

**DYNAMICS OF GROWTH, POVERTY AND HUMAN CAPITAL:  
EVIDENCE FROM INDONESIAN SUB-NATIONAL DATA**

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The aim of this study is twofold. First, despite the vast empirical literature on testing the neoclassical model of economic growth using cross-country data, very few studies exist at the sub-national level. We attempt to fill this gap by utilizing panel data over the 2002-2012 period, a modified neoclassical growth equation, and a dynamic panel estimator to investigate the effect of both health and education capital on economic growth and poverty at the district level in Indonesia. Secondly, whilst most existing cross-country studies tend to concentrate only on education as a measure of human capital, we expand the analysis and probe the effects of health capital as well. As far as we are aware, no study has done a direct and comprehensive examination of the impacts of health on growth and poverty at the sub-national level. Thus this study is a premier at the sub-national level, and our findings will be particularly relevant in understanding the role of both health and education capital in accelerating growth and poverty reduction efforts.

*Keywords:* Neoclassical Growth, Poverty, Human Capital, Health, Education, Dynamic Panel

*JEL classification:* O47, O15, I12, R11, E23

## 1. INTRODUCTION

For many long years, severe disparities among regions in Indonesia have prevailed, especially between the western and eastern regions in the country. In the 1990s, poorer regions persistently expressed their frustration with the central government's development policies, and demand much larger income transfers and more autonomy in regional governance. Following the financial crisis 1997 and the fall of the New Order regime, Indonesia in the early 2000s adopted the new political system with decentralization at the forefront. Even in the aftermath of Indonesia drastically

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transforming from a highly centralized government structure to a highly decentralized system in 2001, the issues revolving around regional economic imbalances still exist, and policy planners debate zealously on the latent causes and determinants responsible for these spatial disparities. Thus the growing interest on spatial income disparities have accentuated the need for research and knowledge on the determinants of regional economic growth and human development in Indonesia.

Numerous economic theories and models exist in relating education and health to economic growth. Human capital in the form of education and health increases an individual's earning potential, but also generate a "ripple effect" throughout the economy by way of a series of positive externalities. Mankiw, Romer and Weil (1992) demonstrated that the Solow model, when augmented to include education capital as a factor of production, did a satisfactory job of explaining the variations in per capita real income that are witnessed across a large and heterogeneous sample of countries. Maksymenko and Rabbani (2011), employing a multivariate time series techniques found significant and positive effect of human capital accumulation on long run economic growth rates. Sahoo, Dash and Nataraj (2012), examined the role of physical and social infrastructure on economic growth and concluded that it is necessary to design an economic policy that improves the physical infrastructure as well as human capital formation for sustainable economic growth in developing countries.

An equally important form of human capital for economic growth is health, which can directly augment labour force productivity by enhancing its physical capacities, such as strength and endurance, as well as mental aptitude, such as cognitive performance and reasoning ability. Unfortunately, little attention has also been paid in the past to the impact of poor health on growth, productivity, and poverty. Effects of education, trade openness, savings, inflation and the initial level of income have been most commonly used to explain regional differences in economic growth and productivity rates (Barro, 1991; Mankiw *et al.*, 1992; Barro and Sala-i-Martin, 1995; Miller and Upadhyay, 2000). However there are many compelling reasons to believe that health is also an important determinant of productivity and standard of living in any region of a country or the world.

Nevertheless, empirical evidence on the relationship between human capital and economic growth is have also been somewhat mixed. For an example, Bills and Klenow (2000) argue that schooling may have only a limited impact on growth. Caselli, Esquivel and Lefort (1996) and Islam (1995) in their panel data studies have also failed to find significance of schooling in standard growth regressions. Sachs and Warner (1995) find a positive, but still insignificant impact of both primary and secondary education on growth, while Romer (1989) find no significant effect for literacy rates. Pritchett (2001) claims that the weak institutional framework, low quality and excess supply of schooling in developing countries are all accountable for the lack of empirical link between changes in educational attainment and economic growth. Acemoglu and Johnson (2001) find no evidence that an increase in life expectancy leads to faster growth in income per capita. Thus in this contest, it will always be worthwhile to continue scrutinizing the

intimate linkages between human capital and development at both the cross-country and sub-national levels.

