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THE IMPACT OF EDUCATION ON ECONOMIC GROWTH IN INDONESIA

Faizal Reza

Student of Master of Science Program
Universitas Gadjah Mada
(reza_9946@yahoo.com)

Tri Widodo

Faculty of Economics and Business
Universitas Gadjah Mada
(kociwid@yahoo.com)

ABSTRACT

Does education promote economic growth? The aim of this study is to find out the impact of education on economic growth in Indonesia. This research employed panel data technique to investigate the relationship between education and economic growth in Indonesia during the period 1996-2009. The empirical results show that education per worker has a positive and significant impact on economic growth. The estimates of panel model suggest that a 1% increase in average education per worker will lead to about 1.56% increase in output. By using instrument analysis, researchers found that Jawa Timur is a province with highest economic growth in Indonesia. In contrast, Bengkulu experiences the lowest position with the lowest economic growth. The results show us that there are still substantial disparities within the provinces in Indonesia

Keywords: *education, economic growth, panel data.*

INTRODUCTION

Economic development is briefly defined as the increase in output per capita in the long run. This means that there are three key words in the economic development namely, process, output per capita, and the long run. The theory of economic growth itself can be interpreted as factors affecting the increase in output per capita in the long run, and briefly the factors affecting economic growth can be grouped into economic and non economic factors. In classical growth theory, capital growth has a central role in the process of output growth, in which the growth rate of output depends on level of capital growth. According to Adam Smith, stock of capital has two effects on the level of total output, the first effect is a direct effect where the accretion of capital will directly affect output, the more input will result the more output. Then the second influence is the indirect effect of capital on output in the form of increased productivity per capita over the possibility higher degree of specialization and division of labor, where specialization and division of labor encourage increased productivity.

Concerning labor issue, Indonesia today has a total population 237.556.363 people as reported by BPS (Central Bureau of Statistics) in August 2010, consisting of 119.507.580 male and 118.048.783 female. The total population has increased compared to the one in 2007 that reached 205.1 million people. Of this amount, residents who entered the labor force are 116.527.546 people, while residents who are ready to work according to the BPS report in the same period are amounted to 108.207.767 people. The large number of labor force may have an impact on a country's economic growth. Then the level of education of the Indonesian population in 2009 spread in various levels of education with the highest proportion in the primary school level (SD) at 94.37%; Junior High School and Vocational Education at 67.4%; General and Vocational High School at 45.06% and higher levels of education as much as 10.3%.

Human capital development can give to us a productive and qualified labor in which it is particularly influenced by education. Therefore, the education level of labor is used as a proxy of human resources that are often used as indicators of the growth progress in a country. Relating to education, it can be said that the school is a form of investment. And the basic specifications and other implications of this investment as we know refer to what is called return in education, usually it reflects the different wages due to investment in education. Mincer (1974) with an elegant formula has made simplification of return estimates using cross-section data to see the rate of return. The formula can estimate the rate of return through years of schooling in a cross section regression to obtain individual wages. In general, return estimated using Mincer formulation results in the range 5-15%. Psacharopoulos (1985) states that the return on the developing countries are higher than returns on developed countries, and obtained the highest return on primary education, but the return on the university is greater than the return of high school. When we can accept this result, it would make sense for us to think that the role of education should be derived from different studies thus it will produce many variations.

In general, if education level of residents in a country is higher, then the level of economic progress that country will be higher too. In line with what is proposed by Barro (1991) in empirical research conducted in developing countries, there is a positive correlation between education and economic growth. In addition, Gemmell (1996) stated that human capital and its growth rate is an important factor in economic growth. However, there are some economists who reiterate the weak impact of education on economic growth. Benhabib & Speigel (1994) found a negative relationship between educational attainments in the workforce on economic growth. This is similar to Musila & Belassi (2004) study on Uganda case. They found that cross-section analysis is less capable in explaining the causality between education and economic growth. Moreover, Benhabib & Speigel (1994) assert that the existence of a weak relationship between these two variables to describe the error and the influence of outliers in cross-country sample. Rodriguez & Rodrik (1999) found that the instrument that is used to underestimate behavior of variables was generally less valid.

In order to be closer to the impact of the education, Webbink (2006) and Oosterbeek & Webbink (2004) attempted to identify the effects of prolonging the year of schooling on earnings of individuals. This study shows that the university graduate encourages earnings by 7%, while lower vocational education has no impact on wages. The previous empirical experience presents the research gaps in the form of dissent and different perception regarding to the method of analysis. Departing from this view, this paper aims to examine the impact of education on economic growth by using a different approach from what has been done by previous researchers. Here researchers have considered the panel data analysis using data period 1996-2009 from provinces in Indonesia The rest of this paper is organized as follows. Part 2 describes the theoretical framework. Estimation results are presented in Part 3. Some conclusions are presented in Part 4.

THEORETICAL FRAMEWORK

1. Neoclassical production function

Neo-classical production function simply assumes there is the possibility of substitution between production factors K (capital) and L (labor), where the production function is usually written as:

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

Here it is assumed that the production function is CRTS (Constant Return to Scale) in which all inputs increase by a certain multiplication on the output will be followed by the same multiplication. So, positive constants can be written:

$$cY = F(cK, cL) \quad (2)$$

For example, if all inputs are doubled, then for the case here c is equal to 2, and output will rise double as well. Now we can take advantage of this characteristic of the CRTS (Constant Return to Scale) to assume c = 1/L, so that gives us:

$$Y/L = F(K/L, L/L) \quad (3)$$

$$Y/L = F(K/L, 1) \quad (4)$$

Then, the equation above can be written:

$$y = f(k) \quad (5)$$

Where we define Y/L and K/L as y and k, here the equation (5) describes the output per worker as a function of capital per worker. In the equation above we can also say that economic growth is necessary not only for the Y, but also required by increasing y. The graph of equation (5) can be depicted in the Figure 1 below.

