Human Capital, Difussion Model, And Endogenous Growth: Evidence From Arellano-Bond Specification

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Abstract

Human Capital is undeniably a very important factor for economic growth. In this paper, we investigate the impact of Human Capital on growth using the Neoclassical and Endogenous Growth models. We use the Generalized Method of Moment (GMM) method with 8 different Human Capital proxies measured in terms of quantity and quality of education. Using the LSDV method, we find: (i) Human Capital plays a significant role in explaining growth, (ii) Identical initial technology assumption cannot be ignored in the growth model, (iii) The selection of proxies in terms of quantity and quality of education is very influential on the conclusion of the impact of Human Capital. to growth. With the GMM method, it is concluded that followers will diffuse to catch-up leader, while countries that are close to the leader will take advantage of the power of innovation. Our results also reinforce the view that trade and institutions are two of the most influential factors in our model. Finally, it is important to examine the issue of income inequality in developing country growth models and the issue of reverse causality between education and economic growth.

Keywords: Human Capital, Education, Endogenous Growth, Generalized Method of Moment (GMM).

1. INTRODUCTION

Economic growth is undoubtedly an interesting issue in the last several decades, even up to now. Lipsey et al. (2005) stated the reason why many economists often focus on economic growth rather than changes in the economy due to the strength (power) of the growth itself. This is acceptable when the growth in GDP is easy to measured using factor accumulation. Initially many researchers used the Neoclassical growth model to predict growth in many countries including developing countries, but in the last two decades many experiences have shown conditions of divergence compared to convergence in these countries and growth

failure in less developed countries. Some experts states when the trend of this phenomenon will be found in less developed countries, the economist so far does not have a set of concepts that can explain why this case happened. Assumptions identicaltechnology across countries are present because the experts did not have a satisfactoryexplanation about the forces that can explain the differences in income between countries. Because the growth failures in many developing countries, many economists believe that the main reason of bad experience in poor countries and developing countries is actually because the error predictions that provided by the 'old' growth model. The assumption of identical initial technology on the Neoclassical growth cannot be accepted so that a number of fundamental growth factors retested for reliability. One of the factors agreed to have a central role in long term growth is Education. Even the issue of growth is now moving about the influence of measures of quantity and quality of education and the appropriate proxy for

representing education, all these facts and questions brings many experts on the birth of the Endogenous Growth Theory (Uzawa, 1965; Nelson and Phelps, 1966; Lucas, 1988; Romer, 1986 and 1990; Aghion and Howitt, 1998, etc).

Some economists themselves assess that Endogenous Growth as the renewal of the Neoclassical growth model than a theory that actually derive the new variables in the model (Islam, 2004). One of the advantage that assessed in Endogenous Growth model is can improve the previous growth assumptions and its relevance to the conditions of many developing countries to grow parallel with the developed country. In contrast to the Neoclassical model assumes exogenous technology, the Endogenous Growth model given the assumption that technological progress or Total Factor Productivity is actually derived from other variables in the model—i.e. Education or Human Capital. Then the implications of this view is to make technological progress or TFP (Total Factor Productivity) is better viewed as an endogenous variable than exogenous. The other effects are very different from the previous growth explanation is now in Endogenous Growth model have other growth explanation through productivity than just growth effect. To meet this assumption, thenformula the Endogenous Growth envolves by allowing two important terms derived from educational variables namely the ability to innovate domestically (inovated term)[1], and the ability to adopt technological advances (difussion term) which available on the broad economy[2]. So, the privilege of this Endogenous Growth Theory that we can see: first, withthe catch-up term, the developing countries are expected to be able to explain or resolve the income differences between countries. Second, the derivation of the other variables in the model, it is possible to derive the relevant policy for developing countries. It seems to many researchers this model is more promising than the "exogenous" model. With the two assumptions above, then the follower is expected to be able to grow faster and catch-up the leader in finite time. The Nelson-Phelps diffusion model has undeniably brought enthusiasm and fresh air to less developed countries. Several attempts have been made by researchers by emphasizing this model as has been done by Ben Habib dan Spiegel (1994, 2000, and 2002), Islam (2004), Kumar (2006). For Indoensia these model has been investigated by Reza dan Handoko (2013), Reza dan Widodo (2013), dan Reza (2017).