The originality of this study is that we link regional or sub-national disparities in economic growth and poverty with a rich set of socio-economic information particularly in relation to health capital. A limited amount of studies have examined the determinants of regional economic performance in Indonesia. However most studies have been done at the province level and with a limited number of explanatory variables, limiting only to education capital using OLS and fixed effect estimators, and with no formal conceptual growth model. Equally important form of human capital for economic growth is health, which can directly augment labor force productivity by enhancing their physical capacities, such as strength and endurance, as well as their mental aptitude, such as cognitive performance and reasoning ability. Unfortunately, as far as we know, no study has made any serious attempt to examine the effect of health capital on regional growth and poverty in Indonesia.

Furthermore, we go beyond conventional fixed effect estimators by employing dynamic panel system-GMM estimators and search for significant determinants of regional disparities in Indonesia based on both the neoclassical growth model and cross-country growth regressions a la Barro (1991, 1997), while paying particular attention to human capital proxies and controlling for a distinctive assortment of variables capturing macroeconomic stability. Doubts also exist about the reliability of Indonesian region level data among some authors (Manning, 1997). Thus this study presents an opportunity to test the reliability and performance of Indonesian regional data within standard economics frameworks and models.

## 2. GROWTH, INCOME DISTRIBUTION AND DEVELOPMENT: SOME EVIDENCE FROM DECENTRALIZED INDONESIA

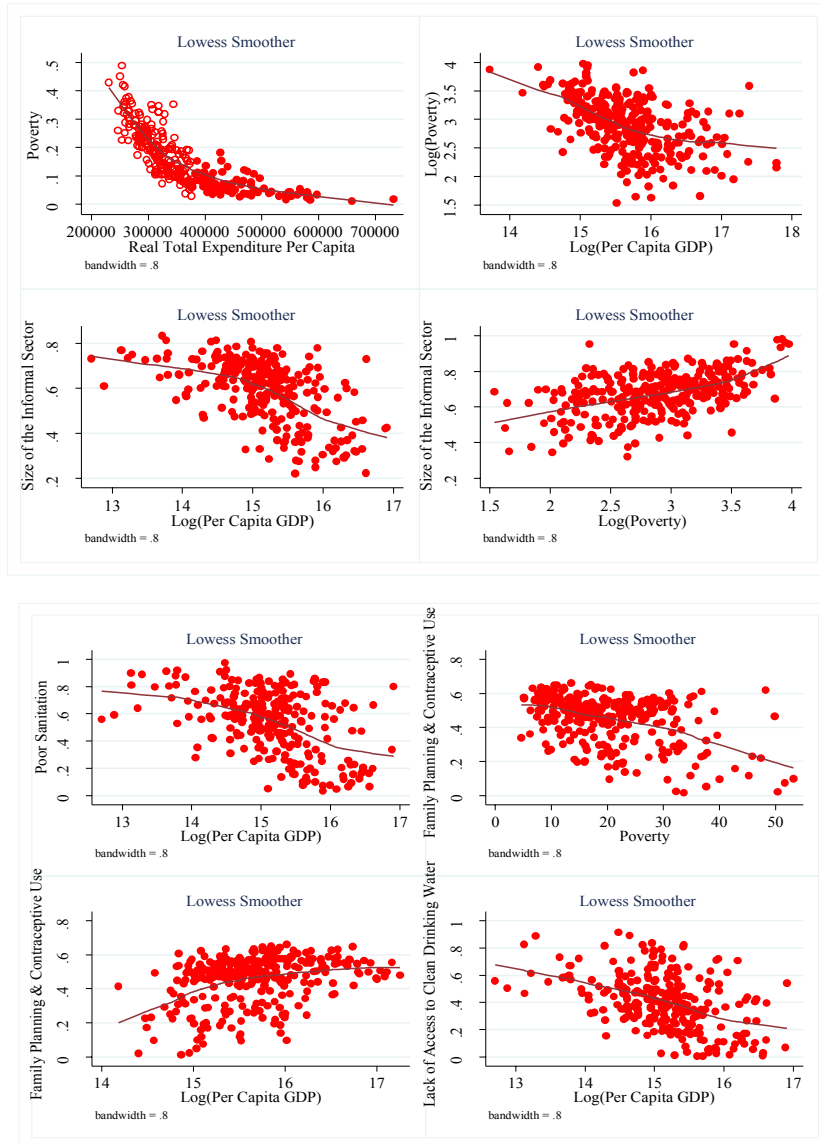
Indonesia, the largest country in Southeast Asia with the world's fourth largest population, is at present using its strong economic growth to accelerate the rate of poverty reduction. The economy almost doubled in size between 2002 and 2011; and per capita GDP rose from US\$909 in 2002 to US\$3,557 in 2012. Indonesia's economy has recovered from the devastation of the Asian financial crisis (AFC), benefited from a boom in commodity prices, and weathered the recent global financial crisis well. While Indonesian economic growth has been strong in aggregate, the level of income per person - remains low relative to its neighbors, and 43 percent of Indonesians are also estimated to be surviving on less than US\$2 per person per day in 2012. Lately, in spite of the sustained economic growth, the rate of poverty reduction has also begun to slow down, with inequality continuing to rise. Indonesia is now facing the twin challenge of accelerating the rate of poverty reduction and at the same time adopting a pro-poor growth framework that allows the poor to benefit more from economic growth, and thereby curb rising spatial disparities in human development. It is now well recognized

