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THE RELATION BETWEEN HUMAN CAPITAL AND ECONOMIC GROWTH IN THE COUNTRIES ATTAINED THEIR INDEPENDENCE WITH THE COLLAPSE OF THE USSR

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Abstract

In this study, the relationship between human capital and economic growth is tested by second generation panel data analysis for the countries gained independence after the collapse of the USSR with the help of four different models by using 1995-2014 period data. Cross-section dependence among these countries was tested by means of Breusch and Pagan (1980) LM test, Pesaran (2004) scaled LM test, Baltagi, Feng, and Kao (2012) bias-corrected scaled LM test and Pesaran (2004) CD methods. Result of this analysis show that there are cross-sectional dependence among these countries. Stationarity of the series is investigated by Hadri and Kuruzomi (2012) panel unit root test and reached that all series are I(1). Westerlund (2008) Durbin-Hausman panel cointegration test is separately conducted for four models and seen that the series are cointegrated. Cointegration coefficients are estimated by Breitung (2005) Two Step Least Squares method. The results indicate that 1% increase in human capital, average life expectancy, health expenditure per capita and education expenditure per capita improves per capita national income by 3.066, 8.186, 0.541 and 0.307 percent, respectively. Moreover, 1% increase in capital stock per capita affects national income per capita between 0.548% and 1.07% with respect to other independent variable in the models

Key words: Economic Growth, Human Capital, Eastern Europe, The Baltic, The Caucasus, Central Asian Countries.

Jel Codes: F43, E24, J24, O15.

Introduction

Economic growth, described as the increase in real national income in time (Lipsey et al. 1984), may be affected by many factors like GDP per capita, capital stock and human capital, technology, population, natural resources, cultural and institutional structure, regime and stability of the country (TEK, 2003).

In a world such that economic growth competition among countries accelerates, one of the major factors providing advantage to countries is the increase in productivity (OECD, 2015). To increase productivity, human capital has to be grown or developed. When the quality indicators of labor like health, education and experience are better off, not only personal efficiency increases but also the productivity of the machinery equipment and capital in use will rise. On the other hand, well-educated labor force will create new ideas and production technologies, which is increasing the level of technology and accelerating economic growth of the country (UNIDO, 2016).

In this study, the relationship between human capital and economic growth is investigated for 10 countries¹⁰ which gains independency after the collapse of USSR for 1995-2014 period by second generation panel data analysis method. Second part of this study covers the theoretical background of the issue. In third part indicates the situation in these countries, literature review is given in the fourth part and in fifth part, econometric analysis is presented. The paper is completed with conclusions and policy implications part.

In this study, human capital, average life expectancy, health expenditure per capita, education expenditure per capita and fixed capital stock per capita variables are used as the determinants of economic growth. To analyze, new generation panel data analysis methods, taking cross-sectional dependence into account, employed. Countries drawing attention as being transition economies among the emerging countries are selected. By this aspect, this study is supposed to make a contribution to the literature as its content, data set and analyzing methods. It is also thought that researchers' interests will be directed to this topic again.

Obtained results and policy advices will be a reminder of the importance of human capital and its subcomponents in economic growth for the policymakers of related countries and other developing countries, leading them to a better economic growth.

2. Theoretical Background

Economic growth implies increase in real GDP in time (Lipsey et al. 1984). Economic growth may occur in two ways. One of them is the short run economic growth based on expected fluctuations arising in a situation which an underemployed economy increases its production to get rid of underemployment. Other is the long run economic growth faced by fully employed economies. It happens with the help of new production factors or increasing efficiency and productivity of labor or capital with contemporary technology (TEK, 2013).

Many theories have been developed about economic growth. These theories generally investigate closely the factors that have significant impact on growth. Growth theories are mainly focus on capital accumulation, technologic improvement and population growth. There exist two basic, widely-accepted approaches about speed of growth: Harrod-Domar and Neo-classic models. Harrod-Domar model claims that speed of growth is determined by capital accumulation. Neo-classic model, on the other hand, examines the response of saving, investment and growth to population increase and technological change. In Neo-classic approach, because the technologic improvement is seen exogenous, it is not explained sufficiently. Therefore, Solow (1956) did try to make technology an endogenous variable and to explain the exogeneity which arises depending on technologic growth (Barro and Sala-i-Martin, 1995).

Economic growth can be investigated through Cobb-Douglas production function as;

$$Y = AF(K, L) \quad (1)$$

$$Y = AK^\alpha L^\beta \quad (2)$$

By taking logarithm of both sides, the equation becomes linearized;

$$\begin{aligned} \text{Log}Y \\ &= \text{Log}A + \text{Log}K^\alpha \\ &+ \text{Log}K^\beta \end{aligned} \quad (3)$$

$$\begin{aligned} \text{Log}Y \\ &= \text{Log}A + \alpha \text{Log}K \\ &+ \beta \text{Log}L \end{aligned} \quad (4)$$

Finally, by derivating both sides with respect to time, the relationship between output growth rate and input growth rate is obtained.

$$\begin{aligned} \frac{\dot{Y}}{Y} \\ &= \frac{\dot{A}}{A} + \frac{\dot{K}}{K} \\ &+ \frac{\dot{L}}{L} \end{aligned} \quad (5)$$

Here; Y is total production, A is technology level, K is capital stock, L is amount of labor, α and β are the shares of capital and labor in production. Equation (5) implies that the output growth rate is the sum of weighted average of the change in technology, in capital and in labor force. According to the equation, major determinants of economic growth are technologic improvement and increase in capital stock and employment (Levin and Renelt, 1992).

