Understanding Indonesia's Economic Growth: A Solow Model Growth Theory Approach

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Abstract—Explaining the determinants of economic growth can be overwhelming. It ranges from economic factors such as consumption, export, and factors of productions; as well as other factors such as geography, technology, infrastructure, and even corruption. This paper analyzes Indonesian economic growth by looking at the basic determinants of economic growth, which is the ability to produce goods or in other words looking from its production side, using the "Solow Model of economic growth with human capital" which captures this basic idea. The discussion is extended by comparing to other countries to see the policy implication that explains those factors.

Index Terms— Economic growth, Solow model, Human capital

I. INTRODUCTION

Indonesia is a large country with an enormous economic potential. It is home to 260 million people which made Indonesia the 4th largest country. It is the largest economy in the South East Asia with a GDP of around US$ 863 billion and a high economic growth ranging around 6% in the past few years. Indonesia even recorded higher economic growth during the global financial crisis compared to the other G20 members. These improving growth prospects and sound macroeconomic policy have made many analysts suggesting that Indonesia will become the newest member of the "BRIC" grouping of leading emerging markets.

Understanding Indonesia's economic growth means understanding what the story behinds it. That is, what are the driving forces behind Indonesia's well economic performance? Numbers of literatures and media suggested that Indonesia's economy is said to be supported by strong growth in consumption, investment, and exports. The contribution of export is said to be mainly driven by the abundant natural resources that Indonesia is endowed with. Along with the rising international commodity prices, both quantity and value of the Indonesian national export increased. In investment, Indonesia has implemented a series of economic policy packages which aimed at stimulating investment and infrastructure improvements and also implementing regulatory reform. The world seems to be optimist with Indonesia's business climate which resulted in a significant increase in investment. Meanwhile, the high domestic consumption is mainly supported by the government through lower interest rate and the existence of financial institution support.

In addition to this, consisting of 240 million people and being the second most consumptive country, Indonesia's market itself has been a source of the economic growth.

So do these factors represent the whole picture behind Indonesia's economic growth? Explaining the determinants of economic growth can somewhat is overwhelming. This is because when we're thinking about economic growth, we can come across so many factors that can potentially impact economic growth. Factors such as consumption, export, and abundant natural resources as described above for Indonesia are probably true. However, one might think that other factors such as capital stock, labor participation, trade, human capital, geography, technology, infrastructure, or even corruption can also be potential determinants of economic growth. And the list continues. To start analyzing economic growth, we can start by looking at the basic determinants of economic growth which is the ability to produce goods. In other words, explaining economic growth from the production side instead of the demand side. The Solow Model of economic growth captures this basic idea. Basically the Solow Model analyzes how real output is determined by two important inputs which are labor and capital, and combines them by technological progress or "knowledge". Adding to this, human capital is another factor that is seen to be very influential in economic growth. Based on Mankiw, Romer, and Weil (1992), the empirical study suggested that the basic Solow Model can be improved by including the human capital factor where human capital describes the different levels of education and skills in each country. This is known as the Solow Model with human capital. This paper is aimed to explain the determinant factors of Indonesia's economic growth based on this Solow Model with human capital model. The discussion is extended by comparing to other countries to see the policy implication that explains those factors. In addition, I will also go beyond the economic growth problem by discussing the relevant development issues faced by Indonesia. Other issues such as high unemployment rate, increasing health issues, and lack of infrastructure are also development problems that Indonesia is struggling with.

II. SOLOW MODEL WITH HUMAN CAPITAL

As explained earlier, there are myriad factors that can affect economic growth in a country, but we can broadly conclude that growth is basically determined by its ability to produce goods and services. The Solow Model with human capital suggests that production is conducted by using three important inputs:

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labor, physical capital, and human capital; and combines them with knowledge about putting those inputs together referred as technology. Thus, the production function is shown below:

$$Y = F(K, AH) = K^{\alpha}(AH)^{1-\alpha}$$

Where K is physical capital, H is skilled labor, and A is labor-augmenting technological progress that grows at constant exponential rate g. Meanwhile, we define H as follows:

$$H = e^{\psi u} L \quad \text{with } \psi > 0$$

This expression explains that individuals accumulate human capital by spending time learning new skills instead of working. Note that u is the fraction of an individual's time spent learning skills and L is total number of labor. The production function above can be transformed in terms of output per worker and thus we can solve for the steady state expression. The production function in terms of per worker is as follows:

With $h = e^{\psi u}$.