that poverty in Indonesia is a complex and multidimensional phenomenon, which is not only evident in low levels of income, but also in poor's vulnerability that is intrinsically linked with many factors such infrastructure, access to services and labor market conditions (see Figure 1). Thus in this context, it is particularly important to examine regional level latent factors associated with growth, poverty and inequality in Indonesia from a dynamic perspective.

In recent years, high levels of income and human development disparities among regions have continued to emphasized the need for research in finding Indonesia's regional growth determinants. However, though there is a wealth of studies on the analysis of growth, poverty and inequality in Indonesia, there is a dearth of micro-econometric literature that explicitly examines the role health capital on growth and human development in Indonesia at the sub-national level.

Balisacan *et al.* (2003) employing panel data from the National Socioeconomic Survey (SUSENAS) for 285 districts for three years 1993, 1996, and 1999, found that education capital and infrastructure to be one of the critical factors contributing to the growth and development of regional economies in Indonesia. Timmer (2004) investigated the growth process in Indonesia over the 1960-1990 period. His study reveals that during those three decades, the growth was instrumental in reducing poverty in Indonesia, while investment in infrastructure made overall growth more pro-poor. Further, Suryadarma, Suryahadi and Sumarto (2005) showed that high inequality reduced growth elasticity of poverty in Indonesia over the 1999-2002 time period. They found that poverty reduction between 1999 and 2002 was very successful due to inequality in 1999 being at its lowest level in 15 years, thus leading to an increased impact of growth on poverty reduction. In another study, Suryahadi, Suryadarma and Sumarto (2009) further examined the relationship between economic growth and poverty reduction by breaking down growth and poverty into their sectoral compositions and geographical locations. They find that the most effective way to accelerate poverty reduction is by focusing on rural agriculture and urban services growth. Resosudarmo and Vidyatamma (2006) examined the growth process of Indonesian provinces during the 1993-2002 period and investigated the determinants of the country's inter-provincial income disparity. Their study findings suggest that, despite the existence of substantial disparities, conditional convergence of regional incomes occurred and the contribution of the gas and oil sectors were found to be important determinants of the variation of growth across provinces. Garcia and Soelistianingsih (1998) revealed that poor provinces have a strong tendency to catch up with middle and high-income provinces, and investments in education capital to play a key role in reducing regional disparities in economic growth. Handa (2007) found that differences in the endowments of physical and human capital to be primarily responsible for regional disparities economic performance. Finally, Suryahadi, Hadiwidjaja and Sumarto (2012) assess the relationship between economic growth and poverty reduction before and after the financial crisis in Indonesia. They find that growth in the service sector is the largest contributor to poverty reduction, and that the importance of agriculture sector growth for

poverty reduction is confined only to the rural sector.