Figure 1 demonstrates that if there was an increase in constant k, then the output will

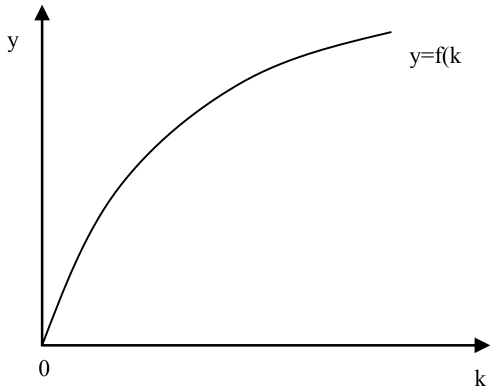

Figure 1. Neo-classical production function

grow as the increase in k, but the slope will decrease because every addition of k is relative to L causing smaller and smaller increase in output. The production function f(k) above represents the supply side or production capacity, but keeps in mind that the amount of capital depends on the function of investment, and investment depends on the desire to save or to do consumption. So as in the Harrod-Domar model which divides goods into two categories, consumption goods and investment goods, in this paper we divide goods into two broad above mentioned categories and consider the consumption function that could explain the relationship between variables. With the initial equation:

$$Y = C + I \quad (6)$$

Where C is consumption, and I is investment, so that by dividing these two variables again by L then equation (6) above will be:

$$Y/L = C/L + I/L \quad (7)$$

$$y = c + i \quad (8)$$

Now c and i are the consumption and investment per worker. Consumption which is assumed as a simple function of income is also influenced by the level of saving rate, δ, so that:

$$C = Y – S \quad (9)$$

$$C = (1 – \delta)Y \quad (10)$$

While S is savings, s=S/L and Y/L=y then C/L = c, the equation (10) can be rewritten:

$$c = (1 - \delta)y \quad (11)$$

Now we can make substitutions between equation (11) and equation (8) which produces:

$$y = (1 - \delta)y + i = y - \delta y + i \quad (12)$$

Subtracting y from the right side and left side, and moving the negative term on δy, then we will find:

$$\delta y = i \quad (13)$$

We can say that the investment per worker is equal to the proportion of income saved. Although the decision to save and to invest can be separated ones, it will not apply to the same person in order to make a simple model, researchers will follow the model above. So researchers assume the saving will be equivalent to investment and all investments consist of new productive capital.

So far, researchers have been specified the neo-classical production function with Y = F (K, L), where F is a function of the relationship between input and output. Yet, the relationship has a limitation on the function where we only get a qualitative conclusion, as an example we can say that the increasing investment (saving) will drive an increasing in Y, but so far we do not know exactly how much. Therefore, we also can use the Cobb-Douglas production function with a more specific mechanism form which can provide more specific quantitative solution.

2. Cobb-Douglas Production Function

Cobb-Douglas production function is often written in the form:

$$Y = AK^{\alpha}L^{1-\alpha} \quad (14)$$

Where A reflects the level of technology and α is a parameter that has a value between 0 and1. As we know that the Cobb-Douglas production function reflects the Constant Return to Scale that is similar to Solow. By multiplying each factor by c then we can get new equation of the Cobb-Douglas function:

$$A(cK)^{\alpha}(cL)^{1-\alpha} = Ac^{\alpha}K^{\alpha}c^{1-\alpha}L^{1-\alpha} = c^{\alpha+1-\alpha}AK^{\alpha}L^{1-\alpha} = cY \quad (15)$$

So the constant return depending on α and 1-α. With using the calculus, we can find that the product of capital and labor are usually written:

$$MP_L = A(1-\alpha)k^{\alpha} \quad (16)$$

$$MP_K = A\alpha k^{\alpha-1} \quad (17)$$

Another advantage of the Cobb-Douglas function is the characteristic which it would not be difficult for us to see the share of each input. By leveraging the intermediate steps of the Cobb-Douglas production function, we can write total output as a function of K and L with the alternative:

$$Y = Ak^{\alpha}L^{1-\alpha} = LAK^{\alpha}L^{1-\alpha}L^{-1} = LAK^{\alpha}L^{-\alpha} = LAK^{\alpha} \quad (18)$$

With under perfect market assumption, then each factor of production will have a marginal product. This means that the share of total output produced by capital will be equal to the amount of capital multiplied by its marginal product, all divided by total output. So from equation (17) and (18) we can obtain a share of capital to total output:

$$K(MP_K)/Y = (KA\alpha k^{\alpha-1})/LAk^{\alpha} = A(A)^{-1}\alpha(k)(k)^{\alpha}(k)^{-\alpha}(k)^{-1} = \alpha \quad (19)$$

Where K/L = k, and the share of labor is the number of workers multiplied by its marginal product and all divided by the total output. Using equation (16) and (18):

$$L(MP_L)/Y = [LA(1-\alpha)k^{\alpha}]/LAK^{\alpha} = 1-\alpha \quad (20)$$

So, it could be concluded that the share of each input *K* and *L* are α and $1-\alpha$. This of course can help us to conclude the contribution of each factor input to the *Y*.

3. Measuring Technological Progress

This paper refers to the simple notion of economic growth, which is defined as the increase in output per capita in the long run we will get three key words here, namely, process, output, and long term. Associated with long-term growth process, there is one thing can explain the neo-classical growth theory that is the existence of technological progress. Good measure of the technological progress will increase our understanding of economic growth. But unfortunately the economic growth is difficult to quantify because it depends on the data, the study of the states, and the time period of the study. This paper puts definition of technological progress as the economic ability to change the entire productive resources into the improvement of community welfare in the form of goods and services. A broader definition includes not only the understanding of technology in the traditional dictionary definition which associated with technology production methods in industry, but also other aspects such as the efficiency of production factors, ideas, methods, and knowledge or know-how.

For example, the decreasing total productivity in all American Latin countries in the 1980s did not reflect the decreasing knowledge that caused people suddenly forget about the way how to produce. It can be interpreted as decreasing efficiency of conversion from input to output rising, unemployment, and inefficient factors of production. Furthermore, Romer (1990) identifies the technology as the idea because technology covers broad concept. In analogy, technology is seen as a black box where all the resources of the productive economy generate improved welfare in the form of goods or services. Black box approach here illustrates the logical source of growth to estimate the productivity production factors, given the broad definition of this technology it could be seen why economists have difficulty in modeling technology that can improve an economy. But keep in mind this is not absolute; researchers still have the approach to measure the progress of technology in the economy. Now, it's assumed that producers in economy follow neo-classical growth model as written:

$$Y = K^{\alpha}(EL)^{1-\alpha} \tag{21}$$

Where E is a labor-augmenting technology, assuming that E grows at an exogenous level, E is related to the total stock of capital so that:

$$E = DK^{\varphi} \tag{22}$$

Where $D>0$ and $\varphi>0$ are constant. Now we can see that E is a function of other variables in the model, namely the capital stock. Substitution of equation (22) into equation (21) results in the following equation:

$$\begin{aligned} Y &= D^{1-\alpha}K^{\alpha}K^{\varphi(1-\alpha)}L^{1-\alpha} \\ &= D^{1-\alpha}K^{\alpha+\varphi(1-\alpha)}L^{1-\alpha} \end{aligned} \tag{23}$$