Capital stock, which is important for countries to increase economic growth by creating employment and productivity, is obtained by subtracting the depreciation of machinery, equipment, building and infrastructure from the accumulated amount of investment on those production factors. In Solow (1956) model, which is the base of Neo-classic growth theories, economic growth is considered as a function of fixed capital stock per worker. Moreover, increase in capital stock is the most important determinant of economic growth in Keynesian and Post-Keynesian theories (Jones and Vollrath, 2013). According to Post-Keynesian approach, increases in demand boost productivity and economic growth by increasing investment (Blomstrom, et al. 1996). Here, investments stimulate new technology and helps new technology to deploy (Barro ve Salai-Martin, 1995).

Labor force is the sum of all efforts on production including both muscle and brain activity. While labor force is dependent on population growth and immigration, productivity of labor force is closely related to education level, capability and health condition of workers (Krugman, 1994). Especially investment on education and human capital accelerates economic growth by creating qualified labor force. Investment on human brings qualified labor force and qualified labor force boosts improvement in technology and productivity (Mathur, 1999). Thus, in this study; human capital, average life expectancy, education and health expenditure per capita are evaluated as part of technologic progress. That is, they are not included in L but in A in this study.

In endogenous growth theory, developed in mid-1980's, human capital and foreign trade is seen as an important source of economic growth (Lucas, 1998; Romer, 1994). In this theory; quality, productivity and creative ideas of labor force is highly critical. By transforming the creative ideas into new products, functional designs and scientific inventions, countries obtain more competitive power in export, leading the country to have a higher share of technology-intensive good in export. By this way, export will add more value for the country and it is expected that the economic growth of the country will significantly improve. (UNCTAD, 2008).

3. Situation In These Countries

Countries separated from the USSR are also referred to as transition economies. These countries have started to meet the free market economy since the mid-1990s. In Table 1, Human Development Index (Human Capital) data is presented for above-mentioned countries.

Table 1. Human Development Index

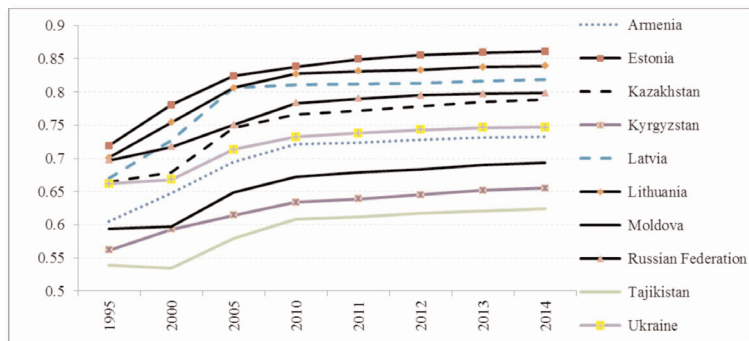
	1995	2000	2005	2010	2011	2012	2013	2014	Ranking in the World 2014
Armenia	0.605	0.648	0.695	0.721	0.723	0.728	0.731	0.733	85
Estonia	0.719	0.78	0.82	0.838	0.849	0.855	0.859	0.861	30
Kazakhstan	0.664	0.679	0.746	0.766	0.772	0.778	0.785	0.788	56
Kyrgyzstan	0.562	0.593	0.614	0.634	0.639	0.645	0.652	0.655	120
Latvia	0.67	0.727	0.806	0.811	0.812	0.813	0.816	0.819	46
Lithuania	0.701	0.754	0.806	0.827	0.831	0.833	0.837	0.839	37
Moldova	0.594	0.597	0.649	0.672	0.679	0.683	0.69	0.693	107
Russian Federation	0.697	0.717	0.75	0.783	0.79	0.795	0.797	0.798	50
Tajikistan	0.539	0.535	0.579	0.608	0.612	0.617	0.621	0.624	129
Ukraine	0.662	0.668	0.713	0.732	0.738	0.743	0.746	0.747	81

Source: Human Development Reports (2016).

According to Table 1, countries having the highest human capital are Estonia, Lithuania and Latvia in order. Other countries need to make more efforts to improve their human capital. These data is given as graph in Graph 1.

Graph 1.
Human Development
Index

Source:
Human Development Reports
(2016).



In Graph 1, it is seen that all included countries' human capital get better off after the collapse of USSR. The reason behind it is thought to be the increase in investment in order to enhance human capital in these countries obtaining stability and independency. Furthermore, decentralization improves the efficiency of these economies. In Estonia, Latvia and Lithuania, higher values are observed and it is due to the fact that these three countries have joined in European Union in 2004. On the other hand, high growth rate of human capital in Armenia deserves attention. In Table 2, subcomponents of human capital and real GDP per capita for these countries are presented as of 2014.