**Figure 1.** Linkages between Poverty, Per Capita GDP and Other Socio-Economic Factors

The most striking characteristics of the geography of economic activity in Indonesia is concentration and unevenness. Heterogeneities in income, output, infrastructure and human capital across regions have resulted in unbalanced development. This has left large regional disparities particularly between Java and non-Java, especially eastern Indonesia. There has also been a tendency for regional inequalities to rise in recent years. Sakamoto (2007), for example, suggests that for 28 years to 2005, there is evidence of increasing regional disparity. Concentration of economic activities in Indonesia has been overwhelmingly within the Java and Sumatra Island. Regional data have shown that the spatial structure of the Indonesian economy has been dominated by provinces in the Java Island, which contributed to the Indonesia's GDP of around 60 percent, followed by about 20 percent from the island of Sumatra, and the rest 20 percent from the Indonesia Eastern Regions.

**Table 1.** Regional Socio-Economic Indicators 2012/2013

	GDP Share	GDP Growth	Human Development Index	Poverty Headcount Index	Gini
Aceh	1.40	6.10	72.51	17.72	0.32
Sumatera Utara	5.20	6.30	75.13	10.39	0.33
Sumatera Barat	1.60	6.30	74.70	7.56	0.36
Riau	7.00	7.80	76.90	8.42	0.40
Kepulauan Riau	1.40	8.30	73.78	8.42	0.35
Jambi	1.10	8.70	73.99	14.06	0.34
Sumatera Selatan	3.10	7.90	73.93	17.75	0.40
Kepulauan Bangka Belitung	0.50	5.80	72.45	14.39	0.29
Bengkulu	0.40	6.60	73.78	5.25	0.35
Lampung	2.10	6.50	76.20	6.35	0.36
DKI Jakarta	16.40	6.60	78.33	3.72	0.42
Jawa Barat	14.10	6.50	73.11	9.61	0.41
Banten	3.20	6.10	73.36	14.44	0.39
Jawa Tengah	8.30	6.70	76.75	15.03	0.38
DI Yogyakarta	0.80	5.30	72.83	12.73	0.43
Jawa Timur	14.90	7.30	71.49	5.89	0.36
Bali	1.20	6.70	73.49	4.49	0.43
Nusa Tenggara Barat	1.10	5.80	66.89	17.25	0.35
Nusa Tenggara Timur	0.80	6.70	68.28	20.24	0.36
Kalimantan Barat	1.10	5.90	70.31	8.74	0.38
Kalimantan Tengah	6.20	11.30	75.46	6.23	0.33
Kalimantan Selatan	0.70	7.80	71.08	4.76	0.38
Kalimantan Timur	0.20	7.70	76.71	6.38	0.36
Sulawesi Utara	0.80	9.40	76.95	8.50	0.43
Gorontalo	2.40	8.40	72.14	14.32	0.44

Sulawesi Tengah	0.20	9.00	72.70	10.32	0.40
Sulawesi Selatan	0.50	10.40	71.05	13.73	0.41
Sulawesi Barat	0.70	-1.10	71.31	18.01	0.31
Sulawesi Tenggara	0.50	5.40	70.73	12.23	0.40
Maluku	0.20	7.80	72.42	19.27	0.38
Maluku Utara	0.10	6.70	69.98	7.64	0.34
Papua	1.20	1.10	70.22	27.14	0.44
Papua Barat	0.60	7.40	65.86	31.53	0.43
Indonesia	100.00	6.23	73.29	11.47	0.41

Table 1 provides some regional-level disparities in income, poverty, inequality, and human development. Vast disparities among provinces become evident: provincial income shares vary from 0.1 to 16.4 percent. The Capital of Indonesia, Jakarta, and other resource abundant provinces, such as Riau and East Kalimantan, have remarkably high income shares. Comparatively, Jakarta records the highest regional GDP per capita and East Kalimantan, the resource-rich province, have the next-highest regional GDP per capita. The other resource-rich provinces such as Riau and West Papua, usually comes next in regional income per capita rankings. At the other extreme are the lagging provinces such as Nusa Tenggara, Maluku and Gorontalo, where the regional income and human development are at the lowest. Table 1 also shows that regional economic growth to vary significantly by provinces, where some provinces grew more than national average. Resource-rich provinces, such as Riau, Papua Barat, and all provinces in Sulawesi grew more than the average national economic growth.

