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The Impact of Physical Capital and Human Capital on Growth in Indonesia, 1970–2017

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Abstract

The purpose of this study is to investigate, using relevant robust econometric modelling, physical capital and human capital, and their impact on growth in Indonesia for policy analysis. Indonesia is already underway to the structural transformation from basic sector to industry and service sectors which requires corresponding human capital. It is very crucial to investigate which level education has been in demand for such transformation process. Therefore, the auto regressive distributed lag (ARDL) by Pesaran and Pesaran (1997) was chosen for supporting the relationship analysis using data from 1970 to 2017. The important finding for policy analysis was that human capital appeared to be a continuing factor shaping Indonesia's growth, along with physical capital accumulation, with particularly strong effects for human capital arising from tertiary education. Physical capital has shown a strong and significant impact on the growth in the long run and indicated that Indonesia needs long term investment to generate growth. Such investment has distinctions related to sustainable operation such as infrastructure, sophisticated services, and venture capital. Consequently, it requires high skill labour supplied by tertiary education institutions. A further development of tertiary education next to enhancement of investment environment in manufacture and service sector should be set as priority programs in inducing growth.

Keywords: economic growth; human capital; autoregressive distributed lag (ARDL); Indonesia's sustainable development policy

JEL classification: O11, O15, O40

INTRODUCTION

A famous paper entitled "A Contribution to the Theory of Economic Growth" was published by Solow (1956). He was then awarded the Nobel Prize in economics in 1987 for his greatest work. Since then, study of economic growth has become more extensively conducted by other economists such Roubini, N., & Sala-i-Martin, X (1995). Using data of multi-countries with a cross-section approach and single country with time series method, the main goal of these investigations is to seek what causes nations' prosperity (Valdes, 1999). The fact that some countries are rich, and others are poor has encouraged economists to find best formula to push the poor to catch up with the rich. This study with a focus on Indonesia is a robust econometric study to help investigate economic growth and its sources for sustainable development analysis.

After the succession of President Soekarno in 1968, Indonesia has been devoting its efforts to boost economic growth through development of industries and other sectors by inviting both foreign and domestic investors to take part in many projects. Consequently, foreign direct investment (FDI) and saving growth have improved in the same period so that the government was confident to expand its economy through agriculture, industry, manufacture, and service sectors. In the context of the ASEAN, Indonesia is expected to become one of the production bases that contributes to ASEAN dynamics and competitiveness.

In education sector, Indonesia has been launching the 9-year length compulsory education since 1950. Following a political instability that was occurring during the period, the program could run more smoothly afterward in 1978 and thoroughly expanded after 1984. In 2012 the Ministry of Education announced to upgrade the compulsory education from 9 years to 12 years (high school attainment). According to demographic data, one-third of Indonesia's population is under 14 years of age which is called 'golden age', thus increasing capacity through

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education can strengthen their ability to get into competitive works that has transformed from the primary sector to secondary and tertiary sector. In accordance with Arrow (1962) analysis, human capital can influence growth through education in many ways such as formal education, R & D, job, and training practices.

Using relevant robust quantitative methods and recent data, this study would explored the relationship between the level of education and economic growth in Indonesia to support policy analysis. The short run and long run approach were applied in the analysis. The plan of the paper was as follows; 1) provided a summary of empirical literature reviews and gaps on the subject-matter; 2) described the methodology that includes data and sources used in the study, the relevant models of growth for Indonesia, their standard tests for appropriate unit roots and short- and long-run dynamics; 3) the results and discussions; 4) conclusions and recommendations along with the pertinent policy implications.

LITERATURE REVIEW

Studies on education and growth start from the production function that incorporate human capital. For example, in evaluating Solow model to perform well and to produce good estimates in explaining the level of growth through education, human capital has been incorporated in the model Mankiw et al. (1992). The inclusion of education in the analysis is because labour has diverse level of skills and education in different economies.

Lucas (1988) and Jones (1998) has provided an assumption that output Y is a combination of capital K and skilled labour H in accordance with Cobb-Douglas production function. The difference of this model from Mankiw model is on the accumulation of human capital. While Mankiw model assumed human capital was accumulated through forgoing consumption, Lucas model assumed labour allocate time for knowledge and skills by learning or going to school.

Using primary and secondary school enrolment rates and cross-countries data, it was found that poor economies with high human capital per person could catch up with rich economies (Barro, 1989). Furthermore, economies with higher human capital tend to have low fertility rates, but high physical capital ratios to GDP.

A study by Petrakis & Stamatakis (2002) using cross-sectional data of the organization for economic co-operation and development OECD and least developed countries (LDC) uncovered that primary and secondary education has various impact on growth because of different stage of economic development. In a group of OECD economies, tertiary education has stronger and more significant impact on growth. Whilst in LDC economies, primary and secondary education seem to have more important role in generating growth. Therefore, when development level increases so does the role of higher education level. However, physical capital is more significant in generating growth among OECD economies.

In term of average years of schooling among adult population, Barro (2013) suggested a positive relationship between school attainment of adult males particularly at the secondary and tertiary education and the growth. Labours with higher education background would be more familiar with technology and able to transfer the skills to their peers in the development process. Different results were revealed when school attainment of females was included in the model. The results showed that female labours with higher education background were less utilized in the labour markets across the countries.

The studies using single country data such as in Goel (1974) undermined the relationship between level of education and economic development in India during the period 1950–51 to 1970–71. It is found that per capita income was significantly associated with different level of education. The results were different from those of study by Self & Grabowski (2004) that revealed a strong and significant relationship only between primary and secondary enrolment rates and growth in India during 1966 to 1996. The different results might arise from different period in which India utilize labours from all education background in early development stage.

A comparative study by Abbas & Nasir (2001) revealed relationship between human capital represented by different level of education and growth using Pakistan and Sri Lanka as case study. Positive and significant relationship occured on secondary and tertiary education. However, primary education had negative impact on the growth in both countries. These results have proven that human capital, particularly at the secondary and tertiary education level has prominent roles in economic development of developing countries.

The link between human capital and economic growth in Guatemala during the period 1951 to 2001 has also been explored (Loening, 2005). The results showed that labours with higher education have more significant impact on economic growth. One percentage increase in average years of schooling was associated with 0.33 percentage increase in output. Furthermore, primary education has played the most important role on output level followed by secondary education. It can be concluded that in Guatemala, general knowledge and basic technical skills have been tools to diffuse technology and innovations.