Since the Solow Model involves both production and capital accumulation function, then we take account the capital accumulation function as follows:

$$\dot{K} = s_K Y - dK$$

Based on the two functions, we obtain the steady state condition as follows:

$$y^*(t) = hA(t) \left(\frac{s_K}{n+g+d} \right)^{\alpha/(1-\alpha)}$$

Based on this steady state condition, we can conclude that countries can be rich if they have a high rate of investment (explained by Sk), large fraction of time is used to learn new skills (explained by h), population growth rate is small (explained by n), and have high level of technology (explained by A).

Growth Accounting

To see the contribution of the physical capital, human capital, and technology to the output growth, we can conduct a growth accounting based on Solow's simple accounting excercise (1957). Based on the process that Solow did, we derive the formula of growth accounting by taking the logs and differentiating the production function as follows:

$$\frac{\dot{y}}{y} = \alpha \frac{\dot{k}}{k} + (1-\alpha)\frac{\dot{A}}{A} + (1-\alpha)\frac{\dot{h}}{h}$$

This equation suggests that growth rate of output per worker is decomposed into the contribution of physical capital per worker growth, multifactor productivity growth (A), and growth in human capital investment. The term A here can be considered more than just technology. While we can obtain the data on output per worker, capital per worker, and human capital, we can compute the growth of A based on all those information. As

Jones (2002) explained, A can be seen as residuals, meaning that they incorporate any differences in production not factored in through the inputs. Furthermore, he explained examples that can be considered as A, namely the quality of educational systems, the importance of experience at work or on-the-job training, and the general health of the labor force. All these are factors contributing to productivity levels which are not explained in the model.

The data of real GDP and number of labor is obtained from the World Penn Table 7.0 and Indonesia Statistics Body (BPS). Meanwhile, the data on capital stock is obtained by using the perpetual inventory method which combines the investment data and depreciation rate. Investment data were also obtained from World Penn Table 7.0 and the Indonesian Investment Board (BKPM), while I use 6% for the standard depreciation rate.

The perpetual inventory method to construct capital stock is based on Caselli (2005). The formula used is K0 = I0/(g + δ) for the initial capital stock and K t = I t + (1 −δ)Kt−1 for the rest of following years. Since the data I am using is 1960-2011, then the initial year (0) for this case is 1960. Meanwhile, the parameter g is the average geometric growth rate for the investment series between the first year and 2011. Meanwhile, the data on human capital is obtained from the 2010 Barro and Lee dataset on Educational Attainment.1 The variable used here is the secondary-school enrollment of working-age population.

III. Growth Accounting Analysis

The observation that the Total Factor of Productivity (TFP) experienced a negative growth in most of the periods, contributing a lower output per worker growth. However, the negative TFP which was substantially large in the early periods has reduced along the time and since 1998 has shown a positive (yet small) growth. On the other hand, capital per worker and human capital has always experienced a positive growth, and thus contributing positively to economic growth. Human capital plays an important role in Indonesia's economic growth contributing more than 40% of the output per worker growth in most periods. In fact, in the periods where Indonesia experience high economic growth, human capital contributes far larger than physical capital and TFP. In times of crisis when Indonesia experienced a negative growth, capital and human capital still experience a slight growth. However, since the TFP growth was negatively large, the overall economic growth shows a downturn. Figure 1 captures the picture that while physical and human capital on average experience a positive growth, TFP goes in the other direction.

TABLE I: CONTRIBUTION OF INDONESIA'S ECONOMIC GROWTH

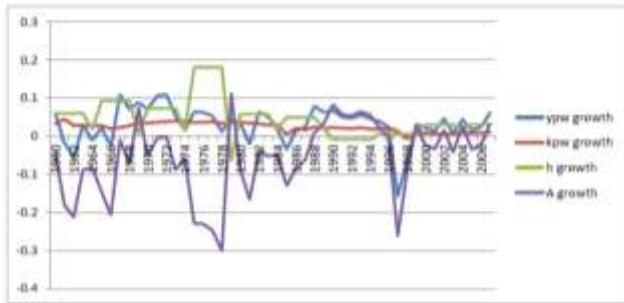|	1963-1966	1966-1982	1982-1997	1997-1998	1998-2008	2008-2011
Output per worker	0.39006807	7.75300809	5.26101069	-39.2221384	2.081426006	6.1219
Contributions from:						
Capital per worker	3.99592636	7.491054136	3.339601216	1.24113252	0.60961440	1.896663
Human Capital	7.16049363	22.34740991	2.559307931	0.547045206	2.794700923	4.2169
Multifactor Productivity	-10.066354	-22.06049054	-0.637966506	-41.0112173	-1.323888374	0.015847