This paper aims to investigate the impact of human capital on growth in Indonesia by using Neoklasik dan Endogenous Growth model. Since there was some debate about the most appropriate proxy for education, we will also use some of the available proxies to examine the

impact of human capital on economic growth. In this paper, we will use 8 education proxies which are divided into proxies that represent the quantity and the quality of education. We use Static Panel and Dynamic Panel Estimator for each growth model. First we will test the Neoclassical model with the addition of human capital, then we will also use Endogenous Growth with the Nelson-Phelps model (1966) that developed by Benhabib and Spiegel (1994) to enrich our conclusions. Neoclassical growth with the addition of separate human capital variable in the model trusted by most economists is a model with satisfactory performance in investigated impact human capital on growth. While on the other side Endogenous Growth developed by many other experts afterwards believe has been offering

[1] Romer (1986) introduced the concept of knowledge accumulation, and Lucas (1988) with concept of humancapital externalities.

[2] Nelson-Phelps (1966) with economic diffusion that facilitated by education.

property and better model 'stability'. The expansion of the concept of productivity in the Endogenous Growth allows for innovation and diffusion of technology and the nature of stressing in the role of education resulted possibility for us to find what exactly way human capital operated in affecting economic growth. The rest of this paper is organized as follows: part 2 describes the theoretical framework. Methodology are presented in part 3. Estimation results and discuss are presented in part 4. Last, some conclusions are presented in part 5.

2. THEORETICAL FRAMEWORK

2.1. DEBATE REGARDING THE EDUCATION AND ECONOMIC GROWTH CAUSALITY

Until now causal effect of education on economic growth can be said still debatable and still attract discussed, the importance of education has brought us into a lot of studies on economic growth. The attention of many economists about Endogenous Growth began when Romer (1986) introduced the existence of knowledge accumulation. Then Lucas (1988)specifies the importance of human capital for economic growth with the ability education to generate technology as a source of long term growth[3]. Then Romer (1990) with his influenced article about the issue of economic growth also revealed the similar things where human capital has enormous power in determining economic growth, more than Neoclassical thinked before. The positive impact of human capital is recorded in the efforts of several researchers such as Benhabib and Spiegel (2000) who found significant effect of educationon growth with technological catch up. Mariana (2015) concludes that education in higher education has a positive and significant effect on growth. Even Glaeser et al. (2004) stated that human capital is a more important source of growth than institutions. Efforts to investigate the impact of education on economic growth in Indonesia actually have been carried by Reza and Handoko (2013) using the Endogenous Growth model. They use the highest educational attainment equivalent to Senior Secondary School by labor. Using panel data, they found that provinces in Indonesia are constantly innovating, while poor regions take advantage of technology diffusion. They also use alternative educational pathwaysthrough physical capital to examine the role of education on growth.

Then Reza and Widodo (2013) use the Mean Years of Schooling to estimate the impact

of Human Capital on Indonesia's growth with the Augmented Solow Model finding that a 1% increase in education will increase 1.56% of output. They concluded that the Augmented Solow Model can explain the relationship between education and economicgrowth in Indonesia. Regarding proxies that reflect the quality of education, research by Hanushek (2013) concludes that although developing countries are increasingly closing the gap in terms of educational attainment, but without improving the quality of education, it willbe difficult to improve their long term economy. Hanushek and Kimko (2000) concluded that the impact of education on growth would be greater if measured in terms of quality than quantity. Without measuring the quality of education will eliminate the importance of education for growth. But in other side Pritchett (2001) found that education is not an important variable or powerful variable in explaining economic growth. Kumar (2006) with

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[3] Human capital ini this term are investment in education, R&D, organization learning, training, or even self-training. In this paper we assume human capital as an formal education from formal schooling.

Endogenous Growth model actually found the absence impact of education on economic growth. Reversed causality between education and growth is also expressed by other researchers such as Bils and Klenow (2000) which stated that growth causes increase in Years of Schooling. Mehrara and Musai (2013) examined the causal relationship between education and GDP. They found that GDP affects education, not the other way. This is why large investments in education in developing countries fail to produce higher growth. However, Temple (1998b) states that the failure to see the connection between education and economic growth due to a sample bias by including some countries that have an exceptional case in their study. But one for sure in empirical research that human capital plays an important role in the growth process, but there are still unresolved questions in what way education can effect on economic growth.