In the study by Taylor (2007) has found that primary school enrolment rates were stronger and more significant in affecting growth than those of higher education in Malaysia. It did not conclude that higher education was not important in generating growth in Malaysia. What was implied that, during the study period of 1963 to 1998, labours with secondary and tertiary education were not well utilized in the economy rather than labours with primary education background. The demand for labours with primary and secondary school was high particularly for some sectors such as constructions and agriculture. Overcoming the labour shortage, Malaysia has been opening employment market for foreign labours.

A more recent study by Pereira & Aubyn (2009) using time series data of Portugal showed positive and significant impact of primary and secondary education on growth. Despite significant increase in tertiary education, its impact on growth was negative, indicated labours with higher skills or with tertiary education background was not well utilized in Portugal due to its technological leadership particularly in European region. Moreover, physical investment is not crowded out by investment in education.

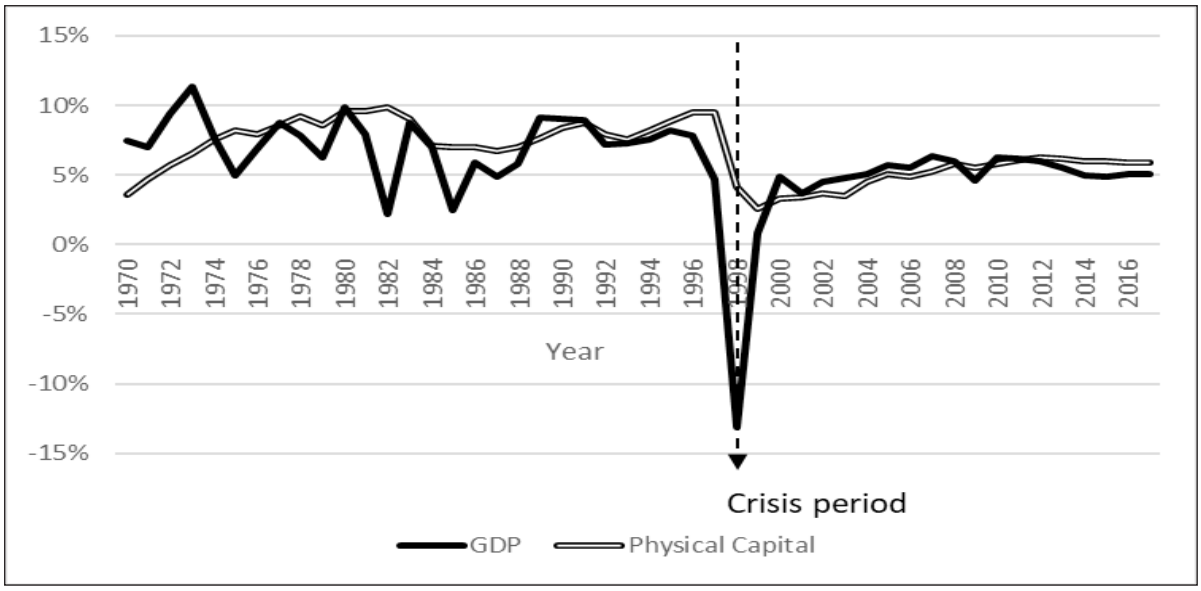
According to this review, there is a gap in relevant recent studies with empirical support for data-based policy analysis in the case of Indonesia. The study addressed this important gap embraced schooling attainment following the endogenous growth approach. Based on the concept of Becker (1962), the subject of human capital analysis has moved on to three directions: production function, human capital formation, and measures of the return to schooling. A study emphasized the importance of ideas and human capital in economic development was also constructed by Romer (1986). He specified the long run growth with an assumption that knowledge was a production input with increasing marginal productivity.

RESEARCH METHOD

Data and Variables

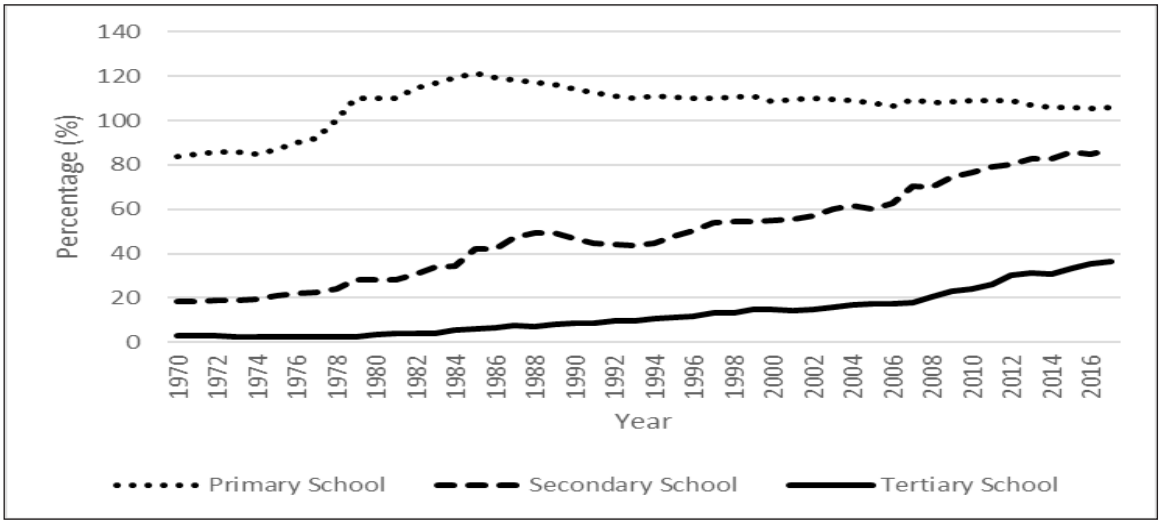
The data used in our study were obtained from various resources using data in the period 1970–2017. GDP and Capital were derived from Feenstra et al. (2015). They provided data of capital stock (K) based on cumulating and depreciation past investments using the perpetual inventory method (PIM) used in this study. Therefore, capital stock (K) was simply inserted in the equation along with other variables without including depreciated factors rates.

The proxies for human capital were enrolment gross rates of primary school, secondary school, and tertiary school. These data were obtained from the World Bank. Some missing data of certain period such as 1979, 1980, and 1985 were replaced by following non-missing data. Crisis was included into the short run model as dummy variable as Indonesia experienced a severe economic crisis resulted for political instability during 1997–1999. The brief description of the data shows dynamic pattern of GDP, physical capital, and human capital is presented as follows,



Source: Author's calculation based on Feenstra et al. (2015)

Figure 1. Indonesian GDP and Physical Capital



Source: The World Bank 2021

Figure 2. Indonesian Human Capital, School Gross Enrolment Ratio

Figure 1 describes that prior to the crisis there had been relatively strong growth of the GDP above 6% in average. Simultaneously, the growth of physical capital had also been resilient and robust as the GDP did. Nevertheless, after the crisis situation changed as the physical capital grew more slowly that prevented GDP from inducing development at the same rate in pre-crisis period.