Fig. 1. Contribution of Indonesia's Economic Growth

I will discuss about the three main components of Indonesia's growth based on the Solow Model. To get a better understanding, I relate the discussion with the policy implication and by comparative studies with other "similar" countries that is Malaysia, Thailand, and Singapore. The reason of comparing Indonesia to these three countries is because of several reasons. All three countries and Indonesia are in the Southeast Asia region which makes geographically similar. They also share similar history in terms of political and economy. All three countries also experienced the Asia financial crisis likewise Indonesia. However, all three countries have higher economic growth than Indonesia, especially Singapore who is known as one of the Newly Industrialized Countries (NIC).

A. Physical Capital Contribution

Indonesia has put much effort on improving the investment climate for private sector in the past decade. In addition to general corruption and legal uncertainty, there are a number of specific factors that have reduced the competitiveness of Indonesia's investment climate, including: corrupt and inefficient customs services; non-transparent and arbitrary tax administration; inflexible labor markets that have reduced Indonesia's advantage in labor-intensive manufacturing; increasing infrastructure bottlenecks; and uncompetitive investment laws and regulations. In the past decade, the Government of Indonesia has implemented a series of economic policy packages aimed at stimulating investment and infrastructure improvements and implementing regulatory reform. Some to name a few are increasing infrastructure and investment spending to about $ 468.5 billion, implemented tax reform legislation by reduced corporate and personal income tax rates, strengthened Indonesia's intellectual property rights (IPR) regime, and enforce laws on eliminating corruption and

legal uncertainty. The government launched the Master Plan for the Acceleration and Expansion of Indonesia's Economic Development (MP3EI) to increase infrastructure and investment spending and to provide a roadmap for Indonesia to move up the value-chain and increase the level of innovation. The plan outlines $ 468.5 billion in potential infrastructure projects in multiple sectors including hydroelectric and solar power, palm oil, new roads including toll motorways, mining, and expansion of broadband internet, and nickel, cobalt and aluminum factories. Parliament passed the long-awaited tax reform legislation. The legislation reduced corporate and personal income tax rates as of January 1, 2009. Corporate income tax rates fell from 30% to 28% in 2009 and to 25% in 2010, with additional reductions for small and medium enterprises and publicly listed companies. The legislation raises the taxable income threshold for individuals, cuts the maximum personal income tax from 35% to 30%, and provides lower marginal personal income tax rates across four income categories. Taxes on dividends also fell from a maximum of 20% to a maximum of 10%. The passage of a new copyright law in July 2002 and accompanying optical disc regulations in 2004 which greatly strengthened Indonesia's intellectual property rights (IPR) regime is also another factor of increasing investment. In March 2006 issued a decree establishing a National Task Force for IPR Violation Prevention. The IPR Task Force was intended to formulate national policy to prevent IPR violations and determine additional resources needed for prevention, as well as to help educate the public through various activities and improve bilateral, regional, and multilateral cooperation to prevent IPR violations. As suggested by the Solow Model, an increasing in investment leads to an increase in capital stock. Align with this theory, as a result of those policies above; Indonesia experienced an increasing capital stock in the past decade.
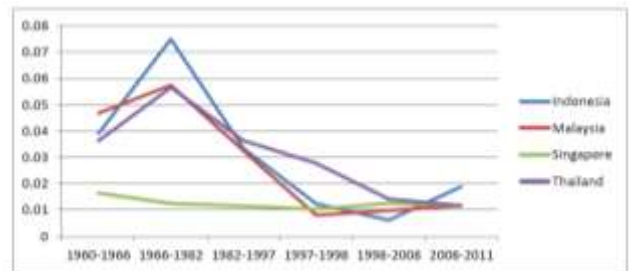