Table 2. Subcomponents of Human Capital and Real GDP Per Capita (2014)

	HDI	Ranking to HDI	LE	Ranking to LE	HE	Ranking to HE	EE	Ranking to EE	SY	Ranking to SY	G	Ranking to Growth
Estonia	0.861	1	77.2	1	1668.3	3	8552.0	1	12	2	3.7	4
Lithuania	0.839	2	74.0	4	1718.0	2	2452.7	5	12.4	1	2.6	6
Latvia	0.819	3	74.2	3	940.3	5	6752.4	2	11.5	4	2.3	7
Russian F.	0.798	4	70.4	9	1835.7	1	4431.9	3	11.7	3	-2.6	10
Kazakhstan	0.788	5	71.6	5	1068.1	4	3515.4	4	10.4	7	7.8	1
Ukraine	0.747	6	71.2	7	584.2	6	1900.1	6	11.3	5	0.3	9
Armenia	0.733	7	74.7	2	362.1	8	852.3	8	10.8	6	1.4	8
Moldova	0.693	8	71.5	6	514.2	7	1316.6	7	9.8	9	2.9	5
Kyrgyzstan	0.655	9	70.4	8	215.1	9	781.1	9	9.3	10	4.3	3
Tajikistan	0.624	10	69.6	10	185.1	10	403.5	10	9.9	8	5.0	2

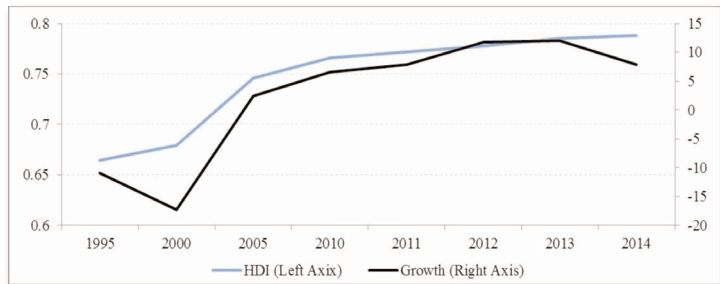
Source: Human Development Reports (2016), World Bank (2016) and Feenstra et al. (2015).

Note: HDI: Human Development Index, LE: Life Expectation, HE: Health Expenditure Per Capita, EE: Education Expenditure Per Capita, SY: Average Schooling Year, Growth: G: National Income Per Capita (annual % growth)

It is clearly seen in Table 2 that countries which are having higher human capital also have greater economic growth rate. For instance, when the relationship between human capital and economic growth for Kazakhstan is investigated, Graph 2 is obtained.²

Graph 2.
The Relationship between
Human Capital and Economic
Growth for Kazakhstan

Source:
Human Development Reports
(2016) and World Bank (2016).



A simultaneous relationship can be mentioned between human capital and economic growth as it is in Graph 2. Only in recent years there seems to be a divergence between these variables. It is evaluated that these diverge originated from non-HDI variables.

4. Literature Review

There are many studies in the literature that examine the relationship between human capital and economic growth. A comprehensive summary of the literature about the relationship between human capital and economic growth is presented here by date.

Frances and Ramirez (2000) examined the relationship between economic growth and human development. Cross country regressions showed a significant relationship between public expenditures on health and education. Wolff (2000) investigated the effects of human capital on the economic growth for 24 OECD coun-

2) Similar graphs are obtained for other countries. Kazakhstan is chosen because the relationship is more clear.

tries over 1950-1990 periods. He found that the convergence in labor productivity levels related to convergence in education levels. Econometric results showed a positive and significant effect of formal education on productivity growth. Kalemli-Ozcan, et al. (2000) investigated the impact of higher life expectancy of human capital on economic growth with a continuous time overlapping generations model. They found that declined mortality and schooling affect the economic growth.

Asteriou and Agiomirgianakis (2001) examined the relationship between human capital and economic growth in Greece. They investigate the relationship and causality between educational variables and GDP, based on the assumption that principal institutional process on developing human capital is formal education. They found that cointegration relation between education level (measured by participation in primary, secondary and higher education) and GDP per capita exists and the way of causality is from education to growth. Only higher education and GDP per capita has a reverse causality.

Boucekkine, et al. (2002) investigated the relationship between economic growth and human capital by OLG model and they reached an ambiguous effect longer schooling on the per-capita growth.

Wang and Yao (2003) created a measure to compute China's human capital stock for 1952-1999 periods and used it to find its relationship between China's growth. According to the study, accumulation of human capital has been very quick and its impact on growth and welfare was significant. Besides, the role of growth of total factor productivity was positive in the reform period, while it was negative in pre reform period.

Chakraborty (2004) investigated the relationship between endogenous lifetime and economic growth by two-period overlapping generations model and reached that when human capital drives economic growth, countries differing in health capital doesn't converge to similar living standards. Gyimah-Brempong and Wilson (2004) examine the relationship between human capital health and growth of income per capita in Sub-Saharan African and OECD countries. According to results, health of human capital strongly and positively affects the growth of income per capita in a quadratic way: when the health stock is relatively large, its impact on economic growth gets small. In conclusion, the higher the human capital health is, the better the steady state income is.

Arndt (2006) examined relationship among HIV/AIDS, human capital, and economic growth in Mozambique by using a dynamic computable general equilibrium approach and reached that HIV/AIDS assumed to slow the rate of human capital accumulation and in the human and physical capital accumulation are shown to interact strongly with technical change and economic growth.