In term of human capital, the enrolment ratio for primary school education has been exceeding 100% since 1978 implying that almost everyone in the country at least has enrolled for basic education. The ratio may pass through 100% as particular group such as over-aged and under-aged students were included in this category.

The enrolment ratio in secondary schools illustrated in Figure 2 is lower than that of primary schools, but it has significant growth over the period. In 1970 the ratio stood at around 18% which was continuously increasing to around 87% by 2017. The secondary education is divided into two groups: junior and senior, each of which provides a three-year teaching program. The latter

consist of different affiliations such as public schools, private schools, vocational schools, and religious affiliated schools.

The development of tertiary education highlights an increasing trend over the period despite its lower ratio compared with the primary and secondary education. In 1970 such education level was still considered as a luxury with its total enrolment ratio at only around 2.8%. Yet, by 2017, the ratio has increased to around 36% catching up with the growth of manufacture and service sectors.

The Models

Investigating factors that generate economic growth of Indonesia begins with aggregate production function framework as adopted in the Solow (1956) that includes human capital. Other researchers used the same framework such as Romer (1990), Mankiw et al. (1992), Frankel et al.(1996), and Aghion (1998). Grossman & Helpman (1993) and some studies also included international trade into model, suggesting the importance of international trade as source of knowledge and lead to an increase of growth. However, studies by Edwards (1993) and Maurer (1994) on the contrary showed little evidence of relationship between trade and growth.

The later study by Rodriguez & Rodrik (2000) even proposed an argument that econometric literature on trade and growth is weak, therefore there is no robust evidence that trade openness is related to economic growth. Some studies on countries also reveals different results such as in a study by Gapinski (1997) found that openness was a significant growth determinant in Hong Kong and Singapore. However, a different result was found by Simorangkir (2006) where trade and financial openness have negative impact of economic growth using Indonesia as a case study. This result has been related to weak competitiveness of Indonesian commodities relative to foreign commodities.

In this study, incorporating trade openness assumes that Indonesia is an open economy and trading with other economies with commitment in several FTA. For this purpose, trade-GDP ratio was used as proxy for the trade openness. An implicit function can be specified to explain growth:

$$Y = F(K, H, L) \quad (1)$$

Where *Y* is output, *K* is physical capital, *L* is employment level, and *H* is human capital. It was assumed that labour and population have the same growth rate. Therefore, in per-capita this equation can be rewritten as,

$$y = kh \quad (2)$$

Where, *y* represents output or GDP per-capita, *k* is physical capital per-capita, and *h* indicates human capital which is measured by primary school ratio (*PSR*), secondary school ratio (*SSR*) and tertiary school ratio (*TSR*).

As this equation is in implicit form, they cannot be statistically estimated but these can be written equivalently and stochastically, as linear in their rates of change (Tran 2003a, 2003b, 2010) or more conventionally as simply linear in their logs,

$$LY = \alpha_0 + \alpha_1 LK + \alpha_2 LPSR + \alpha_3 LSSR + \alpha_4 LTSR + \alpha_5 CRISIS + \alpha_6 OPENNESS + \varepsilon \quad (3)$$

Where,

Y = GDP per-capita

K = Physical capital per-capita

PSR = Total enrolment, expressed as a percentage of the population of official primary education age

SSR = Total enrolment, expressed as a percentage of the population of official secondary education age

TSR = Total enrolment, expressed as a percentage of the population of official tertiary education age

CRISIS = Dummy variable where 1, economic crisis and 0, otherwise

OPENNESS = Trade-GDP ratio

ε = Error term

The inclusion of dummy variable in the model represented by crisis has an important role to have a robust and accurate result due to

its significance in Indonesian economic record. There was a strong shock in 1997 that within a year, the economy plummeted into a catastrophic decline. In the post-crisis period, growth was stimulated, creating a stable path that affirming the economy has found a new equilibrium regardless of the level of performance it had attained in the pre-crisis era.

Estimation of the Models

The autoregressive distributed lag (ARDL) bound test has been a famous method to analyse the growth models both in long run and short run. Compared to Johansen test, ARDL has higher technical advantages particularly for small samples (Pesaran & Shin, 1997). A second advantage of ARDL is that while Johansen test requires all regressors are integrated in the same order, ARDL is applicable to models with different integrated order of *I(1)* and/or *I(0)* but not of *I(2)* (Pesaran, Shin, & Smith, 2001).

There are two steps in conducting ARDL approach according to (Pesaran & Pesaran, 1997). In the first step, the long run relationship among the variables were determined using *F-statistic*. The second step was to determine coefficients and values of the long run relationship followed by estimation elasticity of short run relationship. The error correction was included in the short run model reflected how the system adjust to its long run equilibrium.

The ARDL specification can be represented by following model:

$$\phi(L,p)y_t = \sum_{i=1}^{k} \beta(L_i\, q_i)\; x_{it} + w_t + e_t \qquad (4)$$

Where,

$$\phi(L,p) = 1 - \phi L - \phi_2 L^2 - \cdots - \phi_p L^p \qquad (5)$$

And

$$\beta(L_i, q_i) = 1 - \beta_{il} L - \beta_{i2} L^2 - \cdots - \beta_{iql} L^{iqi}$$

i = 1,2,3,…,k (6)

In these equations, L is the lag operator indicates $Ly_t = y_{t-1}$ and w_t is S x 1 vector of intercept, trends, dummy variables, and other exogenous variables. y represents dependent variable, x_{it} denotes independent variables. The selected optimum lags are based on methodology by *Akaike Information Criterion* (AIC) and *Schwarz-Criterion* (SC).

An ARDL bounding test was the first step to determine a long run relationship among the variables (Pesaran & Pesaran, 1997). It applied the Wald test (*F-statistic*) on the long run variables of the equations to obtain joint significant coefficients. The null hypotheses can be defined i.e:

H0: $\delta_1 = \delta_2 = ... = \delta_i = 0$ against

Ha: $\delta_1 \neq \delta_2 \neq \ldots \neq \delta_i \neq 0$

Where $\delta_1, \delta_2,$ and δ_i are long run coefficient of variables. There are two asymptotic critical values bounds for co-integration test when the independent variables are assumed *I(d)*. The upper bounds are assuming all variables in *I(1)*, whilst the lower bounds only for all variables in *I(0)*. If the *F-statistic* exceeded the upper bound critical value, the null hypotheses of no co-integrating relationship is rejected. If the *F-statistic* fell below the lower bound critical value, then the null hypotheses of no co-integrating relationship cannot be rejected. However, if the *F-statistic* fell within the lower and upper bound critical value, then the result is conclusive and there should be further investigation to obtain accurate order of co-integration.