Fig. 2. Physical Capital Contribution to GDP Growth

From this figure, we can also relate the growth in human capital to economic growth, where the periods of high human capital growth are the periods of high economic growth. In the figure, there is a striking increase in human capital growth in the period of 1966-1982. In this period, the annual GDP per worker growth was around 7.7%. There is also an increase in human capital growth during the past years which is also align with the high GDP per worker growth in this period of around 6%. This explains the importance of human capital for Indonesia's economic growth. Additional note to this is that the downward figure is some period means that even though we may see human capital growth decreasing, it stays high in terms of the real
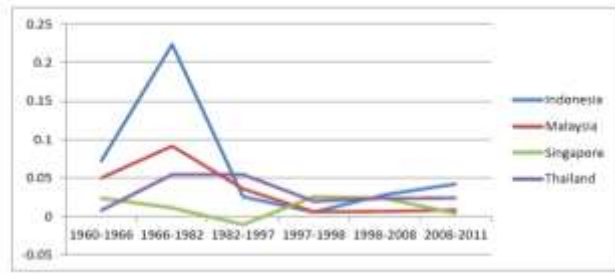
value.

Fig. 3. Human Capital Contribution to GDP Growth

The figure above also shows that the contribution of human capital to economic growth in Indonesia, Malaysia, Thailand, and Singapore fluctuates over time. However, human capital always has a positive contribution to economic growth. In the past few years, Indonesia's human capital growth (and also physical capital) has been the highest between the four countries. However among the four, Indonesia's economic growth is the lowest. This suggests that Malaysia, Thailand, and Singapore can have higher economic growth due to other factors besides physical capital and human capital.

B. Total Factor of Productivity Contribution

As mentioned earlier, Indonesia experienced a negative TFP growth in most periods. The negative growth of implies that the productive efficiency deteriorated and pull down the economic growth. This shows that Indonesia has not put much attention to factors that affects productivity efficiency such as the quality of educational systems, the importance of experience at work or on-the-job training, and the general health of the labor force as mentioned before. Unlike other countries such as Malaysia and Thailand, TFP plays an important role in their GDP growth. Based on the growth accounting I conducted for these two countries, TFP contributes about 40% of its economic growth. Supported by the fact that Thailand and Malaysia have higher TFP growth than Indonesia, and that these countries have lower physical and human capital growth from Indonesia but have higher economic growth, we can safely conclude that TFP plays a vital role in economic growth. Thus, giving much attention to TFP will result in higher economic growth. The government of Indonesia in the early days were not really focusing on these element, rather than how to improve investment in both physical and human capital. However in the past few years, many government programs have been introduced to increased labor efficiency. The existence of many labor trainings provided by the government is one factor. Another factor to be considered is the technical progress. Based on Ikhsan (2006), the liberalization era has delivered much improvement in the level of technology used in Indonesian manufacturing. The increasing Foreign Direct Investment (FDI) has also enhanced production capabilities with more advance technology. This improvement has supported the fact that TFP growth increased with a positive number in the past years.
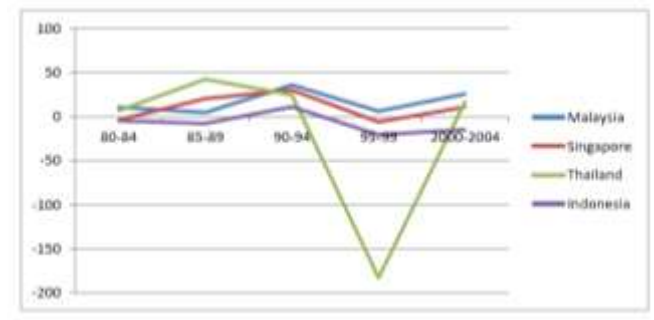

Fig. 4. TFP Contribution to GDP growth

IV. BEYOND ECONOMIC GROWTH

This part of the paper is aimed to briefly describe the development figures of Indonesia compare to the well economic growth Indonesia is experiencing. The underlying idea is that even though Indonesia recently experience high positive growth, problems in development is still concerning. As mentioned earlier, Indonesia's HDI is 0.617, which gives the country a rank of 124 out of 187 countries. A study by Ranis (2004) sees the relation between human development and economic growth in both linkage directions. That is, whether human development affects economic growth, or the reverse.
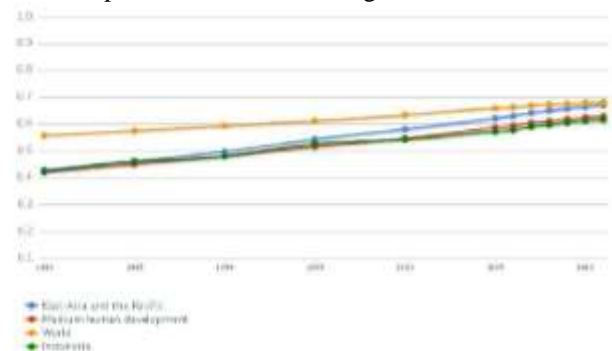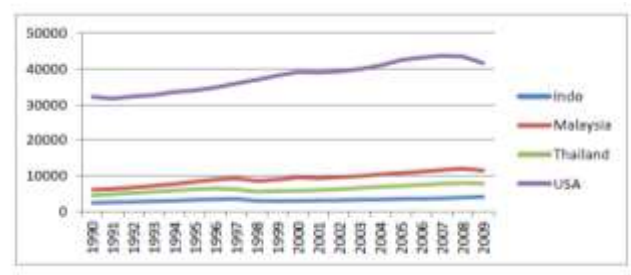

