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Which Types of Education are Important for Economic Growth?

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Abstract

The relationship between education and economic growth has been discussed on numerous occasions, and there is a consensus that education plays an important role toward economic growth. This paper empirically examines 55 countries' panel data to determine which types of education are playing important roles for achieving economic growth. The results showed that the improvement of educational systems, finance skill, Internet usage, and English proficiency has a positive impact on economic growth. On the other hand, educational systems and Internet usage also shrink inequality in the economy. High quality education for students is important for attaining economic growth, and it would confer student's chances and opportunities and promote sound economic growth.

Keywords: Brain drain, Economic growth, Educational system, Employee training, English proficiency, Finance skill, Gini coefficient, Internet usage

1. Introduction

The relationship between education and economic growth has been discussed throughout history. Now, the attention for this issue is mainly focused on developing or newly industrialized economies. However, in most developed economies, recession, low economic growth, decreasing birth rates and aging populations have reignited the discussion on how to increase the quality of education and to boost the competitiveness. As such, exploration of education is occurring all over the world. The relationship between education and economic growth is not a new topic. In academic fields, *endogenous growth theory* has been employed in both theoretical and empirical analyses. Recently, much discussion about this topic has revitalized not only in developed countries but also in developed countries.

Since the industrial revolution in the 1850s, the world has been changing rapidly. Now, Industry 5.0 receives a lot of focus. It seems almost impossible to pinpoint the reasons for economic growth since it is complex. However, most people seem to think that education is one of the important factors that leads to economic growth. This paper focuses on the educational system and the concrete skills affected. It examines which types of education are important for economic growth. This paper is structured as follows. Following section 1, section 2 reviews existing studies. Section 3 provides theoretical analyses of deterministic elements of economic growth from the view of the relationship between economic growth and education. Based on the analyses in section 4, empirical analyses are conducted and the results are examined. Finally, brief summary is provided.

2. Existing Studies

2.1 Existing Studies Related with Educational System

As mentioned in section 1, it is difficult to pinpoint the exact causes of economic growth. This paper divides two aspects that seem to impact economic growth, namely educational systems and business skills, for empirical analyses. There are some studies in each field, but most of them are examined for the view of education or ICT related skills.

Among them, education has received the most attention as many people have found that education impacts economic growth. Gyimah-Brempong, Paddison, and Mitiku (2006) found that human capital in Africa is related to income per capita. Baldwin and Borrelli (2008) showed that expenditures on higher education have a positive relationship with growth of income per capita. Permani (2009) found that education leads to economic growth, but it is not a sufficient condition. Reza & Widodo (2013) also indicated that education is related to economic growth. Qazi, Raza, and Jawaid (2014) showed that a cointegration exists between education and economic growth. Arshad, Roslan, and Hussin (2016) confirmed that higher education has a positive effect on economic growth. Kyophilavong, Ogawa, Kim, & Nouansavanh (2018) employed the Johansen cointegration test and showed that there is a long-term relationship between education and economic growth at the primary, secondary, and higher education levels.

On the other hand, Hanushek and Woessmann (2012) showed that school policy is an important factor to boost growth. Jin and Jin (2014a) found that professors' publication is positively related with economic growth. Delgado, Henderson, and Parmeter (2014) indicated that years of schooling is not a significant variable for economic growth. However, most studies indicate that education seems to be one of the most important factors for economic growth.

The educational system denotes the time from elementary schools to high schools or to universities. However, employee training usually conducted by companies is difficult. It is often a longer period than schooling days. There exists some possibility that employee training plays a much more important role for economic growth than the educational system mentioned just before. Muinelo-Gallo & Roca-Sagalés (2012) suggested that skill-biased technological progress is linked to capital-biased progress. Holmes (2013) showed that employment of those with high level technical skills is related with economic growth.

After working for some time, brain drain can occur. Wong and Yip (1999) showed that brain drain has a negative impact on the economic growth because of income-distributional effects. However, there is little research focusing on this aspect.

2.2 Existing Studies Related with Business Skills

To analyze economic growth from education, business skills should be taken into account. There are a lot of skills related to economic growth, and this paper focuses on three particular business skills.