The Long Run Co-Integration of GDP, Capital, and Level of Education

Before conducting an ARDL bounds test to estimate the long run relationship in the models,

$$\begin{aligned}\Delta LY = {} & \alpha_0 + \sum_{i=1}^{p} \alpha_1 \Delta LY_{t-i} + \sum_{i=0}^{q} \alpha_2 \Delta LK_{t-i} + \sum_{i=0}^{q} \alpha_3 \Delta LPSR_{t-i} + \sum_{i=0}^{q} \alpha_4 \Delta LSSR_{t-i} \\ & + \sum_{i=0}^{q} \alpha_5 \Delta LTSR_{t-i} + \sum_{i=0}^{q} \alpha_6 \Delta OPENNESS_{t-i} + \alpha_7 CRISIS + \varepsilon_1 RLY_{t1} + \varepsilon_2 LK_{t-1} \\ & + \varepsilon_3 LPSR_{t-1} + \varepsilon_4 LSSR_{t-1} + \varepsilon_5 LTSR_{t-1} + \varepsilon_6 LOPENNESS_{t-1} + \varepsilon_{1t} \end{aligned} \qquad (7)$$

an unrestricted error correction Model (UECM) was created, as follows:

Where $\alpha_1,\ldots,\alpha_7$ are the short run dynamic coefficients of the ARDL model. While, the parameters $\varepsilon_1,\ldots,\varepsilon_6$, are the long run multipliers. Before estimating, the long run conditional ARDL (*p, q,*) model between the variables should be established. The model can be shown as the following:

$$LY = \aleph_0 + \daleth_1 LK + \aleph_2 LPSR + \aleph_3 LSSR + \daleth_4 RLPSR + \daleth_5 OPENNESS + \upsilon_{1t} \quad (8)$$

Where all variables are previously defined, in this equation $\aleph_0$ is the constant terms and υ_{1t} is white noise error terms.

The Short Run Dynamics Of GDP, Capital, and Level of Education

The next step was to construct the short run dynamic parameters by estimating an ECM with the long run estimates. The model can be specified as follows:

$$\Delta LY = \Upsilon_0 + \sum_{i=1}^{p} \Upsilon_1 \Delta LY_{t-i} + \sum_{i=0}^{q} \Upsilon_2 \Delta LK_{t-i} + \sum_{i=0}^{q} \Upsilon_3 \Delta LPSR_{t-i} + \sum_{i=0}^{q} \Upsilon_4 \Delta LSSR_{t-i} + \sum_{i=0}^{q} \Upsilon_5 \Delta LTSR_{t-i} + \Upsilon_6 CRISIS + \Upsilon_7 ECM_{t-1} + \varepsilon_{1t} \quad (9)$$

Where ECM_{t-1} is one lagged value of the estimated OLS residual (ε_t) of the long run model in equation (7). $\Upsilon_{1,\ldots,}\Upsilon_6$ are the short run dynamic coefficients of the model's convergence to equilibrium. Υ_7 is considered as the speed of adjustment.

RESULTS AND DISCUSSIONS

Unit-Root Tests with Structural Breaks

In Macroeconomic analysis, structural changes such as economic crisis, regime shift, policy changes, and even war may occur for any reasons. If the existence of structural changes was ignored in the specification of econometric model, it may result in biased outcomes towards the inaccurate non-rejection of the non-stationary hypothesis (Perron, 1989; Peron, 1997). Three alternative equations were used for unit root test which capture three different type of structural breaks as follows,

$$x_t = \gamma_1 + \lambda_t + (\gamma_2 - \gamma_1)DU_t + \epsilon_t \quad (10)$$

$$x_t = \gamma + \lambda_{1t} + (\lambda_2 - \lambda_1)DT_t^* + \epsilon_t \quad (11)$$

$$x_t = \gamma + \lambda_{1t} + (\gamma_2 - \gamma_1)DU_t + (\lambda_2 - \lambda_1)DT_t + \epsilon_t \quad (12)$$

Where DU_t is an intercept dummy denotes a change in the level, while DT_t is a slope dummy represents a change in the slope of the trend function occurs. $DT_t^* = t - TB$ if $t > TB$ and 0 otherwise. These equations explain three types of structural breaks that might occurs in the models. Equation (10) also known as a "crash" model which allows one-time change in the series. Equation (11) is denoted as the "changing growth" model in which a break in slope is permitted. Equation (12) which allows both breaks of level and slope occur at once.

In this study, it was assumed that GDP, capital, and openness were elastically affected by some shocks such as the economic crisis which occurred from 1997 to 1999. This crisis severely hit the Asian region mainly Korea, Thailand, Malaysia, and Indonesia. Therefore, the unit root test with structural break was applied on these variables. The results are reported in Table 1.

Time series regression using non-stationary data can result spurious regression indicated by high determination coefficient without relevant and valid relationship among variables. It merely occurs just as a trend rather than as an economic relationship. However, linear combination of non-stationary variables might be stationary if the residual contains stationary data *I(0)*, or in other words if dependent variables and independent variables are not stationary in level *I(0)* but stationary in first different *I(1)* then co-integrated variables might exist in the long run (Gujarati, 2003). It implies that co-integration test can be conducted when the data are co-integrated in the same degree.

Table 1. Results of Unit Root Test with Structural Breaks

Variable	Level				First Difference			
	Intercept	Time Breaks	Intercept & Trend	Time Breaks	Intercept	Time Breaks	Intercept & Trend	Time Breaks
LY	-2.21	2004	-8.29***	1997	-10.93***	1998	-10.44***	1998
LK	-3.61	1976	-5.03**	1997	-4.98***	1997	-6.95***	1997
LPSR	-5.61***	2013	-7.31***	1977	-6.25***	1979	-5.94***	1979
LSSR	-2.29	1977	-4.50	1982	-7.64***	1990	-7.94***	1989
LTSR	-2.88	1979	-4.50	1983	-8.51***	1980	-8.79***	1979
LOPEN	-3.68	2014	-4.23	2008	-9.57***	1974	-9.61***	1974

Note: *, **, *** represent statistical significance at 10%, 5%, and 1%

Table 2. Estimated Long Run Coefficient Using the ARDL Approach

Equation (8): ARDL (1,3,3,4,3,0) selected based on *SC*. Dependent variable is *LY*			
Regressor	Coefficient	Standard Error	t-Statistic
@TREND	0.006945	0.004943	1.404867
LK	0.478038	0.112281	4.257527***
LPSR	0.086728	0.164815	0.526214
LSSR	-0.043808	0.101157	-0.433073
LTSR	0.149581	0.068739	2.176062**
LOPENNES	-0.03937	0.026948	-1.460933

*** (**) denotes 1% (5%) significance level

The table indicates that some variables are not stationary in level *I(0)*, but the results show that every variable is stationary at first difference *I(1)*, then the ARDL was applied to all models since it can be used with a mixture of *I(0)* and *I(1)* data Pesaran et al.(2001). The other features of ARDL is one single equation set up, as well as possible employing different lag-lengths for different variables.

