacılar için de birtakım öneriler söz konusudur. Araştırmaya konu olan beşeri sermaye bileşenlerinden eğitimde, okur-

yazarlık oranı ve makale sayıları; sağlıkta, obezite ve çocuk aşılama oranları; inovasyon-teknolojide, BİT ürünleri ithalatı ve girişimcilik gibi farklı vekil değişkenlerin verilerine ulaşılarak yapılacak çalışmaların, literatüre önemli bir katkı sağlayacağı düşünülmektedir. Ayrıca, daha farklı gelişmiş ve gelişmekte olan ülkeler ya da az gelişmiş ülkeler dahil edilerek araştırmalar yapılabilir. Bu durumun aynı zamanda, bu çalışmanın sınırlılıklarından biri olduğu ifade edilebilir.

Anahtar Sözcükler: Beşeri sermaye, ekonomik büyüme, sosyal refah, panel VAR analizi.