2.2. ENDOGENOUS GROWTH THEORY

Neoclassical approach has more open the question on the minds of economists with some predictions—such as about how the role of human capital, exogenous technological progress, and the convergence between regions. To overcome the disharmony between the Neoclassical hypothesis and most empirical fact, many experts then release Neoclassical theoretical assumptions and move on Endogenous Growth theory to considered better in explaining the process of economic growth. One of the many efforts made by economists isto model the growth of endogenous technological progress by assuming that the technology isa function of education. This assumption drawned from the reason that an educated workforce will be better in terms of the creation, implementation, and behaviors to adopt newtechnologies that could result in economic growth. Then because Endogenous Growth allow the diffusion of technology which is based on education, technology diffusion assumption is then expected to be able to overcome convergence problems that arise in the countries of the world. Complementing this view economic will modeled experiencing diffusion of the technology i.e leader and follower, the follower would do imitations on leaders who innovate.And because

growth rate follower higher than leader, then the follower countries will begrow faster than leader country and tend to convergence through technological diffusion. Assumption of the diffusion of technology itself appear because identical technologies across countries in the Neoclassical view is unrealistic. Suppose country j and i are the leader and the follower, so gi can be considered as part of the growth rate of leader technological progress who are also part of the world technology, gF, and the difference in growth rates of technological progress between the follower and the leader, gdi, or if its written into another term:

$$g_i = g_F + g_{di} \dots\dots\dots (1)$$

If a country gain benefit from the technology diffusion g_{di} will be positive and indicates technologies converged. However, convergence does not guarantee applied in a country if the country fails to obtain gF resulting value g_{di} becomes negative (divergence)[4]. This is the point where g_i can be debatable because this point can also be said as a steady-

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[4] See Benhabib and Spiegel (2002) for details.

state in the Neoclassical view— this is because the changes in that value can occur in the scenario above, it can be positive and negative. Patterns of g_i will depend on the pattern formed g_{di}, even though g_{di} is positive, then when viewed dynamic over time this value will continue to shrink until it will close to zero, where it can be said that the follower country reduce the gap technology to leader country so they value are likely to zero, or we can be saidthere is an exhausted condition of technology diffusion for the country i. And because the Neoclassical model does not provide extent specifications for g_{di}, then it would be reasonable to assume that the distance between the initial level technology the leader, A_{0j}, and initiallevel technology follower, A_{0i}, is solely determined by the diffusion of technology. In contrast to the Neoclassical growth model, the Nelson-Phelps (1966) model states that therate of technological growth depends on the level of educational attainment and the gap between the "theoretical level of technology", T(t), and "level of technology in practice", A (t), so that by differential equation:

$$\frac{A(\dot{t})}{A(t)} = \varphi(h) \left[\frac{T(t)-A(t)}{A(t)}\right], \varphi'(h) > 0 \dots\dots\dots (2)$$

Based on equation (2) the increase in the rate of technological growth is an increase in the function of educational attainment and the "gap", $\left[\frac{T(t)-A(t)}{A(t)}\right]$. And because the technology of country i does not grow at the exogenous theoretical level of technology but at the growthrate of leader country j. So:

$$\frac{A(\dot{t})}{} = m(H) \left[max^{Aj(t)-Ai(t)}\right], i = 1, \overline{2, 3,\dots\dots n} \quad (3)$$

$A(t)$ i $Ai(t)$

Equation (3) is one source of technological improvement. Endogenous Growth also postulates another source of growth where human capital plays a role in creating and implementing new technologies in the production process with an exogenous growth rate of g(Hi). So that the ability of human capital to facilitate technology is written:

$$\frac{A(\dot{t})}{A(t)} = m(H_i) \left[max^{\overline{Aj(t)} - \overline{Ai(t)}} \right] + g(H_i), \quad i = 1, 2, 3, \ldots\ldots n \quad (4)$$

Based on the Endogenous Growth formula that allows the diffusion of technology anddomestic innovation. Even though a country has lower technology, but with higher human capital stock than the leader, it will be able to catch-up in finite time. So the catch-up speedby follower countries depends on the stock of human capital. On the other hand, countriesthat have the highest human capital will always maintain their position as leaders as long as there are benefits from Human Capital.