Empirical Results

Choosing the order of lag is one of the crucial steps in applying ARDL models. Pesaran et al. (2001) suggested using (SC) for the criteria choice rather than applying (AIC) since SC tends to be a more consistent model-selection criterion. According to Hurvich & Tsai (1989), the AIC criteria tends to lead to an 'over-fitted' model. Consequently, this would hold too many exogenous variables, which means selecting a longer lag length as opposed to optimum lag length.

Table 3. Error Correction Representation of ARDL Model

Equation (9): ARDL (1,3,3,4,3,0) selected based on *SC*. Dependent variable is *LY*			
Regressor	Coefficient	Standard Error	t-Statistic
C	2.335951	0.270005	8.651513***
ΔLGK2	3.457585	0.226946	15.2353***
ΔLGK1	-0.686248	0.345808	-1.984478**
ΔLGK2	0.633156	0.209446	3.023007***
ΔLGPSR	0.063433	0.104653	0.606126
ΔLGPSR1	0.00317	0.101847	0.031125
ΔLGPSR2	0.37195	0.103676	3.587622***
ΔLGSSR	-0.036223	0.037065	-0.97729
ΔLGSSR1	0.011731	0.036496	0.321438
ΔLGSSR2	-0.114833	0.039787	-2.886217***
ΔLGSSR3	-0.176236	0.039354	-4.478207***
ΔLGTSR	0.020271	0.022157	0.914866
ΔLGTSR1	-0.06865	0.025519	-2.690118
ΔLGTSR2	-0.10624	0.020247	-5.247224***
CRISIS	-0.019099	0.008901	-2.145697**
ECM_{t-1}	-0.777791	0.090401	-8.603767***

*** (**) denotes 1% (5%) significance level

Table 4. *F-Bound Test*

Null Hypothesis: No levels relationship				
Test Statistic	Value	Significance	*I(0)*	*I(1)*
F-statistic	8.308907	10%	2.49	3.38
K	5	5%	2.81	3.76
		2.50%	3.11	4.13
		1%	3.5	4.63

Table 5. ARDL Model Diagnostic Test

Breusch-Godfrey serial correlation LM test:			
F-statistic	0.536576	*Prob. F (2,20)*	0.5929
		Prob. Chi-Square (2)	0.3262
*Obs*R-squared*	2.240704		