Dinda (2008) analyzed the effects of social capital and human capital on economic growth. At the end of this study, it was found that human capital accumulation is led by productive consumption and the existence of human capital is essential to improve social capital. Moreover, both human capital and social capital accumulation affect the equilibrium growth rate.

Fleisher, et al. (2010) investigated the relations among human capital, economic growth, and regional inequality in China. They found that human capital positively affects output and productivity growth. Moreover, there are both direct and indirect effects of human capital on total factor productivity growth.

Lee and Mason (2010) analyzed the links between human capital investment and economic growth over the demographic transition by using overlapping generations model. Simulation analysis was employed to show that low fertility leads to higher per capita consumption through human capital accumulation, given plausible model parameters.

Goldin (2014) investigated the relationship between human capital and economic growth by theoretically. In the paper, main components of human capital are listed as education, training, and health. Moreover, the institutions encouraging human capital investment and the human capital's impact on economic growth are discussed. Queirós and Teixeira (2014) analyzed the relationship between human capital and economic growth in OECD countries for 1960-2011 periods. It is found that one of the most critical factors for growth is the country-specific production dynamics. Furthermore, human capital and structural change towards high knowledge-intensive industries affects economic growth.

Pelinescu (2015) investigated the impact of human capital on economic growth for European Union countries by panel data methods. The study revealed the functions of human capital in growth and found that sustainable development is influenced by low human capital investment in these countries. Study of Shahzad (2015) observes the role of human capital formation on economic growth in Pakistan by utilized the secondary data form the period of 1990 to 2013. The study clearly revealed that human capital, health and physical capital are keys to boost the economic growth of Pakistan. As a result of this study human capital has a positive and significant impact on GDP. Gross fix capital formation has positive significant impact on GDP. There is negative but significant relationship between Infant Mortality Rate and GDP of Pakistan.

Boztosun, et al. (2016) researched the relationships between human capital and economic growth were analyzed by using Hatemi-J (2008) cointegration and Hacker and Hatemi-J (2006) causality tests in Turkey for the 1961-2011 period data. They found that a dual causality relationship between human capital and economic growth variables. In addition a 1% increase in human capital yielded about a 3.2% increase in GDP. Wang and Liu (2016) investigated the effect of educated human capital on economic growth by using paned data methods for 1960-2009 period data of 55 countries. In the study, education level of human capital is categorized as primary, secondary and higher education to analyze the effect of different education levels on growth. It is concluded that higher education has a positive and significant impact on economic growth while the impact of primary and secondary education is not significant. Moreover, per capita GDP growth is positively correlated with human capital and life expectancy.

5. Econometric Analysis

5.1. Motivation

General result of the literature concludes that human capital affects economic growth. To measure human capital, Human Development Index, Health Expenditures, Education Expenditures and Life Expectancy data is employed mostly. It is realized that there exists limited study on the countries established after the collapse of the USSR. This study will contribute the literature because the number of studies on those countries is limited.

5.2. Model

In this study, based on Solow (1956; 1957), Swan (1956) and Bernanke and Gurkaynak (2002), the following models were created by using the Equation (2):

$$Y = AK^{\alpha} L^{\beta} \quad (6)$$

Dividing both sides by L, income per worker will become a function of technology and capital stock per worker.

$$\frac{Y}{L} = \frac{AK^{\alpha} L^{\beta}}{L} \quad (7)$$

$$\frac{Y}{L} = \frac{K^{\alpha}}{L^{1-\beta}} \quad (8)$$

Under the assumption of constant return to scale, $\alpha + \beta = 1$ and thus, $\alpha = 1 - \beta$.

$$\begin{aligned} \frac{Y}{L} &= A \frac{K^\alpha}{L^\alpha} \end{aligned} \quad (9)$$

$$\begin{aligned} \frac{Y}{L} &= A \left(\frac{K}{L} \right)^\alpha \end{aligned} \quad (10)$$

It can be rewritten as:

$$y = Ak^\alpha \quad (11)$$

In equation 11; y is output per worker, A is technology (Solow residual) and k is fixed capital stock per worker. Linearizing equation 11, we obtain:

$$\begin{aligned} \text{Log} y &= \text{Log} A \\ &+ \alpha \text{Log} K \end{aligned} \quad (12)$$

Then, econometric form of it will be:

$$\begin{aligned} \text{Log} y_{it} &= \beta_0 + \beta_1 \text{Log} A_{it} + \beta_2 \text{Log} K_{it} \\ &+ \varepsilon_{it} \end{aligned} \quad (13)$$

In this final equation; i stand for countries, t for time. β_0 is constant term (impacts of non-included variables on output per worker), β_1 is elasticity of output per worker for technology and β_2 is elasticity of output per worker for fixed capital stock per worker, while ε is random walk residuals. Technology cannot be obtained as a time series, therefore the following variables is used to proxy it: Human Capital (HC), Life Expectancy at birth as years (LE), and Health Expenditure per capita (HE) and Education Expenditure (EE) and each variable is used in different models.