First is finance skill. Vieira (2012) indicated that financial knowledge leads to economic growth and development. Baidoo, Boateng, and Amposah (2018) showed that financial literacy is linked to saving, investment, and economic growth in Ghana. However, Greenwood and Jovanovic (1990) suggested a nonlinear relation between financial development and economic growth. Claessens, Djankov, Fan, & Lang (2002) indicated that there is no confirmed conclusions about the topics

The second is IT skill. Mankiw, Romer, Weil (1992) and Pohjola (2002) confirmed that the effect of ICT on economic growth is significant and positive in high income per capita countries and is not significant in developing countries. Haftu (2009) showed that mobile phone usage has a positive impact on income per capita. Kurihara & Fukushima (2013) indicated that the Internet can increase economic international trade, but it has not been related with economic growth. Jin and Jin (2014b) found that frequent usage of the Internet is related with economic growth. Lapatinas (2019) suggested that Internet prevalence is related with sophistication of exported products.

The last skill is English skill. English proficiency seems to be one of the most vital and necessary skills for performing global business. However, there is little research that examines the relationship between economic growth and English proficiency.

Kurihara and Fukushima (2013) indicated that the impact of IT skills continues positively on income, but negatively on the Gini coefficient. This continues for a few years, however, educational systems are not taken into account. The quality of educational system is vital,

however, there are not many studies examining this aspect. Also, Kurihara (2014) showed that the impact of finance skill improvement on economic growth occurs positively, but the effect continues only a few years at most using response analysis. Also, it indicated that the impact of IT skills continues positively on income, negatively on the Gini coefficient, and continues for a few years.

Finally, this paper focuses on inequality. This paper's topic is the relationship between education and economic growth, however, there are some possibilities that economic growth leads to inequality of the economy. Günther (2007) confirmed that education leads to both economic growth and inequality at the same time. Rodriguez-pose & Tselios (2010) found that education has a positive effect on economic growth, however, the impact of initial income is not certain. Inequality does not always lead to sound economic growth.

3. Theoretical Analysis

This study divides deterministic elements into two aspects, educational system and business skills. Based on these variables, empirical analyses are conducted.

There is a consensus that high quality education is strongly related with economic growth. On the other hand, education that is experienced after school plays an important role for economic growth. So, some other elements, employee training in this study is considered. Also, brain drain should be taken into account.

Finance skill that reduces the cost of access efficiently to money markets is beneficial to people and lead them to pay for more high quality education. This confers efficiency of capital allocation, however, the relationship between skill and economic growth is sometimes complex. High skill of finance skill decrease inequality by conducting funding funds to poor people with more (see, for example, Galor & Zeira, 1993). On the other hands, finance skill can be used for more speculative transactions, and much more inequality would be promoted.

The Internet has overcome many obstacles by reducing time and distance and by increasing efficiency. The Internet also plays an important role for economic growth.

English proficiency seems to promote economic growth. As globalization is continuously ongoing, proficient English ability increases business activity. On the other hand, English proficiency is not necessary for all people because translating machines have improved greatly as AI greatly acquire abilities. The next section shows the empirical methods, conducts them, and analyses the results.

4. Empirical Analysis

4.1 Empirical Methods

Most empirical studies use GDP per capita as the dependent variable. This study also uses Gini coefficient. For explanation variables, education related skills (i.e., educational system,

employee training, and brain drain) and business related skills (i.e., finance skill, Internet usage, and English proficiency (TOEFL)) are used for the regression and analyzed.

The equations are as follows:

$$\text{GDP per capita} = \alpha + \beta_1 \text{Educational system} + \beta_2 \text{Employee training} + \beta_3 \text{Brain Drain} + \varepsilon \quad (1)$$

$$\text{Gini coefficient} = \alpha + \beta_1 \text{Educational system} + \beta_2 \text{Employee training} + \beta_3 \text{Brain Drain} + \varepsilon \quad (2)$$

$$\text{GDP per capita} = \alpha + \beta_1 \text{Finance skill} + \beta_2 \text{Internet usage} + \beta_3 \text{English proficiency} + \varepsilon \quad (3)$$

$$\text{Gini coefficient} = \alpha + \beta_1 \text{Finance skill} + \beta_2 \text{Internet usage} + \beta_3 \text{English proficiency} + \varepsilon \quad (4)$$

IMD World Competition Yearbook is used as a proxy. This book scores the degree from 0-10. The exceptions are Internet usage and English proficiency. Internet usage is defined from 0-1000. Also, English proficiency scores from 0-100. The indicators are calculated based on interviews with senior business leaders in many countries. The estimated countries are Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Chile, Columbia, Croatia, Cyprus, Czech, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Korea, Latvia, Lithuania, Luxembourg, Malaysia, Mexico, Mongolia, Netherlands, Norway, Peru, Philippines, Poland, Portugal, Romania, Russia, Slovak, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan/China, Thailand, Turkey, Ukraine, United Kingdom, United States, and Venezuela. Some of the countries are omitted for data availability.