Fig. 5. Indonesia's HDI

Fig. 6. GDP per capita profile

Ranis (2004) argued that there is a two-way linkage between human development and economic growth. Economic growth obviously has an impact on human development. The higher the economic growth, the higher the ability to provide programs to increase human development. He argues that these are subject to the condition of the society where one important component is the distribution of income. The quality of the government became crucial here. Relating to this, Indonesia's inequality is actually still moderate compare to neighbor countries where Indonesia's Gini Coefficient in 2009 is 36.8% while Malaysia is 46.2% and Thailand 53.6%. This suggests that Indonesia has maintained its capability to deliver the impact of economic

growth to human development. Thus, Indonesia's low HDI does not come from the distribution affect, but can be sourced by the low GDP per capita that limits Indonesia to develop its development program. Meanwhile in the other direction, human development is also seen to affect economic growth. Human development such as education and health allows agents to discover and develop their comparative advantage and productivity. For the case of Indonesia, a study by Bloom et.al (2004) argued that health has a positive and statistically significant effect on economic growth where a one-year improvement in a population's life expectancy contributes to an increase of 4% in output.

V. CONCLUSION

There are myriad factors contributing to economic growth that we can think of. Solow Model with human capital can be used as a starting point to explain economic growth by looking at the production side. I explained factors contributing to Indonesia's economic growth by using this model and conduct the growth accounting developed by Solow (1957). From this exercise, I obtain several interesting observations. First, human capital plays an important role in Indonesia's economic growth contributing more than 40% of the output per worker growth. I found that in periods of successful economic growth, human capital contributes far larger than physical capital and TFP. The high human capital contribution was supported by the "9 Year ducation Compulsory" Program by the government which was established since the New Order regime. Even in times of crisis, Indonesia's human capital growth has maintained a positive growth which contributes to the economic growth as a whole. Second, Indonesia's economic growth is also sourced by the capital per worker growth. As suggested by the Solow Model, an increasing in investment leads to an increase in capital stock. Thus, increasing physical capital growth can be explained by a series of economic policy packages that Indonesia has implemented in the last few years aimed at stimulating investment. Third, I observe that Total Factor of Productivity (TFP) experienced a negative growth in most of the periods for Indonesia, contributing a lower output per worker growth. The lack of policies relating to the productivity efficiency explains this figure. However, the negative growth has reduced along the time and since 1998 as government started to give their attention to this.

Liberalization policy has also seen to be contributing to the productivity efficiency as technological transfer has increased. One key finding is that in the past few years, Indonesia's physical and human capital growth has been higher than Malaysia, Thailand, and Singapore. However among the four countries, Indonesia's economic growth is the lowest. By doing the same growth accounting method to the other three countries, I conclude that higher economic growth is contributed from the high TFP growth that they have. From the figures, we can safely conclude that TFP plays a vital role in economic growth. Furthermore, TFP's role in economic growth has became more important as the data shows an increasing trend in the contribution of TFP over time, while the physical and human capital contribution shows a downward slope. Taking this into consideration, Indonesia should consider put more attention to

the TFP development to improve economic growth. Adding to the discussion of economic growth, I observe that even though Indonesia experienced high economic growth, Indonesia's welfare is still far behind from other countries. Indonesia's GDP per capita is still low and the Human Development Index (HDI) as a broader parameter of welfare is also low. I observe that improving HDI can contribute to economic growth. And thus support the argument that the old-fashioned view of "grow first and worry about human development later" is not supported by the evidence. Improving levels of education and health should have priority or at least move together with efforts to directly enhance growth.

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