$$\begin{aligned} \text{Model 1: } \text{Log} y_{it} &= \beta_0 + \beta_1 \text{Log} HC_{it} + \beta_2 \text{Log} K_{it} \\ &+ \varepsilon_{it} \end{aligned} \quad (14)$$

$$\begin{aligned} \text{Model 2: } \text{Log} y_{it} &= \alpha_0 + \alpha_1 \text{Log} LE_{it} + \alpha_2 \text{Log} K_{it} \\ &+ \varepsilon_{it} \end{aligned} \quad (15)$$

$$\begin{aligned} \text{Model 3: } \text{Log} y_{it} &= \gamma_0 + \gamma_1 \text{Log} HE_{it} + \gamma_2 \text{Log} K_{it} \\ &+ \varepsilon_{it} \end{aligned} \quad (16)$$

$$\begin{aligned} \text{Model 4: } \text{Log} y_{it} &= \delta_0 + \delta_1 \text{Log} EE_{it} + \delta_2 \text{Log} K_{it} \\ &+ \vartheta_{it} \end{aligned} \quad (17)$$

Relationship between human capital and economic growth is analyzed by these models (equation 14-17).

5.3. Data Set

In this study, countries attaining their independence after the collapse of the USSR (Eastern Europe: Russia, Belarus, Ukraine, Moldova; Baltic: Estonia, Latvia, Lithuania; the Caucasus: Georgia, Armenia, Azerbaijan; and Central Asian: Turkmenistan, Uzbekistan, Kyrgyzstan, Kazakhstan, Tajikistan) was intended to analyze in order to reveal the impact of human capital on economic growth. However, Azerbaijan, Belarus, Georgia, Turkmenistan and Uzbekistan were excluded from the analysis due to their incomplete data set. For remaining 10 countries, following data covering 1995-2014 periods is used:

Dependent Variable (y): Expenditure-side real GDP at chained PPPs (in 2011US\$) obtained from Penn World Table 9.0 (<http://www.rug.nl/ggdc/productivity/pwt/>) and it divided by population series, which is obtained again Penn World Table 9.0 (<http://www.rug.nl/ggdc/productivity/pwt/>). By this, real GDP per capita series is obtained and logarithm of that series is used.

Independent Variables:

Human Capital (HC): Human capital index, based on years of schooling and returns to education series of Penn World Table 9.0 (<http://www.rug.nl/ggdc/productivity/pwt/>) is employed after transformed into an index having the greatest value 100. Then the logarithmic form of the series is used.

Life Expectation (LE): Life expectancy at birth (years) from World Bank (<http://data.worldbank.org/indicator/SP.DYN.LE00.IN?end=2014&start=1990&view=chart>). The series is used in logarithmic form.

Health Expenditure (HE): Real health expenditure per capita PPP (constant 2011 international \$) obtained from World Bank (<http://data.worldbank.org/indicator/SH.XPD.PCAP.PP.KD>). The series is used in logarithmic form.

Education Expenditure (EE): Education expenditure per capita (PPP, Adjusted savings, constant 2011 international \$) obtained from World Bank (<http://data.worldbank.org/indicator/NY.ADJ.AEDU.CD>). The series is used in logarithmic form.

Capital Stock (k): Capital stock at constant 2011 national prices (in mil. 2011US\$) obtained from Penn World Table 9.0 (<http://www.rug.nl/ggdc/productivity/pwt/>) and population series of the same table is divided to obtain per capita fixed capital stock. The series is in dollar and logarithmic form.

We have thought dividing the GDP, HE, EE and Capital Stock series by labor force instead of population, however considering the close relation of health and education of labor force with health and education of population, studying with per capita data instead of per worker data becomes more meaningful. On the other hand, Human Development Index of United Nations could not be used because of many missing data in it.

5.4. Methodology

In this study, cross section dependence is checked by Breusch-Pagan (1980) LM test, Pesaran (2004) scaled LM test, Baltagi, Feng and Kao (2012) bias-corrected scaled LM test and Pesaran (2004) CD test. Stationarity of the series is analyzed by Hadri and Kuruzomi (2012) panel unit root test, while cointegration is investigated by Durbin-Hausman panel cointegration method developed by Westerlund (2008). Cointegration coefficients are estimated by Two Step Least Square estimator of Breitung (2005).

5.5. Cross-Sectional Dependency Test

Considering cross-sectional dependence in the panel or not is highly affects the results of analysis. When cross-sectional dependence is ignored in estimation, consequences like unaccounting residual dependence

resulting efficiency loss in estimator and invalid test statistics may arise. There are a variety of tests for cross-section dependence in the literature. Cross-section dependence among these countries was tested by means of Breusch-Pagan (1980) LM test, Pesaran (2004) scaled LM test, Baltagi, Feng, and Kao (2012) bias-corrected scaled LM test and Pesaran (2004) CD in this study. These tests can be investigated based on a panel data model in following equation:

$$y_{it} = \beta_{it}'x_{it} + u_{it} \quad (18)$$

Here; β_1 are the corresponding cross-section specific vectors of parameters to be estimated. The general null hypothesis of cross-section dependence may be stated in terms of the correlations between the disturbances in different cross-section units;

$$\rho_{ij} = \text{Corr}(u_{it}, u_{jt}) = 0 \quad \text{for } i \neq j \quad (19)$$