With the simplified assumptions that labor is constant and $\varphi = 1$. It can be defined that $A = (DL)^{1-\alpha}$, so that the equation becomes:

$$Y = D^{1-\alpha}KL^{1-\alpha} = (DL)^{1-\alpha}K = AK \tag{24}$$

Technically, the assumption that $E = DK$ is useful for linearity technology functions. Thus, accumulation of capital will increase the technology which can shift the diminishing return. Under conditions of Increasing Returns to Scale, economic growth will be possible, if there is the possibility of diminishing returns for each factor of production, so that the capital can grow if there is growth of employment, and if labor is growing, then the capital will grow faster as a result of technology in it. AK above model can also be explained by the output function, let's assume that the level of technology represented by E in the production function (learning by doing) relates directly to the output, so that:

$$E = BY \tag{25}$$

Where B>1 and φ=1, then we can generate equation (25) can be integrated into the equation (21) and find:

$$Y = K^{\alpha}(EL)^{1-\alpha} = B^{1-\alpha}K^{\alpha}Y^{1-\alpha}L^{1-\alpha} \tag{26}$$

By dividing both sides by $Y^{1-\alpha}$, then we can isolate the variables Y and obtain:

$$YY^{-(1-\alpha)} = YY^{-}Y^{\alpha} = Y^{\alpha} = B^{1-\alpha}K^{\alpha}L^{1-\alpha} \tag{27}$$

If the population is zero and the assumption of L is constant, then (B1-αL1-α)1/α = A will describe the AK model once again:

$$(Y^{\alpha})^{1/\alpha} = Y = (B^{1-\alpha}L^{1-\alpha})^{1/\alpha}(K\alpha)^{1/\alpha}$$
$$= AK \tag{28}$$

From the model above we find that with the condition of Increasing Returns to Scale, it could be found that once again a model of technological progress is a function of the investment, even if it is assumed that the advancement of technology is less than linear (picture shown below), the growth can be generated from the growth population.

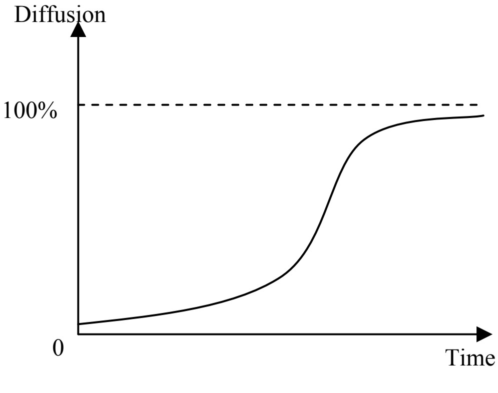

Figure 2. The advancement of technology

4. Education and Economic Growth

There are several ways to modeling how a major expansion in education can boost economic growth. The first, the view of education as human capital investment which was used by Krugman (1994) when investigating the success of Asian tiger through investments in education. Secondly, positive externalities results show that the "education as part of the community and also part of the overall profits". Externalities are defined as the impact of education level of other people on the productivity an individual. Here we must distinguish between statistical externalities in which education has a one-time effect on output (Lucas, 1988) and dynamic externalities that can make economic growth faster as a result of increased human capital, increased innovation (Romer, 1990) or the ease of doing imitation of technology (Nelson & Phelps, 1966). Then a higher level of education will show declining mortality rate (Lleras-Muney, 2005) and decreasing level of crime (Lochner & Moretti, 2004). If the return of public education is greater than return of private education, there will be positive externalities from education. If the average education in a country affects the average wage, and if this effect is greater than that estimated for the individual relationship, then there is a positive impact of externalities to education statistics. Furthermore, if the average education in a country has an effect on the growth of output, then there is a dynamic impact of positive externalities to education. Externalities are also an indicator for the policy (Aghion & Howitt, 1998). The idea of positive externalities is actually not a 'new item' where 200 years ago the classical economists argued that government should support education to create externalities which in turn will promote the educated labor force as a function of economic growth and democracy in society.

Further, in a social perspective of return and this second way, by using cross-country data, have found varying results. Fuente & Domenech (2006) took data from OECD countries and found the weakness of time series data which is the elasticity of GDP per worker and the school year is almost 1. The social returns from education is about 10 percent, this result is far above the individual return in OECD countries. This result reveals positive externalities. While Cohen & Soto (2001) have used the data of 95 countries and found the social return of about 8-9 percent, and the result is very similar to the results of individual returns in many countries, with slightly difference in externalities, thus we can conclude that there is almost no positive externalities based on the research conducted by Cohen & Soto (2001). While the results of research by Moreti (2004) found a very large externalities in cities in the United States, but different results have been obtained by Ciccone & Peri (2006) with the data of American cities in which their results show that the externality value is almost zero.

The last way in modeling the role of education is referring to the view saying that human capital is an important input in innovation and R & D activities. This is analogous that education can create the idea and will accelerate technology. This third model is identical to the Schumpeterian assumption of product competition in imperfect markets which allow a process of "creative destruction". Countries that have advanced technology usually have an educated population, and economy with high income levels usually provide their residents with more education than in developing countries. The average years of education for developing countries is about 3.9 years, while the average years of education for countries that have developed / advanced is about 11.1 years. For Indonesia itself according to United Nations Development Programme (1994), Human Development Report reveals an average school year by 4.1 years for the population above 25 years which consists of 3.1 years for women and 5.3 years for men. And the percentage of university graduates in this population is only about 0.6 percent.

The importance of education and human capital has brought a lot of studies on economic growth. Robert Lucas in the late 1980s specified the importance of education as a force that can generate technology in the economy. Lucas says further that education creates human capital that affects labor productivity and differences in the level of technology in the world. Because the importance of the human capital concept, and the role of education is that many researchers have been investigating the role of education through human capital on economic growth. Edward Denison disclosed reversal argument in which he clearly separates education and economic growth in which education is not regarded as a major contributor to economic growth. The statistical differences explaining relation between education and growth are also often found in other study such as Krueger and Lindahl (2001) who try to solve the conflict between macro and micro estimates of the role of education.