3. METHODOLOGY

We use panel data and dymanic panel estimator to estimate our model. The data used in this research comes from several sources, our Gross Domestic Regional Product (GDRP) data is taken from the Central Statistics Agency Republic of Indonesia, capital data is taken from the Indonesian Investment Coordinating Board which consists of domestic investment and foreign investment, our Labor data is taken from the National Labor Force Survey

(SAKERNAS) which is proxied by population aged 15 years and over with working status, Human Capital is measured through formal education with 8 different proxies consisting of Mean Years of Schooling (YoS), Gross Enrollment Ratio, Gross Enrollment Ratio for Junior Secondary School, Gross Enrollment Ratio for Senior Secondary School, Literacy Rate, Pupil-Teachers Ratio for Junior Secondary School, Pupil-Teachers Ratio for General Senior Secondary School and Pupil-Teachers Ratio for Vocational Senior Secondary School. Trade data is taken from the Ministry of Trade Republic of Indonesia which is measured by the ratio of exports plus imports to GDRP. Our institutional data is taken from Indonesia Democracy Indices. Finally, Financial Development data is measured from Bank Deposits to GDRP obtained from The Financial Services Authority of the Republic of Indonesia. To modeled the long-run growth we consider the equation as follows:

$$\text{Log } Y_t = \text{Log } A_t(H_t) + \alpha \text{Log } K_t + \beta \text{Log } L_t + \text{Log } \varepsilon_t \quad .... (5)$$

Endogenous Growth postulate that a country's ability to adopt and implement new technologies from the broad economy is a function of the education workforce, then thespeed of a country in pursue the leader (diffusion) is also a function level of education. Because TFP on the NGT model is assumed to depend on two channels as discussed above—
i.e. education effect on domestic innovation (domestic endogenous innovation) and the widespread diffusion of technology in the economy (catch-up the leader)—then TFP in equation (5) will be:

$$\text{Log } A_T(H_t) = c + gH_i + mH_i \, [(Y_{max} - Y_i)/Y_i] \quad ..... (6)$$

Where A = TFP/Solow's residual, c = constant, gH_i = endogenous technological progress that related with domestic innovation ability, and $mH_i \, [(Y_{max} - Y_i)/Y_i]$ = technology diffusion from broad economy where Y_{max} represented as TFP leader province, i.e. the province with the highest output. The above equation transforms exogenous technology on Neoclassical growth into technology which is a function of human capital. If equation (6) substituted with equation (5), then we will obtain Endogenous Growth equation with panel data as follows:

$$\text{Log } Y_{it} = c + gH_{it} + mH_{it} \, [(Y_{max} - Y_{it})/Y_{it}] + \alpha \text{Log } K_{it} + \beta \text{Log } L_{it} + \text{Log } \varepsilon_{it} \quad (7)$$

Equation (7) above is the main aim of the Endogenous Growth model who want to generate long-term economic growth in the model. Then for Dynamic Panel estimation of equation (7) we apply the Generalized Method of Moment (GMM) with the following specifications:

$$y_{it} = \alpha_1 y_{it-1} + \sum_{j=1}^{4} \beta_1 x^j + \mu_i + \eta_t + v_{it} \quad .... (8)$$

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Where y_{it-1} is lagged GDRP, χ_{it}^j are explanatory variables, μ_i is country-fixed effect where each province assumed to have different initial technology, η_t is period-specific intercepts, v_{it} is transitory error term. Lowercase letters in equation (8) are estimated in log form using the difference GMM method that was developed by Arellano and Bond (1991). Many experts argue that growth is also heavily influenced by other variables so that general spesifications follows:

$$gdi = f[\frac{A0j}{A0i} , X] \ldots\ldots\ldots\ldots (9)$$

Where (A0j/A0i) is technology gap between leader and follower, and X is another important variable vector. The variables considered relevant and have great influence such as trade (Yanikkaya, 2003; Hye et al., 2016; Idris et al., 2016; Jalil and Rauf, 2021), institutions (Yildirim and Gokalp, 2016; Bhattacharjee and Haldar, 2015; Ngo and Nguyen, 2020), financial development (Ang, 2007; Yucel, 2009; Hassan, M. Kabir et al., 2011; Kar et al., 2011).