Here; ρ_{ij} is the product-moment correlation coefficient of the residuals. Pagan (1980) Lagrange Multiplier (LM) test statistic is obtained as;

$$LM = \sum_{i=1}^{N-1} \sum_{j=i+1}^N T_i \hat{\rho}_{ij}^2 \sim \chi_{\frac{N(N-1)}{2}}^2 \quad (20)$$

Pesaran (2004) extended this test for situations where N is too large and obtained this scaled test statistic;

$$LM_s = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T_i \hat{\rho}_{ij}^2 - 1) \sim N(0,1) \quad (21)$$

Pesaran also adjusted the size distortion of LM and LM_s tests obtained CD test as:

$$CD_P = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N T_i \hat{\rho}_{ij}^2 \sim N(0,1) \quad (22)$$

Baltagi, Feng, and Kao (2012) developed a simple asymptotic bias correction for the scaled LM test statistic:

$$LM_{BC} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T_i \hat{\rho}_{ij}^2 - 1) - \frac{1}{2(T-1)} \sim N(0,1) \quad (23)$$

Null hypothesis of these tests are no cross-section dependence. Cross-sectional dependence tests were applied with EViews 9.0 and obtained results were shown in Table 3.

Table 3. Cross-sectional Dependence Test Results

	<i>LM</i>	<i>LM_s</i>	<i>LM_{BC}</i>	<i>CD_P</i>
y	715.13***(0.00)	69.58***(0.00)	69.32***(0.00)	26.48***(0.00)
HC	630.53***(0.00)	60.66***(0.00)	60.40***(0.00)	23.36***(0.00)
LE	695.76***(0.00)	67.54***(0.00)	67.27***(0.00)	26.28***(0.00)
HE	839.01***(0.00)	82.64***(0.00)	82.37***(0.00)	28.96***(0.00)
EE	798.71***(0.00)	78.39***(0.00)	78.13***(0.00)	28.23***(0.00)
k	713.64***(0.00)	69.42***(0.00)	69.16***(0.00)	15.70***(0.00)

Note: Values in parentheses are probability values, d.f.=45, ***; indicates the presence of cross-sectional dependence at the 1% significance level.

According to Table 3, null hypothesis is robustly rejected in all series meaning that there exists cross-sectional dependence among these countries. That is, an economic or social shock arising in a country can affect the others. Therefore, in order to determine the policies in one country, policymakers have to closely monitor the developments in other countries. Rest of the analysis is carried on with the second generation panel data method which is regarding cross-sectional dependence.

5.6. Panel Unit Root Test

Stationarity of the series is investigated by Hadri and Kuruzomi (2012) panel unit root test. This test, taking the cross-sectional dependence into account, includes the unit root of common factors that forms the series while allowing common factors exist. Furthermore, it allows autocorrelation in data and eliminates it by AR(p) process based on Seemingly Unrelated Regression (SUR) procedure of SPC method developed by Sul, Phillips and Choi (2005) or by AR(p+1) process, in which 1 is added to lag length, of Lag Augmented (LA) method based on Choi (1993) and Toda and Yamamoto (1995). In a series whose data generating process is like following:

$$y_{it} = z_i' \delta_i + f_i y_i + e_{it} \quad (24)$$

f_i show common factors. e_{it} has got an $AR(1)$ process and can be written in following way.

$$e_{it} = \phi_1 e_{it-1} + u_{it} \quad (25)$$

In SPC method, y_{it} is assuming as it is $AR(p)$ and modified as it is in following equation:

$$y_{it} = z_i' \delta_i + \hat{\phi}_{i1} y_{it-1} + \dots + \hat{\phi}_{ip} y_{it-p} + \hat{\zeta}_{i0} \bar{y}_t + \dots + \hat{\zeta}_{ip} \bar{y}_{t-p} + \hat{u}_{it} \quad (26)$$

Long term variation of the estimated equation is;

$$\hat{\sigma}_{u_i}^2 = \frac{1}{T} \sum_{t=1}^T \hat{u}_{it}^2 \quad (27)$$

Variation of SPC is calculated by using this variation;

$$\begin{aligned} \hat{\sigma}_{u_i|SPC}^2 \\ = \frac{\hat{\sigma}_{u_i}^2}{(1 - \hat{\phi}_i)^2} \end{aligned} \quad (28)$$

Employing this, Z_A^{SPC} test statistics is obtained as follows;

$$\begin{aligned} Z_A^{SPC} \\ = \frac{1}{\hat{\sigma}_{u_i|SPC}^2 T^2} \sum_{t=1}^T (S_{it}^w)^2 \end{aligned} \quad (29)$$

In LM method, series in equation (18) is written as $AR(\rho+1)$ process.

$$\begin{aligned} y_{it} = \\ x_t' \hat{\delta}_i + \tilde{\phi}_{i1} y_{it-1} + \dots + \tilde{\phi}_{ip+1} y_{it-p-1} + \tilde{\zeta}_{i0} \bar{y}_t + \dots + \tilde{\zeta}_{ip+1} \bar{y}_{t-p-1} + \\ \tilde{u}_{it} \end{aligned} \quad (30)$$

Long run variation of the estimation is;

$$\begin{aligned} \tilde{\sigma}_{u_i}^2 \\ = \frac{1}{T} \sum_{t=1}^T \tilde{u}_{it}^2 \end{aligned} \quad (31)$$