Macro study has shown a weakness in association / relationship between growth of GDP per capita and change in education with cross section data. Micro study as presented by Bils & Klenov (1998) found an inverse relationship in which economic growth results in higher levels of education, and they found the reverse effect which is greater than the relationship of education to growth. Bils & Klenov (2000) also found that although there is a positive relationship between growth and initial level of education, no positive relationship between growths and the rate of change in education. An inverse relationship was also presented by Heckman & Klenov (1998) and Topel (1999). They think education is a matter of what is produced by growth and do not cause economic growth. Even some economists expressed the difficulty in measuring the effect of education because education operates through many channels. For examples, FDI (Foreign Direct Investment) plays an important role in the transfer of technology in which education operated in technology, so that education can operate indirectly through FDI. And then, this group also stated that there are tendency of foreign investors to transfer technology through FDI by looking at whether there are workers who have higher education and able to handle the newer methods and more complex procedures. IMF study through Kim & Kim (1999) mentioned that education can stimulate economic growth in which education will increase the mobility of workers. High mobility causes easier and faster changes in the structure for international trade.

Other work by Jonathan Temple (1998) which employed data from the education and economic growth together with data from Benhabib & Spiegel (1994), then examine data from a different angle. Temple found that the failure in seeing the relationship between education and economic growth is caused by bias including a few sample countries that have a remarkable case in their study. When few exceptional cases (such as economic growth is too slow) are applied, then education has a positive and significant influence. But one thing that can be highlighted such as presented by Nazrul Islam (1995) is that human capital plays an important role in the growth process, but there are still unresolved questions on what channel exactly? It leaves the job for many researchers. Regardless of these differences, we might agree that education and human capital remain an interesting discussion of a concept in economic studies of growth and development, especially after the economy such as Hong Kong, Korea, Singapore, and Taiwan have achieved economic growth unprecedented previously through large investments in education. Therefore, it is still much debate, and this paper will estimate the effect of education on economic growth in the form of panel analysis.

METHODOLOGY

1. Data and Measures

The data used in this study is from several sources such as the Indonesian Center Agency of Statistic (*Badan Pusat Statistik, BPS*) and Regional Agency of Investment (*Badan Penanaman Investasi Daerah* (BPID). Data will be analyzed by the panel method, the data which was used in this study is the data period 1996-2009. These panel data were classified into several regions or provinces and grouped as follows:

1. Region 1 consists of the provinces with low GDP growth and FDI growth rate; these provinces include Bengkulu, Jambi, Daerah Istimewa Yogyakarta, Central Kalimantan, South East Sulawesi, and Central Sulawesi.
2. Region 2 consists of provinces with high GDP growth and high growth of FDI, these provinces include North Sumatera, Riau, DKI Jakarta, West Java, East Java and East Kalimantan.

GDP data was taken from the BPS for period 1996-2009 where the data will be used is the constant price of GDP according to the division of provinces in Indonesia. Data on capital was taken from the BPID from 1995-2009, i.e. Data Foreign Direct Investment (FDI) according to each region in Indonesia. With the selection of Foreign Direct Investment researchers intend to see how the high growth of FDI does generate economic growth through education. The assumption used here is that education technological progress plays a role in translating the role of FDI in economic growth, and investors often decide to invest by looking at the presence or absence of highly educated workers in the production process. While the labor data used here is labor data in 1996-2009. For the education variable, researchers used years of schooling during the period 1996-2009. In addition to observe the direct impact on economic growth, this variable also will accommodate and capture the impact of changes in the level of education on growth. Use of data panel intended to avoid the weakness of time series analysis and cross section analysis that was mentioned in many previous studies, so that by looking at the results between regions researchers can conclude the impact of education on economic growth and further to give their views by way of education about work in the economy. However, this paper will not eliminate the provinces with low growth to see the real impact of education. After all, by eliminating regions with low economic growth researchers will directly reduce the variations in results and will experience less valid results. This paper will see an average significance between regions/provinces to draw conclusions based on existing variation. With the deviations that occur between the observed variables, it can be assumed that there are other variables that work in influencing economic growth outside the model being discussed.

2. Model

The model used in this paper is a model based on the aggregate production function:

$$Y_t = AK_t^{\alpha} L_t^{\beta} H_t^{\gamma} \tag{29}$$

Where:

Y_t = Real GDP
K_t = Physical capital
L_t = Numbers of worker
H_t = Human capital
A = Technology
A, α, β, γ = Estimated Parameter

Since human capital is defined by:

$$H_t = E_t\, L_t \tag{30}$$

Where:

E_t = Average education level of worker
L_t = Numbers of worker

With the substitution of the equation (30) into the equation (29) could be rewrite as follows:

$$Y_t = AK_t^{\alpha} L_t^{\tau} H_t^{\gamma} \tag{31}$$

Where τ = β + γ. Equation (31) can be developed into econometric equations and express the impact of education on economic growth. Theoretically, there is a positive relationship between economic growth and increased supply of capital, labor, and level of labor education. Since the purpose of this paper is to examine the impact of education on economic growth, then by using logarithmic transformation, the growth of output is a logarithmic function of the growth in supply of capital, labor, and education. So that the econometric model can be written:

$$\text{Log GDP} = a + \alpha \text{ Log } K_t + \tau \text{ Log } L_t + \gamma \text{ Log } H_t + \varepsilon_t \tag{32}$$

Where:

Log GDP = logarithm of output (real GDP)
Log K = logarithm of capital formation
Log L = logarithm of worker
Log H = logarithm of education level per worker
a, α,τ,γ = parameters to be estimated
ε = error term, and
t = level of observation.

ESTIMATION RESULTS

For the panel data analysis, there are three methods commonly used to estimate the parameters in the model. This paper will estimate the parameters that proposed previously by using one method with a variety of considerations. As it is known, panel data is a combination between the time series data from 1996-2009 and cross section data between 12 regions or provinces in Indonesia. It means that by using this combined data, researchers will have a rich data in information and variations which can explain the real condition. Also, by using this data, it will obtain a better results of regression that if we use time series data or cross section data only, with a high observation has implications on the data to avoid a colinearity between variables and to improve the degree of freedom (df), and then this data is believed to minimize bias caused by aggregation of individual data. With the use of panel data, researchers expect the control of the heterogeneity of the regions/provinces which can be used in building a more complex behavior models for each region/province. Then above these advantages there is another implication that it not a must to do classical assumption in panel data model (Verbeek, 2000; Gujarati, 2003).