Panel analysis is used for estimation. It would take each data characteristic into account and increase the number of the data. Panel analysis, using GDP per capita as a dependent variable, is conducted, however, in the equations, Gini coefficient is also used as a dependent variable. However, due to the data unavailability, average data is used for estimation for the case of Gini coefficient. In both panel data and average data, Ordinary Least Squares (OLS) and Robust Least Squares as empirical methods are employed for estimations. Robust estimation is unlike maximum likelihood estimation. OLS estimates for regression are sensitive to observations that do not follow the pattern of other observations. This is not a problem if the outlier is simply an extreme observation from the tail of a normal distribution, however, if the outlier is from non-normal measurement error or some other violation of standard OLS, it compromises the validity of the regression results if a nonrobust regression method is employed (Kurihara, 2014).

In the panel analyses, fixed effects model and random effects model are employed. Fixed effects model is that model parameters are fixed or non-random and random effects model is that model parameters are random variables. All regression coefficients are restricted to be the same across cross-sections, so this is the same with estimating a model on the stacked data, using the cross-sectional identifiers only for the fixed effect. The random effects specification assumes that the effect is uncorrelated with the idiosyncratic residual.

4.2 Empirical Results

Before the regressions analyses are performed, each variable is checked statistically. Table 1 shows descriptive statistics for these variables.

Table 1. (Three years' average from 2015 to 2017)

	GDP	Gini	Educational system	Employee training	Brain drain	Finance skill	Internet usage	English proficiency
Mean	31956.29	35.29	5.31	5.77	4.66	6.27	713.38	89.05
Median	29380.90	33.70	5.32	5.70	4.61	6.45	805.95	89.66
Maximum	70376.97	63.00	8.93	7.57	8.31	8.19	892.67	99.33
Minimum	6703.791	25.00	1.96	4.07	1.60	4.06	252.86	71.00
Std. dev.	16021.54	7.71	1.74	0.89	1.53	1.08	185.93	6.64
Skewness	0.40	1.14	0.11	0.26	0.07	-0.21	-0.96	-0.48
Kurtosis	2.44	4.60	2.25	2.36	2.64	2.23	2.65	2.77
Jarque-Bera	2.24	17.83	1.39	1.57	0.34	1.77	8.78	2.26
probability	0.32	0.0001	0.49	0.45	0.84	0.41	0.01	0.32
Sum sq. dev.	1.39E+10	3210.55	165.15	43.22	127.65	63.21	1866881	2387.28
Observations	55	55	55	55	55	55	55	55

The data of Gini coefficient is 2017.

The highest correlation of explanation variables is 0.73 (the case between finance skill and Internet usage), however, others are not so high. The regression results of equations (1), (2), (3), and (4) are shown in Tables 2, 3, and 4. Table 2 shows the results of panel analysis that the dependent variables are GDP per capita. The empirical methods used are OLS and Robust least equation. Table 3 shows the results when fixed and random effects are taken into account. Except this point, other conditions are the same with the equations in Table 2. In Table 2 and Table 3, the dependent variable is GDP per capita in all of the equations. Finally, the dependent variable is Gini coefficient in all of the equations.

Table 2. Panel Analysis and Education

Equation	(1)	(1)		(3)	(3)
C	5286.924	-25.910	C	-59966.58***	-66038.12***
	(0.809)	(-0.003)		(-4.241)	(-4.639)
Educational system	4705.641***	5296.293***	Finance skill	6127.900***	7223.479***
	(5.126)	(5.805)		(4.655)	(5.454)
Employee training	-1461.361	-1079.581	Internet usage	2117.411	2227.266*
	(-1.032)	(-0.767)		(1.619)	(1.691)
Brain drain	2047.002**	2108.779**	English proficiency	422.653**	404.213**
	(2.145)	(2.224)		(2.462)	(2.339)
Adj.R-squared	0.366		Adj.R-squared	0.363	
Adj.Rw-squared		0.515	Adj.Rw-squared		0.519
F-statistic	32.567		F-statistic	32.248	
Prob(F-statistic)	0.000		Prob(F-statistic)	0.000	
Rn- squared statistic		128.147	Rn- squared statistic		119.039
Prob(Rn- squared statistic)		0.000	Prob(Rn- squared statistic)		0.000
Schwartz-criterion.	21.887	211.183	Schwartz-criterion.	21.891	226.684
Durbin-Watson stat	0.051		Durbin-Watson stat	0.095	
Method	Panel least squares	Robust Least squares	Method	Panel least squares	Robust Least squares
Dependent variable	GDP per capita	GDP per capita	Dependent variable	GDP per capita	GDP per capita