Variance of LA is computed by using $\tilde{\sigma}_{u_i}^2$;

$$\begin{aligned} \hat{\sigma}_{u_i|LA}^2 = \\ \frac{\hat{\sigma}_{u_i}^2}{(1 - \tilde{\phi}_{i1} - \dots - \tilde{\phi}_{ip})^2} \end{aligned} \quad (32)$$

Then, Z_A^{SPC} test statistics is obtained in following form;

$$\begin{aligned} Z_A^{LA} \\ = \frac{1}{\hat{\sigma}_{u_i|LA}^2 T^2} \sum_{t=1}^T (S_{it}^w)^2 \end{aligned} \quad (33)$$

Hypothesis of this test is:

$$H_0: \phi_i(1) \neq 0 \text{ for all } i, \quad \text{no unit root}$$

$$H_1: \phi_i(1) = 0 \text{ for some } i, \text{ has a unit root}$$

In this study, Hadri and Kuruzomi (2012) panel unit root test is conducted and the results are presented in Table 4.

Table 4: Results of Hadri and Kuruzomi (2012) Panel Unit Root Test

Variables	Level		First Difference	
y	4.07 (0.00)	5.90 (0.00)	-1.23*** (0.89)	-1.82*** (0.96)
HC	136.32 (0.00)	84.06 (0.00)	-2.51*** (0.99)	-2.48*** (0.99)
LE	10.09 (0.00)	124.47 (0.00)	1.31*** (0.90)	20.91*** (0.40)
HE	6.14 (0.00)	9.62 (0.00)	-0.15*** (0.56)	-0.55*** (0.71)
EE	150.73 (0.00)	631.00 (0.00)	0.59*** (0.27)	0.09*** (0.46)
k	17.20 (0.00)	108.05 (0.00)	-0.05*** (0.52)	-1.09*** (0.86)

Note: *** implies Stationarity at %1 significance level. Trend and intercept model was used in testing level value of series and intercept model was used in testing differenced value of series. Numbers in parenthesis are probabilities.

According to Table 4, all series are stationary when differenced and not stationary in level values, that is all series are I(1). By this result, it can be said that economic growth, human capital and capital stock in included countries are not stable and show substantial fluctuations. Therefore, in order for these countries to have a stable economic growth, human and physical capital investments has to be stable.

5.7. Panel Cointegration Test

In this study, existence of cointegration relationship within series is investigated by Durbin-Hausman panel cointegration test developed by Westerlund (2008). Main advantages of this method are inclusion of cross-section dependency and common factors. Westerlund (2008) studied on Fisher equation in developing process of the test:

$$\begin{aligned} i_{it} \\ &= \alpha_i + \beta_i \pi_{it} \\ &+ z_{it} \end{aligned} \quad (34)$$

Here,

$$\begin{aligned} \pi_{it} \\ &= \delta_i \pi_{it-1} \\ &+ w_{it} \end{aligned} \quad (35)$$

$$\begin{aligned} z_{it} \\ &= \lambda_i' F_t \\ &+ e_{it} \end{aligned} \quad (36)$$

$$\begin{aligned} F_{jt} \\ &= \rho_j F_{jt-1} \\ &+ u_{jt} \end{aligned} \quad (37)$$

$$\begin{aligned} e_{it} \\ &= \phi_i e_{it-1} \\ &+ v_{it} \end{aligned} \quad (38)$$

Westerlund (2008) developed two different test statistics; Durbin-Hausman group statistics for heterogeneous panel and Durbin-Hausman panel statistics for homogeneous panel. Country-specific intercept and trend variables are used in order to compute Durbin-Hausman group statistics DH_g . On the other hand,

Durbin-Hausman panel statistics is proposed under homogeneity in panel assumption. Computing the test statistics (DH_p), common intercept and trend variables are used.

$$DH_g = \sum_{i=1}^n \hat{S}_i (\tilde{\phi}_i - \hat{\phi}_i)^2 \sum_{t=2}^T \hat{e}_{it-1}^2 \quad (39)$$

$$DH_p = \sum_{i=1}^n \hat{S}_i (\tilde{\phi}_i - \hat{\phi}_i)^2 \sum_{t=2}^T \sum_{t=2}^T \hat{e}_{it-1}^2 \quad (40)$$

Here,

$$\hat{S}_i = \frac{\hat{\omega}_i^2}{\hat{\sigma}_i^4} \quad (41)$$

and,

$$\hat{\omega}_i^2 = \frac{1}{T-1} \sum_{j=-M_i}^{M_i} (1 - \frac{j}{M_i+1}) \sum_{t=j+1}^T \hat{v}_{it} \hat{v}_{it-j} \quad (42)$$

where $\hat{v}_{it}$ is the OLS residual, M_i is a bandwidth and $\hat{\sigma}_i^2$ is variance. Hypothesis of Durbin-Hausman group statistics are;

$H_0: \phi_i = 1$ for all i , no cointegration for any cross – section.

$H_1: \phi_i < 1$ for some i , cointegration for some cross – sections.

Hypothesis of Durbin-Hausman panel statistics are;

$H_0: \phi_i = 1$ for all i , no cointegration for all cross – sections.

$H_1: \phi_i = \phi < 1$ for all i , cointegration for all cross – sections.

DH_g and DH_p test statistics have got standard normal distribution.