Although researchers realized the difficulties to obtain the data that can describe accurately the real conditions, this paper expects to account for any variations from estimated results, thus close to real conditions. As mentioned in the data and previous measurements, researchers will consider the study design according to the division of regions or provinces based on the two categories (provinces with high Gross Regional Domestic Product growth and the provinces with lower growth of Gross Regional Domestic Product). This paper assumes that the provinces will be considered as having average high of GDP growth if it is above 3%, and vice versa average GDP is low if less than 3%, however the provinces with low economic growth will not be eliminated. Gross Regional Domestic Product itself is one of the macro indicators that are often widely used and often used in assessing the welfare of a society, the Gross Regional Domestic Product among the regions will reflect the total revenue and total spending on the economy for goods and services produced by the region concerned, and it seems that this measure is a natural measure in explaining the level of welfare of an provinces.

In this panel data estimates, there are three methods which will be compared. The first is the panel method with Pooled Least Square (PLS), which is a method to estimate the panel data using OLS, while the Fixed Effect Method (FEM) is a method to consider the change in the characteristics between regions or provinces and over time variation through the intercept. The third way is by using a Random Effects Method (REM) which is a variation of the estimate of the Generalized Least Square (GLS). This method accommodates the differences between regions or provinces and over time variation through an error in the model, this technique also calculates that the error may be correlated along the time series and cross section. In this paper we will examine the above methods by using several tests in which this test can provide guidance about which method is suitable for us. It is known that because the panel data is a combination of data time series and cross section data, the PLS method is considered less able to accommodate differences in slope and intercept of change between individuals and over time, the weakness is due to incompatibility PLS model with actual conditions, the condition of each province observed are different from each other, even one province at a time will be different from the same province at another time. So it is unrealistic to assume that there is the same intercept and slope among provinces and over time. To handle it, the fixed effect method that can show the constant differences among the provinces observed can be used, "fixed" here is to assume that a province has a constant magnitude for various periods of time, as the regression coefficient had a fixed magnitude over time (time invariant). But there are some weaknesses in this method. The method is actually similar with using dummy variables as independent variables. Because these variables are considered to still contain uncertainty, the method of random effects can be used in which it doesn't use pseudo-variable but accommodate this uncertainty through errors that allegedly has a relationship over time and between individuals or provinces, it appears that this last method is more preference to be used. But there are conditions we must meet to be able to use this method where the number of provinces must be greater than the number of observed variables, for this rule, we have met these requirements. But to draw conclusions about the panel method which will be used, this paper will conduct a test earlier by using the Chow test and Hausman test. Chow test is used to choose between the PLS method and method fixed effect, if the value of Chow Statistics (F_{stat}) is greater than F_{table}, then the null hypothesis is rejected so that the model we use is the fixed effect model and vice versa. While the Hausman test is used to select the method of fixed effect or random effects method, if the value of Hausman test result is greater than the table, then the null hypothesis is rejected so that the model being used is the fixed effect model and vice versa. Because this determination test is very important to determine the methods to be used, it will be conducted gradually and systematically after seeing the results of the three methods above.

1. Pooled Least Square Method of Provincial

In this method, there are 168 observations and each variable (capital, labor, and education) has a positive and significant impact on economic growth variables. Adjusted R square coefficient in this method is 0.8649, explains that the independent variables in this capital, labor and education can explain the formation of Indonesia's economic growth by 86.5%, while the remaining 13.5% are influenced by other variables outside the models such as trade, infrastructure, etc.

In this method, each increase of 1% in the education variable will increase 1.684% economic growth with the assumption that other variables are constant. The results of the estimation of the PLS method states that the contribution of education variable is larger than the other two variables contribution to economic growth, in which increased 1% variable capital will raise 0.409% economic growth. The labor contributes only 0.392% to economic growth. It means that the contribution of education variable four times larger than the contribution of two other variables. These results seem to fit with what has been hypothesized where the effect of education is significant at 1% level, as well as the labor and capital. But as explained earlier, there are flaws in this method where the PLS method actually assumes the same intercept and slope between the provinces, of course this is less realistic in which each province should have a different intercept and slope over time.

Considering the exploitation features that provided by the E-Views 6, since this package software provides an option for setting the assumption of cross and the period, it helps us to see the results of this exploration. For a fixed period, it is found that the influence of educational variables are positive and significant at 1% level, it applies to labor and capital variables. The contribution of education is also greater than the labor and capital variables where each increase of 1% in education will lead to 1.779% increase in economic growth, larger than capital and labor (0.374% and 0.488%). The adjusted R^2 value increased by 95.84%, this result shows us that, now the independent variables are better to explain economic growth by using periods that are considered to be permanent. The problem here

Table 1. Estimation Result: Pooled Least Squares
(Dependent Variable: Economic Growth, Y?)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Capital (LOG_K?)	0.408694	0.026009	15.71367	0.0000
Labor (LOG_L?)	0.391911	0.040720	9.624544	0.0000
Education (LOG_H?)	1.683975	0.225529	7.466778	0.0000
R-squared	0.866536	Mean dependent var		7.284958
Adjusted R-squared	0.864919	S.D. dependent var		0.677231
S.E. of regression	0.248906	Akaike info criterion		0.074210
Sum squared resid	10.22241	Schwarz criterion		0.129995
Log likelihood	-3.233600	Hannan-Quinn criter.		0.096850
Durbin-Watson stat	0.472649			

lies in which the value of the constant is negative and not significant.

Furthermore, with random period based on the Wallace-Hussain method, it is found that the influence of education was again positive and significant at 1% level (as well as with capital and labor variables), where each 1% increase in education will increase economic growth by 1.836% (0.374% to 0.491% for capital and labor), but the constants are insignificant and negative. This method does not provide a intercept for each province. The results of both Swamy-Arora method and Wansbeek-Capteyn method are not much different, but this paper will specify to use the method of Wallace-Hussain for the method of estimation, because the method of Wallace-Hussain estimator is considered to be able to more explain the components of variance.