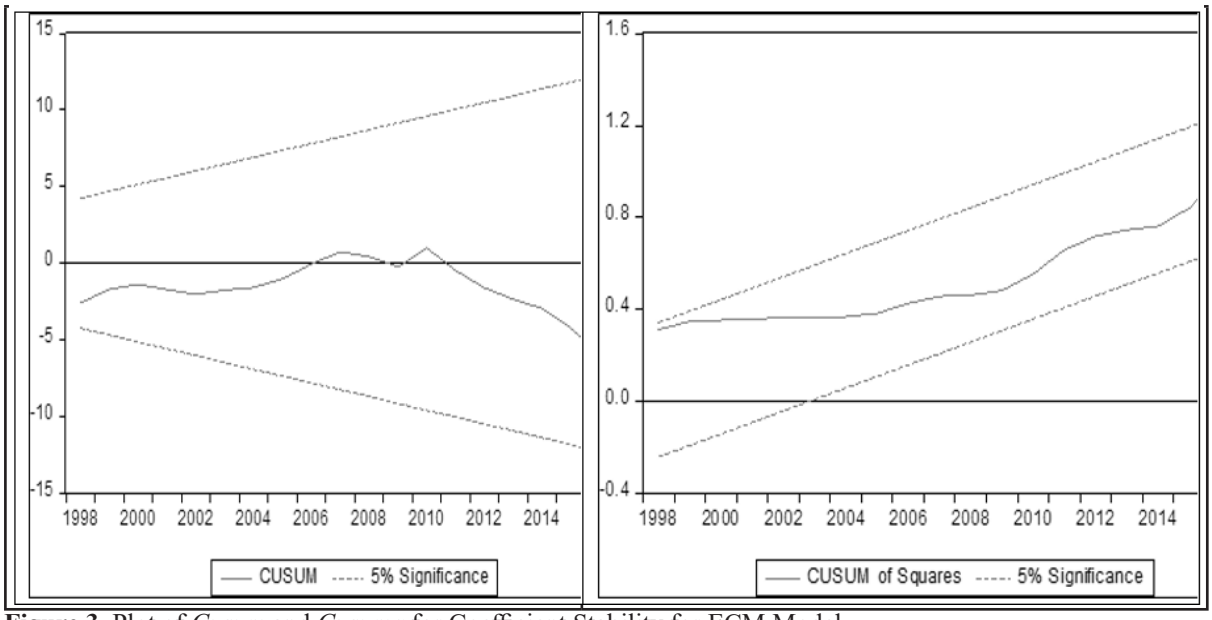


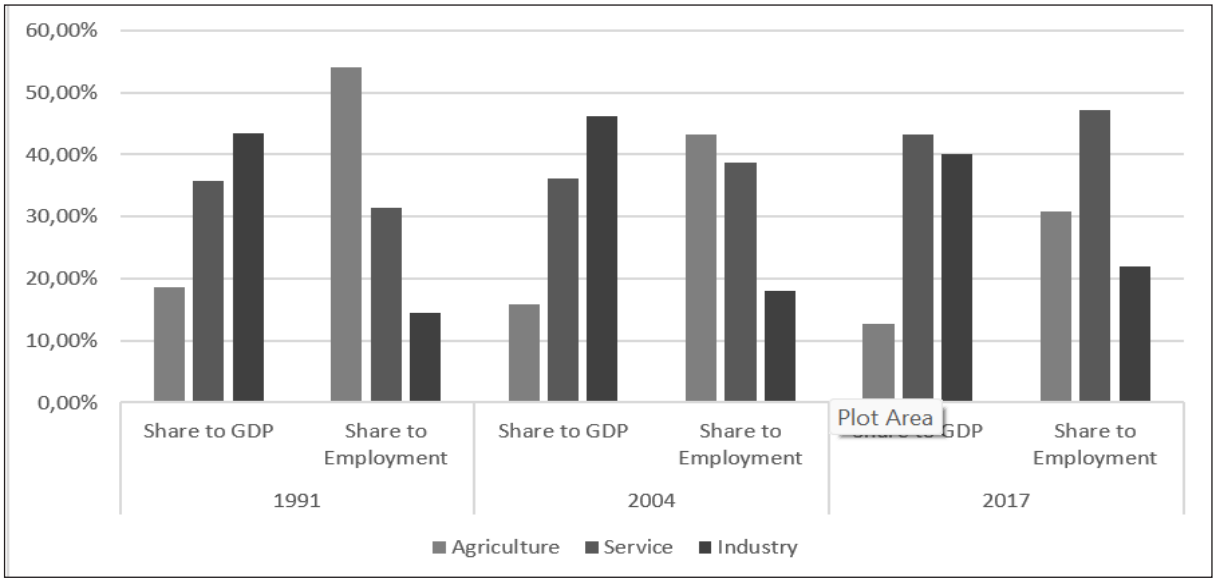
Figure 3. Plot of *Cusum* and *Cusumq* for Coefficient Stability for ECM Model

The lag specification based on the *SC* for the equation has a maximum lag of 4 as presented in Table. 3, ARDL (1,3,3,4,3,0) that include primary education *(PSR),* secondary education *(SSR)*, and tertiary education *(TSR)*. Employing the bound test in Table. 4 produced *F-statistic* values of 8.308907 above the upper bounds critical value at a 1% significance level. This confirms long run cointegration relationships among the variables. The *LM test* results in Table. 5 indicated the value of *Prob-F* and *Prob Chi-Square* are respectively exceed 5%. It implies that null hypothesis cannot be rejected or in other words null hypothesis is accepted. It can be concluded that there is no serial correlation in the equation. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) plots (Figure. 3) from a recursive estimation of the model also indicate stability in the coefficients over the sample period.

The results as specified in Table. 2 showed that among the human capital regressors, the tertiary school ratio has most reliable result reflecting positive and significant impact on economic growth in the long run, at the 5% level. One percentage change in the ratio was associated with a change 0.15 percentage of growth in the long run. Table. 2 also showed that capital accumulation has a positive and significant impact on economic growth. One percentage change in capital was associated with a change of 0.48% of economic growth in the long run. The financial crisis has negative and significant impact on the growth in the short run. Since the ECM coefficient was negative and significant at -0.77 the association between short run dynamic coefficients and the long run relationships was confirmed. It can be concluded that 77% of disequilibrium in previous year was adjusted in current year.

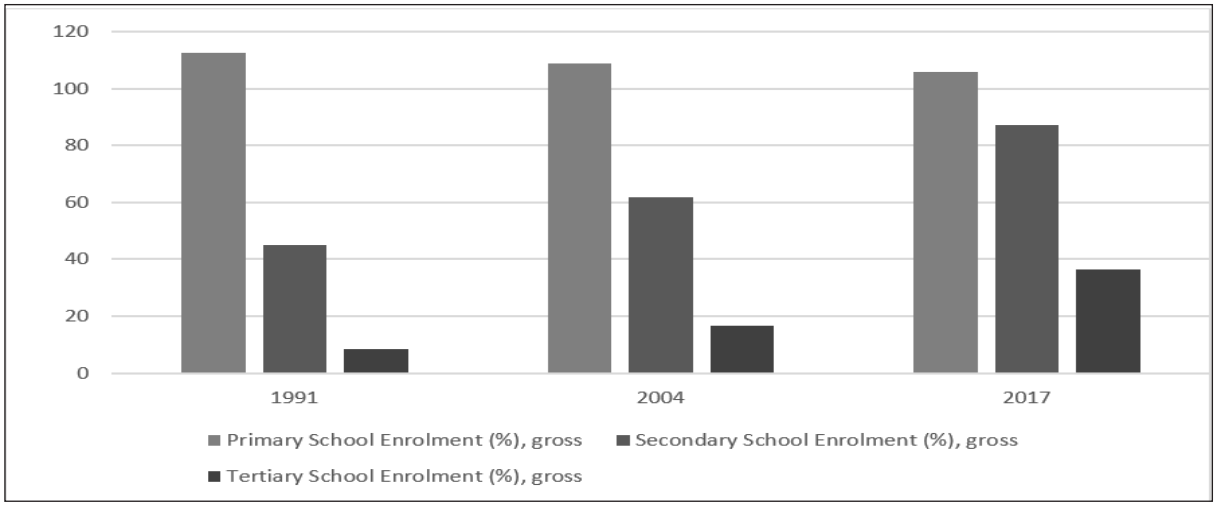
This study investigated the Indonesian economy mainly from two aspects, physical capital and human capital. The analysis of the production function, which includes human capital, indicated that physical capital along with tertiary education have the strongest and robust coefficient in influencing the growth. In term of human capital, this showed that an increase in GDP was more elastically influenced by tertiary education than other education variables. There are some arguments for this finding: 1) Indonesia's growth is mainly induced by manufacture and service sector which require higher qualification of labours; 2) The supply of labours with tertiary education is lower compared to those with primary and secondary education; 3) Additional labours with primary and secondary education has reached diminishing return to employer.

Figure 4 shows a comparison between sectoral share to GDP and employment. Agriculture has least proportion to the GDP, but



Source: The World Bank (2021)

Figure 4. Sectoral Share to GDP and To Employment

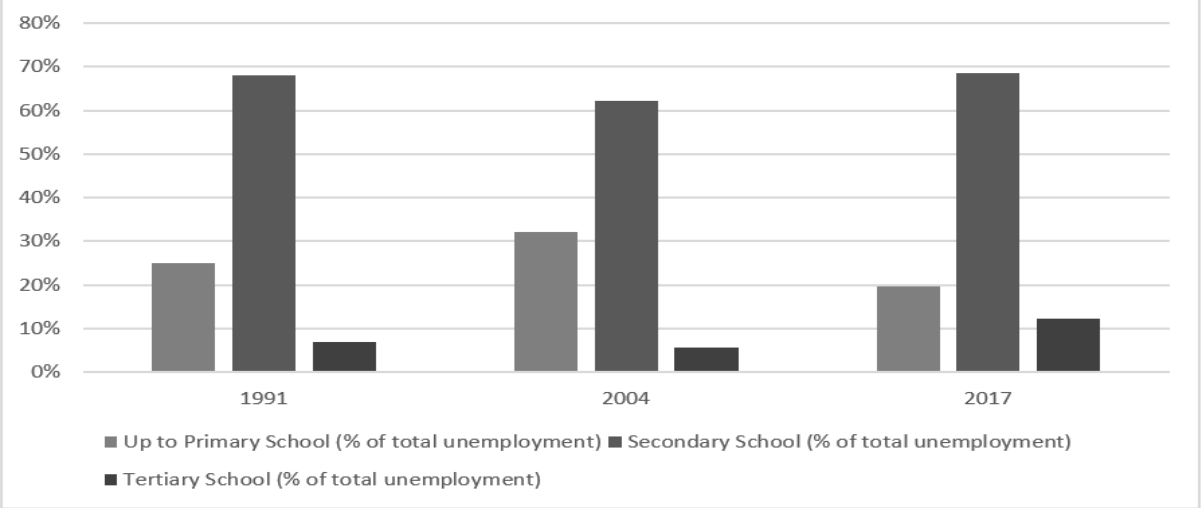


Source: The World Bank (2021)