In this study, Westerlund (2008) Durbin-Hausman panel cointegration test is separately conducted for four models which are represented in Equation (14-17) and the results are given in Table 5.

Table 5: Results of Westerlund (2008) Durbin-Hausman Panel Cointegration Test

	<i>DH_g</i> Test Statistic	<i>DH_p</i> Test Statistic
Model 1	3.41*** (0.00)	4.92*** (0.00)
Model 2	5.31*** (0.00)	2.00** (0.02)
Model 3	2.89*** (0.002)	-1.23 (0.89)
Model 4	3.30*** (0.00)	0.22 (0.41)

Note: ** and *** implies existence of cointegration in model at 5% and 1% respectively. Probability values in parentheses.

According to Table 5; cointegration relationship exists in all countries in Model 1 and Model 2, while in some countries in Model 3 and Model 4. These results reveal that national income per capita (economic growth) is moving together with human capital and fixed capital stock variables in the long run. That is, economic growth is affected by human capital and fixed capital stock. To calculate the magnitude this effect, cointegration coefficients were estimated.

5.8. Estimation of Cointegration Coefficients

Cointegration coefficients are estimated by employing Breitung (2005) Two Step Least Squares (TSLS) method. This method, which is used to estimate cointegration coefficients, is a VAR-based method which generates more effective results than Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) when the time dimension is short (Breitung, 2005). In this study, cointegration coefficients are estimated using TSLS method and results are presented in Table 6.

Table 6: Estimated Cointegration Coefficients

Dependent Variable (y)	HC	LE	HE	EE	k
Model 1	3.066***				
[7.231]	-	-	-	1.07*** [14.147]	
Model 2	-	8.186*** [18.719]	-	-	0.62*** [9.106]
Model 3	-	-	0.541*** [31.402]	-	0.58*** [14.666]
Model 4	-	-	-	0.307*** [25.752]	0.548*** [11.214]

Note: Values in brackets are *t* statistics. *** implies that the parameter is confident at 1% significance level.

All coefficients in Table 6 are statistically significant. That is, the selected variables are the true determinants of economic growth. In Model 1, a 1% rise in human capital and capital stock per capita increase national income per capita by 3.066% and 1.07% respectively. In Model 2, national income per capita increases 8.186% and 0.62% in response to 1% increase in average life expectancy and capital stock per capita, respectively. According to Model 3, per capita national income improves 0.541% and 0.58% as a result of 1% increase respectively in health expenditure and capital per capita. Finally, results of Model 4 show that 1% increase in education expenditure per capita and capital stock per capita increase the national income per capita by 0.307% and 0.548%, respectively. As a general result, the most influential variable on per capita national income is the average life expectancy and this is because of the fact that included countries' production is labor intensive.

Conclusions and Policy Implications

In this study, the relationship between human capital and economic growth was investigated for 10 countries which gained independency after the collapse of USSR for 1995-2014 period by second generation panel data analysis method. Cross-section dependence among these countries was tested by means of Breusch-Pagan (1980) LM test, Pesaran (2004) scaled LM test, Baltagi, Feng, and Kao (2012) bias-corrected scaled LM test and Pesaran (2004) CD methods. The result is the existence of cross-section dependency among countries. That is, an economic or social shock arising in a country can affect the others. Therefore, in order to determine the policies in one country, policymakers have to closely monitor the developments in other countries included in panel.

Stationarity of the series was investigated by Hadri and Kuruzomi (2012) panel unit root test and it is found that all series are stationary when first differenced and not stationary in level values. By this result, it can be said that economic growth, human capital and capital stock in included countries are not stable and show substantial fluctuations. Therefore, in order for these countries to have a stable economic growth, human and physical capital investments has to be stable.

Cointegration relations within series in four different models are analyzed by Westerlund (2008) Durbin-Hausman panel cointegration test and the series were found to be cointegrated. These results reveal that national income per capita (economic growth) is moving together with human capital and fixed capital stock variables in the long run. Furthermore, human capital and fixed capital stock affect economic growth.

Cointegration coefficients were estimated by Breitung (2005) Two Step Least Squares method. The results indicate that 1% increase in human capital, average life expectancy, health expenditure per capita and education expenditure per capita improves per capita national income by 3.066, 8.186, 0.541 and 0.307 percent, respectively. Moreover, 1% increase in capital stock per capita affects national income per capita between 0.548% and 1.07% with respect to other independent variable in the models. As a general result, the variable having the most influence on per capita national income is the average life expectancy and this is because of the fact that included countries' production is labor intensive.

Interpreting the outcomes of this study, it can be said that in order for the countries which gained their independence after the collapse of the USSR to have a stable and greater economic growth, these countries should better off their human capital and improve their capital stock per capita. To better off human capital, policies towards increasing average schooling year, average life expectancy, health and education expenditure per capita will be useful and effective. If national circumstances are not sufficient to increase capital stock per capita, foreign direct investment will be a good solution. Therefore, these countries should incentivize international firms to invest in their country. On the other hand, international firms consider not only the incentives, but also the politic and economic conjuncture of the countries'. Politically and economically stable countries will attract more foreign direct investment. Furthermore, improved capital stock may help transforming into a capital intensive country from a labor intensive one; a process that may bring foreign trade competitive power and more economic growth.

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