Table 2. Estimation Result: Fixed Effect Model
(Dependent Variable: Economic Growth, Y?)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.424385	0.306946	-1.382604	0.1688
Capital (LOG_K?)	0.374336	0.017451	21.45060	0.0000
Labor (LOG_L?)	0.488838	0.035179	13.89579	0.0000
Education (LOG_H?)	1.779974	0.274011	6.495994	0.0000
Fixed Effects (Period)				
1996--C	0.093491			
1997--C	0.030292			
1998--C	-0.164786			
1999--C	-0.213649			
2000--C	-0.229451			
2001--C	-0.229256			
2002--C	-0.262377			
2003--C	-0.282138			
2004--C	0.215984			
2005--C	0.208489			
2006--C	0.202020			
2007--C	0.209073			
2008--C	0.211476			
2009--C	0.210833			
Effects Specification				
Period fixed (dummy variables)				
R-squared	0.962452	Mean dependent var		7.284958
Adjusted R-squared	0.958473	S.D. dependent var		0.677231
S.E. of regression	0.138007	Akaike info criterion		-1.027329
Sum squared resid	2.875931	Schwarz criterion		-0.711214
Log likelihood	103.2957	Hannan-Quinn criter.		-0.899034
F-statistic	241.9066	Durbin-Watson stat		0.388105
Prob(F-statistic)	0.000000			

Table 3. Estimation Result: Random Effect Model
(Dependent Variable: Economic Growth, Y?)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.482549	0.323061	-1.493675	0.1372
Capital (LOG_K?)	0.373657	0.018164	20.57142	0.0000
Labor (LOG_L?)	0.491101	0.036620	13.41062	0.0000
Education (LOG_H?)	1.835891	0.284193	6.460010	0.0000
Random Effects (Period)				
1996--C	0.091786			
1997--C	0.030947			
1998--C	-0.157393			
1999--C	-0.204024			
2000--C	-0.219246			
2001--C	-0.219175			
2002--C	-0.251874			
2003--C	-0.271035			
2004--C	0.206452			
2005--C	0.199297			
2006--C	0.192842			
2007--C	0.199412			
2008--C	0.201524			
2009--C	0.200486			
Effects Specification				
			S.D.	Rho
Period random			0.202070	0.6641
Idiosyncratic random			0.143726	0.3359
Weighted Statistics				
R-squared	0.947714	Mean dependent var		1.465223
Adjusted R-squared	0.946758	S.D. dependent var		0.602173
S.E. of regression	0.138947	Sum squared resid		3.166235
F-statistic	990.8686	Durbin-Watson stat		0.402733
Prob(F-statistic)	0.000000			
Unweighted Statistics				
R-squared	0.869041	Mean dependent var		7.284958
Sum squared resid	10.03058	Durbin-Watson stat		0.488878

2. Fixed Effect Method and Random Effect Method of Provincial

As we see above, although the PLS method provides acceptable results, but still has some weaknesses which assumes the same intercept between provinces, although in fact this condition is not acceptable even if random period between provinces can be assumed. So that would be better if we tried another method and see the results in accordance with a reasonable assumption. This paper assumes that each region has different characteristics over time, this assumption is considered to be more powerful and plausible if it is assumed that there are fixed effects over time. With the fixed effect method, the following results was obtained:

Table 4. Estimation Result: Random Effect Model
(Dependent Variable: Economic Growth, Y?)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.376227	0.816371	6.585516	0.0000
Capital (LOG_K?)	0.093660	0.031481	2.975165	0.0034
Labor (LOG_L?)	0.031839	0.072965	0.436365	0.6632
Education (LOG_H?)	1.074859	0.757573	1.418818	0.1580
Fixed Effects (Cross)				
_BENGKULU--C	-0.665246			
_JAMBI--C	-0.395618			
_YOGYA--C	-0.266771			
_KALTENG--C	-0.342500			
_SULTRA--C	-0.587316			
_SULTENG--C	-0.441938			
_SUMUT--C	0.261625			
_RIAU--C	0.194812			
_JAKARTA--C	0.571317			
_JABAR--C	0.659657			
_JATIM--C	0.748487			
_KALTIM--C	0.263490			
Random Effects (Period)				
1996--C	-0.161055			
1997--C	-0.178040			
1998--C	-0.258556			
1999--C	-0.260356			
2000--C	-0.254778			
2001--C	-0.242791			
2002--C	-0.246364			
2003--C	-0.240746			
2004--C	0.266394			
2005--C	0.284119			
2006--C	0.296665			
2007--C	0.315145			
2008--C	0.334547			
2009--C	0.345817			
Effects Specification				
			S.D.	Rho
Cross-section fixed (dummy variables)				
Period random			0.180224	0.8133
Idiosyncratic random			0.086337	0.1867
Weighted Statistics				
R-squared	0.992929	Mean dependent var		7.284958
Adjusted R-squared	0.992282	S.D. dependent var		0.600368
S.E. of regression	0.052742	Sum squared resid		0.425604
F-statistic	1534.718	Durbin-Watson stat		0.380519
Prob(F-statistic)	0.000000			
Unweighted Statistics				
R-squared	0.833927	Mean dependent var		7.284958
Sum squared resid	12.72007	Durbin-Watson stat		0.285878

From the results, it could be seen that education and the workforce have no significant effect, the only significant variable is capital. But from the results above it can be seen that each region has a varying intercept in which the province of East Java has the highest intercept, followed by West Java, Jakarta, East Kalimantan, North Sumatra, and Riau. In accordance with actual conditions, these provinces are provinces that are categorized as provinces with high economic growth earlier. As the provinces have been classified, the province that have relatively low economic growth are clearly described as having a negative intercept. The weighting results in that the independent variables can explain 99.22% of the economic growth, while the rest was influenced by other variables outside the model. However it is a need to see Chow test and Hausman test to determine the best method of the panel. Another estimation by using random effects should be conducted. However, firstly researchers must assume the best condition that comes closest to reality. It is assumed that each region should have a different intercept and a random period that also across regions. So with uncertainty assumption explained in the error, the results will be obtained with the method of random effects as follows in Table 5.

The results of random method above are better in a way that all variables have positive and significant at 1% level. In addition, the education variable still has the greatest contribution of the other variables. Then we also see, now every province still has the intercept as we expected, East Java are still occupying the top position followed by East Kalimantan, Jakarta, West Java, Riau, North Sumatra. From this result, it can be concluded that the economic growth of Bengkulu is the lowest amongst others. Consistent with the data from all provinces, Bengkulu is a province with the smallest share of economic growth.