Some researchers also believe growth is closely related to several variables such as improving education and health infrastructure, the integration of international financial markets, macroeconomic conditions, income inequality, etc. In this paper we also estimate the Augmented Solow Model with basic form:

$$Log\ Y_{it} = A + \delta Log\ K_{it} + \theta Log\ L_{it} + \gamma Log\ H_{it} + \varepsilon_{it} \ldots\ldots\ldots (10)$$

In this paper we also combine the data of East Kalimantan and North Kalimantan to overcome the lack of observations because the separation of provinces in 2012. So total number of provinces observed in this paper is 33.

4.   ESTIMATION RESULT AND DISCUSSION

Panel Data has been widely used in studies in economic growth. First, in this paper, we apply Panel Data using the LSDV method to examine the impact of human capital (education) on economic growth. As discussed in the methodology section of this paper, we use several different educational proxies. In (Table 3) we apply the LSDV Panel Data for the Neoclassical and Endogenous Growth model. In the Neoclassical model, it can be seen that the human capital variable can explain growth very well. The Human Capital variable showsa positive and significant sign in almost all proxies. While the Neoclassical[a] model is a Neoclassical model with the addition of an initial income variable. We include initial income in our model because initial income itself believed by many experts to be one of the variable that affect growth regression. After this variable entered in regression, there was a change in the sign of the Human Capital variable which was initially negative to positive. The strong conclusions that can be drawn are that: (1) initial income variable is an important variable in growth regression. (2) The Human Capital variable in the Augmented Solow model is undeniably a variable that influences economic growth. In contrast to the Neoclassical model,the spirit of Endogenous Growth hypothesizes that human capital affects growth in two ways,namely creating innovation and facilitating the diffusion of technology from followers to leaders.

Endogenous Growth analysis can be seen in column (3). There is a pattern ofinfluence of the Human Capital variable on growth where the human capital proxy which reflects the quality of education shows a positive sign on the Innovation and a negative sign on the Technology Diffusion variable. While the proxy that reflects the quantity of education shows a negative sign on Innovation and positive on Diffusion. The entire impact of human capital on growth is significant at the 1% level. These mixed results indicate that the selectionof proxies for education greatly influences conclusions about the impact of the variable itself.

In some cases of model (1b), the addition of the initial income variable is actually seen to change the significance of the Human Capital variable. However, we must be careful in interpreting this change, if the initial income agreed to be an important variable in the growth model, then it can be interpreted that this change is solely the real impact of human capital to growth. It is undeniable that the effect of initial income has been a serious concern by many researchers. Because empirically the income difference is allegedly caused by the irrelevant assumption of identical technology between countries, the lack of attention of the Neoclassical model on differences in productivity and technology between countries has forced researchers to reformulate the concept of Total Factor Productivity (TFP). In the concept of Endogenous Growth, the ability to innovate which is a function of the stock of human capital will be easily applied in technology advanced countries, while diffusion from the wider economy will be effective for areas with low growth. So to prove this prediction, we divide the samples into classes, namely 40 percent of the sample with low TFP (approximately the income of each province), 40 percent of the middle sample, and 20 percent of the sample with high income. (g) is predicted to be positive in the high and middle class, while (m) will be positive in the lower class. Model (2) in (table 4) is a static panel for the Endogenous Growth model which has been divided into classes.

As predicted, innovation has a positive and significant value in almost all Human Capital proxies categorized into upper and middle class provinces. However, the results are quite ambiguous shown by the provinces in the lower class where instead use diffusion, they actually do domestic innovation. Although the LSVD estimator is unbiased even at anunlimited number of N and T, but to avoid mis specified models and correlated error terms wewill consider using the GMM estimator in the next analysis. In the field of economics, the useof dynamic models is considered richer than static models. Besides being able to explore short term and long term effects, naturally the relationship between several variables is often influenced by the lag of the variable itself. In this paper we will use the GMM estimator with the First Difference GMM method that was developed by Arellano and Bond (1991). (Table 5) is the result of our estimation using the First Difference GMM estimator. In this time we use the entire sample with using different 8 education proxies. As in the LSDV model, Human Capital has a significant effect at the 1% level where now the sign of the coefficient depends on the addition of the Initial Income variable. For the Endogenous Growth model, again most of the proxies show the Innovation variable with a significant positive value and diffusion with a significant negative value. Except for the Literacy Rate and Pupil-Teachers Ratio for Junior Secondary School (JSS) proxies. A negative value on technology diffusion means that the follower will not catch-up the leader at finite time. Nelson and Phelps (1966) state effect of increasing human capital takes time to influence A(t) as well as its rate of change.