Figure 5. School Enrolment by Education Level (%), Gross

it is superior in the employment contribution. In 1991 the share of agriculture to GDP was only 18.56% but it contributed to the employment by absorbing 54.02% of total labours. Since low skilled labours were concentrated in the primary sector and the share of agriculture to GDP has been declining, an additional labour would not significantly generate the value added.

In the case of service and industry sectors which have bigger proportion to GDP, these require labours with higher skill from both secondary and tertiary education. However, Figure 5 indicates a big gap of school enrolment between secondary and tertiary education. In 1991, the enrolment for the former level was 44.8%, much higher than the latter level at 8.6%. The figure does not even change in 2017 that the enrolment of tertiary level was still far behind the secondary education. This implied that the supply of labours with tertiary education was lowest compared to the other ones, meanwhile the demand for such labours was increasing along with the development of service and industry sectors. This also indicated that labour with secondary education was no longer scarce in both sectors.



Source: Badan Pusat Statistik (Statistics Indonesia) (2021)

Figure 6. Open Unemployment by Education

Figure 6 has revealed that among levels of education, unemployment with secondary school has the highest rate. It has been increasing from 1991 to 2017 at the rate of 68% and 69% of total unemployment respectively. Whilst tertiary school has shaped graduates with the lowest unemployment rate at workplaces. Apparently, total potential output of the economy can be further generated, if the government can shift the unemployment of secondary school to attach with tertiary school.

The data in Figure 4 to Figure 6 support a study by Oberman et al. (2012) that estimates an undersupply of two million tertiary graduates by 2030 in Indonesia. The shortfall of tertiary graduates will be faced by employers following growth of industry and service sectors in the next decades. The footwear industry for instance, needs supply of model designers, mechanical engineers, processing managers, software operators, and managers. The fact that unemployment still exist among tertiary graduates indicates that some skills still do not meet requirement in industry sectors which should be focus of improvement.

A report by Colclough et al. (2009) suggested that returns to tertiary education had the strongest coefficient of 17.2% in Indonesia followed by higher secondary, lower secondary, and primary education at 13.7%, 8.4%, and 5% respectively. Furthermore, the report by the ILO (2012) revealed that wages for university graduates had been growing rapidly, whilst wages for other lower education graduates had been relatively stagnant. These situations do not imply that primary and secondary education are least important to Indonesia, rather their enrolment rates have been much higher than the rate of tertiary education along with the structural transformation to manufacture and service sector. If these sectors are regarded as engine of growth and knowledge as its driver, then the accumulation of knowledge is expected to be generated by a highly trained and educated labours.

An earlier report produced by the World-Bank (2014) and ILO (2015) also confirmed the significance of tertiary education in Indonesia. Demand for tertiary education graduates, particularly from private companies, had been growing continuously, especially for more strategic jobs such as leaders, managers, or professionals (60%), and supervisors or key technical staff (30%). Jobs for employees with tertiary education have grown positively at 21%, compared to total job growth at 8%. Tertiary education has an important role to play as a long-term investment both for the individuals involved and the economy by absorbing higher skilled labour into more complex economic sectors.

CONCLUSIONS AND RECOMMENDATIONS

Having outlined the findings of the research, several conclusions and recommendations have been suggested, as follows:

1. Human capital, through formal education, plays an important role in inducing growth. Among education levels, tertiary is empirically confirmed to have the strongest coefficient in affecting growth, but its enrolment rate is still lower than other education levels in Indonesia. In comparison with other countries the tertiary enrolment rate in Indonesia is also low. In response to that finding, the government should formulate policies to make tertiary education more accessible. Since Indonesia is an archipelago nation, consisting of more than 17,000 islands with different stages of development, access to tertiary education should be equally distributed over the region.
2. Along with human capital, physical capital has a positive and significant impact on growth. This suggests the need for an education development framework that links education and work within vocational and polytechnic schools to anticipate incoming investment in the industry and services sectors. It is also suggested to open education market for international providers to enhance competitiveness of domestic education.
3. The government can improve and focus on the quality of education for primary school and secondary school since the rate of enrolment has already been high. It can be done by developing school curriculum and school infrastructure as well as further training for teachers to have international qualification.
4. A conducive environment to attract long-term investment begins with both reforms on regulatory framework and financial institution reforms. These investments should be closely related to absorbance of higher educated labours to generate maximum impact on the growth. Several measures that impede investment inflows such as labour laws, restrictive regulation on foreign ownership, infrastructure bottlenecks, and access to financial institution should be relaxed. There are still much efforts to be conducted since these investment impediments still exist in the Indonesian bureaucracy as stated in many economic indicator reports.

REFERENCES

Abbas, Q., & Nasir, Z. (2001). Endogenous growth and human capital: a comparative study of pakistan and Sri Lanka [with comments]. *The Pakistan Development Review*, 987-1007.

Aghion, P. (1998). *Endogenous growth theory.* Cambridge, Massachussets & London, England: The MIT Press.

Arrow, K. J. (1962). The economic implications of learning by doing. *Review of Economic Studies, 29*(3), 155:173.

Badan Pusat Statistik. (2021). *Data Sosial dan Kependudukan*. Retrieved from https://www.bps.go.id/subject/6/tenaga-kerja.html#subjekViewTab3.

Barro, R. J. (1989). Economic growth in a cross section of countries. *The Quarterly Journal of Economics, 106*(2), 407–443.

Barro, R. J. (1990). Government spending in a simple model of endogenous growth. *Journal of Political Economy, 98*(5), S103-26.

Barro, R. J. (2013). Education and economic growth. *Annals of Economics and Finance, 14*(2), 301-328.