3. Chow Test versus Hausman Test of Provincial

As we emphasized earlier, this Chow test will compare the PLS method and the fixed effect method, we obtain the result that the value of the Chow Statistics (F_{stat}) equal to 10.7221 and the value F_{table} 5% is 1.87, and since F_{stat} is greater than F_{table}, then the null hypothesis is rejected so that the model we use is the fixed effect model. The method of fixed effect looks better than PLS method since this method allows for intercept differences between provinces. In contrast with ordinary PLS method in which researchers have difficulty in explaining the differences between regions which is very important. By considering the Hausman test it is allowed to compare between the fixed effect method and random effect method, this test will be selected from the appropriate method to be used. The null hypothesis of Hausman test is as follows (see Table 6):

H0: random effect model

H1: fixed effect model

From the Hausman test results, we got the result that the value of Chi-Sq statistic is smaller than the Chi-Sq table, and note that the probability is not significant at 1%, 5%, even 10%. So it is concluded that H0 is accepted while H1 is rejected or using random effects methods.

4. Discussion

The estimation results show that capital and labor have a positive and significant effects in boosting economic growth. From three variables estimated, it is found that education is the most dominant influencing variable in Indonesia's growth. Based on partial analysis, it is proven that the estimation result is in accordance with the real conditions. The provinces with high Gross Domestic Product Regional show consistent results compared with provinces that have low Gross

Table 5. Estimation Result: Two-Way Random Effect Model
(Dependent Variable: Economic Growth, Y?)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.673487	0.529681	3.159426	0.0019
Capital (LOG_K?)	0.243505	0.022666	10.74315	0.0000
Labor (LOG_L?)	0.355435	0.049523	7.177240	0.0000
Education (LOG_H?)	1.564704	0.495991	3.154699	0.0019
Random Effects (Cross)				
_BENGKULU--C	-0.350925			
_JAMBI--C	-0.187211			
_YOGYA--C	-0.094648			
_KALTENG--C	-0.114346			
_SULTRA--C	-0.236511			
_SULTENG--C	-0.137355			
_SUMUT--C	0.039432			
_RIAU--C	0.069137			
_JAKARTA--C	0.236754			
_JABAR--C	0.185961			
_JATIM--C	0.347138			
_KALTIM--C	0.242574			
Random Effects (Period)				
1996--C	-0.017709			
1997--C	-0.052966			
1998--C	-0.203667			
1999--C	-0.230584			
2000--C	-0.236866			
2001--C	-0.231523			
2002--C	-0.253683			
2003--C	-0.261233			
2004--C	0.235030			
2005--C	0.238109			
2006--C	0.240215			
2007--C	0.251484			
2008--C	0.259936			
2009--C	0.263458			

Effects Specification

	S.D.	Rho
Cross-section random	0.126937	0.2444
Period random	0.203948	0.6310
Idiosyncratic random	0.090601	0.1245

Weighted Statistics

R-squared	0.609321	Mean dependent var	0.770958
Adjusted R-squared	0.602175	S.D. dependent var	0.123721
S.E. of regression	0.078035	Sum squared resid	0.998667
F-statistic	85.26073	Durbin-Watson stat	0.622159
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.773249	Mean dependent var	7.284958
Sum squared resid	17.36756	Durbin-Watson stat	0.240033

Table 6. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	63.217750	3	0.0000
Period random	1.888938	3	0.5958
Cross-section and period random	0.000000	3	1.0000

Regional Domestic Product. The results show that East Java province has the highest economic growth which followed by the East Kalimantan, Jakarta, West Java, Riau, and North Sumatra respectively. Areas with low Gross Domestic Product Regional show a negative intercept. Province with the lowest economic growth is Bengkulu. From the estimation, researchers found that education has positive and significant impact in economic growth in Indonesia, an increase of 1% on education will lead to increased economic growth for 1.56%, and an increase in capital and labor for 1% respectively would increase the economic growth about 0.24% and 0.36%.

The aforementioned result shows that education has the greatest impact on economic growth. This impact is four times greater than the impact of labor on the growth and six times greater than the impact of capital in Indonesia. In this model, independent variables can explain the economic growth for 77.32% and the rest of 22.68% is explained by other variables outside the model. Given the great scale impact of education on economic growth in Indonesia during the period, if the average education in a country has an effect on the growth of output, then we have positive externalities on education. Externalities are also an indicator for the policy (Aghion & Howitt, 1998), it is a wise decision if the government can take policies that are positive in the field of education. Because education is believed to assist in the process of technology transfer in Foreign Direct Investment (FDI), it is recommended that government policy is not limited in the field of education alone, but also in investment and employment policies. Magnitude estimation technology in which we do by 1.67%, we strongly suspect that education is indeed operating at the proper lane, with highly educated labor and have good skills then it will tend to attract foreign investment into Indonesia. It is also acceptable in which human capital acts as an important input in innovation activities and R & D, then the results found are also sufficient to prove the opinion of some economists who proposed that the tendency of foreign investors in transferring technology through Foreign Direct Investment (FDI) by looking at the presence or absence of high educated workforces who are capable in handling the newer methods and more complex procedures. It is in line with the Schumpeterian hypothesis proposing technologically advanced countries usually have educated population and high income level economy that the population with better education that developing countries do. Indonesia itself has an average number years of school above the standard of developing countries set by United Nations Development Program (1994) in which 1.4 years greater for men, but still lower for women. Therefore education policy for women that considers the role of labor in this study is significant, even larger than the capital (0.36% > 0.24%).

Furthermore, action that need to be done by the government is to encourage provinces that are considered to have a low economic growth, the estimation results show that almost none of provinces with low GDP has a positive intercept, even with fixed effect method. This further reinforces the notion that indeed stills a high difference or high gap between rich and poor provinces. All the provinces with high growth are almost residing on the Java Island. From the results was also obtained that the Yogyakarta is the only province in Java which has a negative intercept, but the value is relatively small so we were more in agreement to classify them to transition province from the province with a small growth leading to the provinces with high economic growth. From the outside corridor of Java, only a few provinces have such encouraging growth such as Riau, East Kalimantan, and North Sumatra. But as we know these provinces still rely on natural resources as a driver of growth. One fundamental reason is that economic activity is still concentrated in Java, Central Bureau of Statistics (BPS) in 2010 showed that 58% is contributed by Java, followed by 23.1% contribution in Sumatra, Kalimantan and Sulawesi respectively 9.2% and 4.6% contribution to national GDP. So, with the acceleration and expansion of economic development through economic development master plan in the future, it is expected to push economic growth above 7% per year. Therefore, the government must speed up economic corridor development plan in order to accelerate and expand national development, and each corridor must have main economic activities for boost their growth.