***, **, * denotes significant at 1, 5, and 10%. Parentheses are t-value.

Table 3. Fixed/Random Effect and Education

Equation	(1)	(2)		(3)	(4)
C	28700.75***	26045.17***	C	-16043.83	-24144.57**
	(11.121)	(8.499)		(-1.453)	(-2.366)
Educational system	787.879*	1201.818***	Finance skill	252.786	526.158
	(1.950)	(3.083)		(0.651)	(1.376)
Employee training	-428.107	-486.310	Internet usage	927.772***	836.144***
	(-0.959)	(-1.106)		(3.368)	(3.065)
Brain drain	209.556	379.531	English proficiency	589.878***	654.161***
	(0.587)	(1.085)		(4.869)	(5.904)
Cross-section random/S.D.		13201.07	Cross-section random/S.D.		13123.08
Cross-section random/Rho		0.989	Cross-section random/Rho		0.991
Idiosyncratic random/S.D.		1368.081	Idiosyncratic random/S.D.		1189.644
Idiosyncratic random/Rho		0.010	Idiosyncratic random/Rho		0.0082
Adj.R-squared	0.993	0.067	Adj.R-squared	0.994	0.209
F-statistic	410.035	4.966	F-statistic	542.870	15.479
Prob(F-statistic)	0.000	0.002	Prob(F-statistic)	0.000	0.000
Schwartz-criterion.	18.641		Schwartz-criterion.	18.362	
Durbin-Watson stat	1.637		Durbin-Watson stat	1.782	
Method	Panel least squares/fixed effect	Panel EGLS	Method	Panel least squares/fixed effect	Panel EGLS
Dependent variable	GDP per capita	GDP per capita	Dependent variable	GDP per capita	GDP per capita

***, **, * denotes significant at 1, 5, and 10%. Parentheses are t-value.

The results are clear. Almost of all the results are expected. Educational system, finance skill, Internet usage, and English proficiency have a significant impact on economic growth. Educational system and Internet usage shrink inequality. High quality education for students is important for attaining economic growth.

One important point in the solution of inequality depends on low or high wage earners (Jerzmanowski & Nabar, 2007). Each country should consider this fact for sound economic development. Inequality, along with economic growth, sometimes causes instability of the economy and society. This problem is an eternal problem that cannot be solved easily, however, education would confer students' chances and opportunities and promote sound economic growth

Table 4. Gini Coefficient and Education

Equation	(9)	(10)		(11)	(12)
C	44.587***	46.885***	C	47.362***	57.868***
	(7.550)	(8.194)		(3.695)	(4.873)
Educational system	-3.566***	-2.804***	Finance skill	-0.030	0.383
	(-4.346)	(-3.527)		(-0.029)	(0.402)
Employee training	-0.064	-1.434	Internet usage	-0.020***	-0.014***
	(-0.049)	(-1.142)		(-3.520)	(-2.660)
Brain drain	2.148**	2.347***	English proficiency	0.034	-0.171
	(2.501)	(2.820)		(0.025)	(-1.108)
Adj.R-squared	0.291		Adj.R-squared	0.199	
Adj.Rw-squared		0.420	Adj.Rw-squared		0.271
F-statistic	8.423		F-statistic	5.488	
Prob(F-statistic)	0.0001		Prob(F-statistic)	0.002	
Rn- squared statistic		21.311	Rn- squared statistic		13.515
Prob(Rn-squared statistic)		0.00009	Prob(Rn-squared statistic)		0.003
Schwartz-criterion.	6.793	94.924	Schwartz-criterion.	6.916	80.786
Durbin-Watson stat	1.959		Durbin-Watson stat	1.735	
Method	OLS	Robust Least squares	Method	OLS	Robust Least squares
Dependent variable	Gini coefficient	Gini coefficient	Dependent variable	Gini coefficient	Gini coefficient

***, **, * denotes significant at 1, 5, and 10%. Parentheses are t-value.

5. Conclusion

This paper examined which types of education play important roles for achieving economic growth. The empirical results showed that educational system, finance skill, Internet usage, and English proficiency have positive impacts on economic growth. Also, the empirical results showed that educational system and Internet usage shrink inequality. High quality education for students is important for attaining economic growth. It would confer students' chances and opportunities and promote sound economic growth. Economic growth is important, however, attention should be given to sound economic growth. There may be some ways to solve this problem during this process.

Finally, there exists room for other studies. Increasing the number of countries and expanding the time period would more detailed analysis. Also, It would be possible to regress by other explanation variables or instrumental variables and by other empirical methods.

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