Many growth experts emphasize the important role of trade as a medium for technology diffusion. Apart from trade, another factor that is believed to greatly influence growth is institution. To see the impact of trade on diffusion, we insert these variables into our equation. We also include the Financial Development variable in model (6). The results of the expansion of the Endogenous Growth matrix can be seen in (table 6). After these important variables were included, the direction and significance of the Diffusion variable changed to positive and significant, while the Innovation variable was dominated by negative and significant signs. In Endogenous growth framework one consequence of trade is to increase the scale of operations which in the Neoclassical growth model is not permitted due to the assumption of Constant Return to Scale (CRS). Once the assumption of identical technology between countries is ignored, the diffusion of technology will play its role through trade. That is why the role of trade is very important in the study of the theory of Endogenous Growth. Our analysis supports this theory, Diffusion is positive and significant in almost all models. Again, Anomalies appear in the Pupil-Teachers Ratio for Junior Secondary School (JSS) where two of the four models show positive Innovation and significant negative Diffusion. In this analysis, the Financial Development variable is negative and significant for most models and human capital proxies.

The importance of Institutional variables also seen in the results of our analysis. This variable is positive and significant in a number of models and each human capital proxy. This indicates that human capital requires a good institutional environment to develop. The right policies will contribute to growth. Good bureaucracy will improve economic function and create efficiency. Anwar and Cooray (2012) emphasized that increasing political rights and civil liberties together with financial development contributed significantly to economic growth. Even Islam (2004) states that institutional improvement brings closer to the "source of miraculous growth". Despite the satisfactory performance of trade and institutions, the negative sign of Innovation may bring one question. Does innovation really not work in the provinces in Indonesia? To check it, we redivided all provinces into three equal classes[5]. The reason why our all samples are divided into three equal classes is because since the standard Dynamic Panel Estimator is not suitable for small number of N and large number of T, the 40-40-20 percentile scheme cannot be used. So we enlarge the range of the upper percentile by 10 percent more than in the previous analysis. We now have 10 cross-section units eachfor the upper and middle classes and 12 for the lower class. This extension gives us the advantage that dynamic panels can be implemented. This extension also allows us to dynamically examine human capital behavior across classes. Unlike model (3), we separate the Trade and Institution variables in this analysis to see the individual impact of these variables.

The results of the analysis can be seen in (table 7) where now the direction of the Innovation and Diffusion variables seems to follow the category. As predicted, the Innovation variable is positive and significant in the middle class, while Diffusion dominates in the lower class. This sign fits with our theory and predictions. But surprisingly, the provinces in the upper class are more likely to do diffusion for the catch-up leader. Why does innovation not work even for provinces that are close to the leader? We suspect that the failure of innovation to generate growth is caused by two reasons. First, the failure of innovation is not solely due to the unequal distribution of education (quantity and quality), but is also influenced by the issue of income inequality. There are only 8 provinces with an average income above the national average. This means that only 24% of the province can be said to live above the

national average. In fact, when viewed from the duration of schooling, there are 21 provinces with Mean Years of Schooling achievement above the national average.

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[5] We divided all provinces in 30-30-30 percentile scheme, exactly 33 percentile for each class. The difference between 30 and 33 percentile has no effect on our number unit cross-section.