Becker, G. S. (1962). Investment in human capital: a theoretical analysis. *Journal of Political Economy, 70*. doi:https://doi.org/10.1086/258724

Colclough, C., Kingdon, G., & Patrinos, H. A. (2009). *The pattern of returns to education and its implications.* Cambridge: Research Consortium on Eductional Outcomes and Poverty (RECOUP).

Edwards, S. (1993). Openness, trade liberalization and growth in developing countries. *Journal of Economic Literature, 31*(3), 1358-1393.

Feenstra, R. C., Inklaar, R., & Timmer, M. P. (2015). The next generation of the penn world table. *American Economic Review, 105*(10), 3150-3182.

Feridhanusetyawan, T., & Pangestu, M. (2003). Indonesia trade liberalization: estimating the gains. *Bulletin of Indonesian Economic Studies, 39*(1), 51-74. doi:10.1080/00074910302008

Frankel, J., Romer, D., & Cyrus, T. (1996). Trade and growth in east asian countries: cause and fffect? *NBER Working Paper Series*(5732), 1-21. doi:10.3386

Gapinski, J. H. (1997). Economic growth in the asia pacific region. *The Asia Pacific Journal of Economics & Business, 1*(1), 68-91.

Goel, S. C. (1974). Education and economic growth in India. *Comparative Education, 10*(2), 147-58.

Grossman, G., & Helpman, E. (1993). *Innovation and growth in the global economy.* Cambridge: MIT Press.

Gujarati, D. N. (2003). *Basic econometrics* (4th ed.). New York: McGraw-Hill/Irwin.

Hartono, D., Priyarsono, D. S., Nguyen, T. D., & Ezaki, M. (2007). Regional economic integration and its impacts on growth, poverty, and income distribution: the case of Indonesia. *Review of Urban & Regional Development Studies, 19*(2), 138-153. doi:10.1111/j.1467-94OX.2007.00131.x

Hurvich, C. M., & Tsai, C. L. (1989). Regression and time series model selection in small samples. *Biometrika, 76*(2), 297-307. doi:10.1093/biomet/76.2.297

ILO. (2012). *Labour and Social Trends in Indonesia 2011: Promoting Job-Rich Growth in Provinces.* Jakarta: ILO Country Office for Indonesia.

ILO. (2015). *Labour and Social Trends in Indonesia 2014-2015: Strengthening Competitiveness and Productivity Through Decent Work.* Jakarta: ILO Country Office for Indonesia.

Jones, C. I. (1998). *Introduction to economic growth* (1st ed.). New York & London: W. W. Norton & Company, Inc.

Loening, J. L. (2005). Effects of primary, secondary and tertiary education: evidence from Guatemala. *Policy Research Working Paper, 1 of 2*. doi:10.1596/1813-9450-3610

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3-42. doi:10.1016/0304-3932(88)90168-7

Mackinnon, J. G. (2010). Critical values for cointegration tests. *Queen's Economics Department Working Paper*(1227).

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics, 107*(2), 407-437. doi:10.2307/2118477

Maurer, S. (1994). International trade and economic growth: a survey of empirical studies. *Kiel Working Paper*(60).

Oberman, R., Dobbs, R., Budiman, A., Thompson, F., & Rosse, M. (2012). *The archipelago economy: unleashing Indonesia's potential.* Jakarta: McKinsey Global Institute, McKinsey & Company.

Pereira, J., & Aubyn, M. S. (2009). What level of education matters most for growth? evidence from Portugal. *Economics of Education Review*, 67-73. doi:10.1016/j.econedurev.2007.12.001

Peron, P. (1997). Further evidence on breaking trend functions in macroeconomic variables. *Journal of Econometrics*, 355-385. doi:10.1016/S0304-4076(97)00049-3

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, 1361-1401. doi:10.2307/1913712

Pesaran, M. H., & Pesaran, B. (1997). *Working with microfit 4.0 : interactive econometric analysis.* Oxford: Oxford University Press.

Pesaran, M. H., & Shin, Y. (1997). *An autoregressive distributed lag modelling approach to cointegration analysis.* Working Paper, Trinity College, University of Cambridge, Department of Applied Economics, Cambridge.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bound testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326. doi:10.1002/jae.616

Petrakis, P. E., & Stamatakis, D. (2002). Growth and educational levels: a comparative Analysis. *Economics of Education Review, 21*(5), 513-520. doi:10.1016/S0272-7757(01)00050-4

Rodriguez, F., & Rodrik, D. (2000). Trade policy and economic growth: a skeptic's guide to the cross-national evidence. *NBER Macroeconomics*(15), pp. 261-325.

Romer, P. M. (1986). Increasing returns and long run growth. *Journal of Political Economy, 94*. doi:https://doi.org/10.1086/261420

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5), S71-S102.

Roubini, N., & Sala-i-Martin, X. (1995). A growth model of inflation, tax evasion, and financial repression. *Journal of Monetary Economics, 35*(2), 275-301. doi:10.1016/0304-3932(95)01192-Q

Self, S., & Grabowski, R. (2004). Does education at all levels cause growth? India, a case study. *Economics of Education Review, 23*(1), 47-55. doi:10.1016/S0272-7757(03)00045-1

Simorangkir, I. (2006). The openness and its impact to Indonesian economy: a SVAR approach. *The Graduate Program in Economic Development's 50th Anniversary Conference.* Nashville TN, USA: Vanderbilt University.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70*(1), 65-94. doi:10.2307/1884513

Taylor, R. J. (2007). *Technical progress and economic growth: an empirical case study of Malaysia.* Cheltenham Glos, UK and Massachussets, USA: Edward Elgar Publishing Limited.

Tran, V. H. (2003a). *Growth of Asian regional trade and income convergence: evidence from ASEAN+3 based on extended Helpman-Krugman hypothesis and flexible modelling approach.* University of Wollongong Working Paper Series 03(02), University of Wollongong, Department of Economics, Sydney, Australia.

Tran, V. H. (2003b). *New Asian regionalism: evidence on ASEAN+3 free trade agreement from extended gravity theory and new modelling approach.* University of Wollongong Working Paper Series 03(03), University of Wollongong, Department of Economics, Sydney, Australia.

Tran, V. H. (2010). Australia-China free trade agreement: causal empirics and political economy. *Economic Papers, 27*(1), 19-29.

Valdes, B. (1999). *Economic growth: theory, empirics and policy.* Cheltenham Glos, UK & Northampton, Massachussets, USA: Edward Elgar.

World Bank. (2014). *Tertiary Education in Indonesia: Directions for Policy.* Jakarta: The World Bank.

World Bank. (2021). Data of Indonesia. Retrieved from https://data.worldbank.org/country/indonesia?view=chart.