Reviewing back at the results of the random effects method, it would make sense to continue using this result. Each province shows that its real characteristics based on the data. Presumptive the factors affect economic growth, East Java is a province that most developed and has an advanced industrial sectors and services. This province has a relatively high economic significance, which contributes 14.85% of the national Gross Domestic Product. Besides having a large number of industries, East Java is also having the highest number of university in Indonesia. With the advanced manufacturing sector (PT PAL in Surabaya, a major shipbuilding company in Southeast Asia, PT INKA in Madiun, PT Tjiwi Kimia paper mill in Sidoarjo and PT Leces in Probolinggo; Wismilak cigarette factory in Surabaya and Gudang Garam in Kediri , Sampoerna in Surabaya and Pasuruan and Bentoel in Malang; Semen Gresik and Petrochemical) make this province as a promising area for foreign investment and ultimately will create huge job opportunities. While the East Kalimantan is a region produce of oil, natural gas and coal. Another emerging sector is the agriculture, tourism and manufacturing industries. Foreign direct investments (FDI) also often go into the province because of its natural wealth. Not much different from East Kalimantan, North Sumatra is rich in natural resources such as natural gas, the rivers in the mountains around Lake Toba is also a considerable potential natural resource to be exploited that is a source for hydroelectric power. Asahan hydropower which is the largest hydro power plant in Sumatra, located in Toba Samosir regency. In addition, in the mountains there are many geothermal hot spots are very likely to be developed as a source of heat energy and steam which can then be transformed into electrical energy. The province is also famous for its plantation area. Until now, the plantation continues to be the belle in North Sumatra, plantations are managed by private companies and the state. Riau is one of the richest provinces in Indonesia, this province has natural resources such as oil, gas, and gold, and the wealth of forest and plantations, and then it still has the wealth of the rivers and the sea.

In other regions in Java, West Java for more than three decades has experienced rapid economic growth. Today marked an increase in the modern economy with an increase in manufacturing and service sectors. In addition to social and infrastructure development, most manufactures contribute through investment, nearly three-quarters of industrial non-oil manufacturing industries centered around West Java. West Java GDP in 2003 reached Rp 231.764 billion (U.S.$ 27.26 Billion) accounted for 14-15 percent of national GDP, the highest figure for a province. However, because of population size, GDP per capita in West Java was Rp 5,476,034 (U.S.$644.24) including oil and gas, represented 82.4 percent and 86.1 percent of the national average. While the neighbor of West Java, Jakarta is an advanced province. At the same time, Jakarta is also a center of business and finance. Currently, more than 70% state money circulating in Jakarta. Jakarta is one of the cities in Asia with a sizable middle class society. In 2009, 13% of the people of Jakarta income above U.S.$10,000. This amount, places Jakarta parallel to Singapore, Shanghai, and Mumbai. With so much potential in these rich provinces, it is possible if they are included in provinces with high growth economic, and this is consistent with the research results. Its contrast happening in the slowly growing province such as Jambi, since the potential resources have not been optimized, as well as Southeast Sulawesi, Central Kalimantan, and other areas.

From the technological point of view, from the results obtained, it is shown that the East Java technology coefficient is 2.0206> 1, which means the province of East Java have the most advanced technology among the other provinces followed by the East Kalimantan and successively other advanced areas. This is because the corridors of Sumatra and Kalimantan has been designed as the centers of production, crops and barns processing, and national energy, then corridor of Java as a driving force of national industries and services, and from time to time these provinces tend to use capital-intensive investments that also tend to have more advanced technology. With the transfer of technology into the capital, coupled with increased education will result in high economic growth, and vice versa.

While other provinces have adopted the technology that looks forward, but inequality still prevails in which the value of technology is partially showing negative numbers for the regions that are classified as having a less rapid growth. For example, Bengkulu is still a province that has the lowest technology than any other area which is equal to 1.32. To keep in mind, that technological progress is not solely the progress in methods, processes, and equipment industry in the economy, but also includes such conversion efficiency from input to output, ideas, and even because of high unemployment. Unemployment can be caused by lack of capital accumulation that stimulates economic activity, so the available labor cannot be absorbed fully in the economy. By contrast this is not happening in provinces which have a relatively high amount of investment both Domestic Investment (PMDN) and Foreign Direct Investment (FDI) such as East Kalimantan, East Java, North Sumatra, Riau, and Jakarta. East Kalimantan and Riau are famous for its abundant natural resources, as the main producer of national oil and gas. The calculation results Tadjoeddin *et al.* (2001) showed that the GDP of 7 regional oil and gas center in Indonesia, namely North Aceh, Riau and Bengkalis, Kutai, Bulungan and Balikpapan, and Fakfak (Papua) controls 72% of national oil and gas GDP. The result of this calculation shows that all these areas with a population of only 9% of the total population of Indonesia contributed 33% of National GDP.

But, one fact that is in concern is that if aggregate output is calculated without the oil and gas, the GDP contribution of the oil-rich regions such as Riau and East Kalimantan will become smaller. Riau and East Kalimantan accounted for 5% of Indonesia's GDP, whereas if no role of oil and gas is only 2%. However, in 2000, the contribution of regional output produced by the East Kalimantan with support of oil and gas sector declined to 1.6%, while in Riau increased to 5.4%. It also provides an indication that the oil and gas well not the only factor of economic performance in a rich region. It means that there are other growth factors that can explain the economic growth of a region such as education, trade, infrastructure, etc. In this paper, we prefer to conclude more generally that the path of economic growth is not solely viewed from the capital, labor, and human capital. This model is simpler way of a more complex model, and to view and analyze on a more complex model we need to know through what channels the real economic growth occurs. As many researchers stated that: *this area leaves a number of challenges and questions, so more works are awaiting to be done*.

CONCLUSION

This paper has applied panel data estimation procedures to investigate the impact of education on economic growth in Indonesia during the period starting 1996 to 2009. The empirical work also highlights capital and labor input as some of the key variables that seem to affect the economic growth performance of the country. The results indicate that average education per worker is positively correlated with economic growth.

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