From these 21 provinces, unfortunately only 6 provinces are categorized as having income as well as education above the national average. (Figure 1) explains how in our analysis provinces with high education do not always have high incomes. Then we divide the provinces in Indonesia into 4 quadrants showing the relationship between education and income.
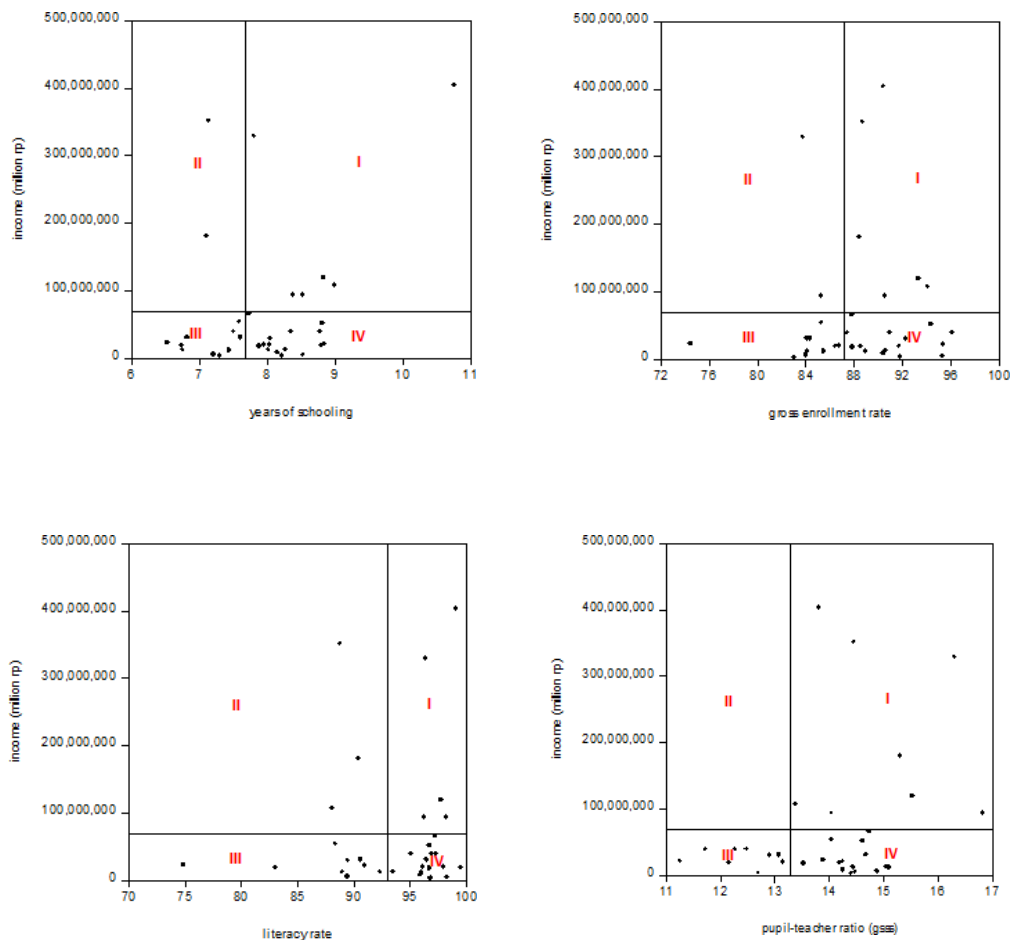
Picture 1. Educational Attainment vs Income

The vertical line is the national average line of education which shows the boundary between low and high education, while the horizontal line is the average line of national income which shows the boundary between low and high income. So quadrant I contains provinces with high education and income, quadrant II contains provinces with low education and high income, and

so on. We hope that higher education will bring the province to high income too. But it is clear that most of the samples are clustered in quadrants III and IV. So even though the educational attainment of the provinces in Indonesia is quite satisfactory, there is no guarantee that these provinces will enjoy high incomes as well. Around 57%-72% of provinces in Indonesia have good educational attainment in all the proxies we researched. However, like most other developing countries, the strategy of increasing educational attainment is not always followed by an increase in the economy. So now where is the link between education and growth?. The second reason is the possible feedback effect from income to education. Endogenous growth with the diffusion model that we analyze postulates that even though a country has a lower initial technology than the leader, but with a higher level of education it will be able to catch-up the leader in a finite time period. As an example for the Mean Years of Schooling proxy, from our sample there are only two regions with highincomes but have educational attainment (Mean Years of Schooling) below the national average. The rest of the provinces with high income are provinces with high educational attainment as well. However, the Endogenous Growth model that we estimate does not consider this reverse causality, a tendency appears that not all regions with above-average educational attainment have high incomes. The long transition period causes the impact of Human Capital to not be fully visible because the rate of technical progress in practice depends on two things: namely the length of the duration of the new technology and the benefits of the new technology. So it is clear that if innovation is still considered as "expensive goods", then it will be easier to do diffusion than innovation.

5.   Conclusion

Using the difference GMM, the results of our analysis reveal several important facts about the interaction between education and growth in Indonesia. First, we find the importance of diffusion for the regions of Indonesia in pursuit of convergence. This study also supports the argument for the importance of the other factors such as trade and institutions as in many growth reports. An important symptom of the weak power of innovation generated by education will be a major task for the Indonesian government to create how Indonesia's educational environment can act as an engine of long-term innovation.

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