Regional disparities in poverty are also evident from Table 1. It can be seen that although rates of poverty vary across and within all regions, provinces with low-income shares are mostly in the eastern part of the country. Papua, Maluku, and East Nusa Tenggara had the highest poverty rates, in contrast, Jakarta, Bali, and South Kalimantan exhibits low poverty rates. In absolute numbers, the poor are nevertheless concentrated in Java-with West Java, Central Java, and East Java each having around 4.5 million poor people on average. Papua has the highest inequality among Indonesian provinces, and Bangka Belitung has the lowest inequality together with highest rate of poverty reduction in recent years. Generally, income distribution tends to be more equal in provinces where nonfood crops are important than in mineral-rich provinces. Oil and mineral-abundant areas tend to have significantly greater inequality than areas that are not mineral dependent, which means that usually a smaller share of income is going in to the hands of the poor.

The status of health and education varies vastly among districts and provinces in Indonesia. There are significant differences in educational access and quality across the country, and effective targeting of additional resources is required to provide lagging districts and provinces with sufficient funds to catch up with better performing regions. For an example enrollment rates in Indonesia vary widely by region and these regional

gaps are more pronounced than the enrollment gaps in income levels. The poor's likelihood of enrollment varies by region, even within the same income quintile. The poor in Papua have low net enrollment rates even at primary school level (80 percent). National averages also hide wide variations in health within Indonesia. For instance, the poorer provinces of Gorontalo and West Nusa Tenggara have post-neonatal mortality rates that are five times higher than in the best performing provinces in Indonesia. Similar regional discrepancies are shown in under-five mortality rates (infant and child). While most provinces are below, or only slightly above, the 40 deaths for every 1,000 live births mark, nine provinces have rates of over 60. The rates for West Nusa Tenggara, Southeast Sulawesi and Gorontalo are as high as 90 or 100.

### 3. HUMAN CAPITAL, POVERTY AND GROWTH EMPIRICS

It is well-known in the growth literature that education capital differences account for a significant part of the variation observed in regional income distribution. Based on several decades of thought about human capital, and centuries of emphasis to education especially in the advanced countries, it is natural to propose that any effective development strategy should be to raise the education level of all populations groups in any country. Indeed, this is exactly the policy approach of many developing countries while also being a central element of the Millennium Development Goals.

The importance of human capital generally, and of education in particular in growth theory started to receive attention only in the 1980s and 1990s mainly due to endogenous growth models and the augmented neoclassical growth model of Mankiw, Romer and Weil (MRW). The augmented neoclassical growth model assumes human capital as an additional factor, hence countries that have faster growth rate of education will have faster transition growth rates and ultimately higher incomes. Endogenous growth models view education as a process that has an impact on the production technology itself (innovations, processes, or knowledge) (Romer 1989, 1990; Aghion and Howitt, 1998; Nelson and Phelps, 1966), makes it easier to adapt foreign technology (Barro, 1997, 1999; Barro and Sala-i-Martin, 1995; Sala-i-Martin, 1999; Hall and Jones, 1999), or facilitate resource transfer to the most technologically dynamic sector of the economy (Kim and Kim, 2000; Schiff and Wang, 2004). Based on an overlapping generations model with heterogeneous agent framework, Baldi (2013) find that better educational institutions to increase the income of the individuals and are also to be associated with lower income inequality. In the endogenous growth literature, education is seen as subject to increasing returns so it could overcome the growth reducing effect of diminishing returns to physical capital (Romer, 1989; Lucas, 1988).

There is a vast amount of empirical literature which investigates the growth-poverty-education capital nexus. This literature in general reveals that education to have a positive and significant impact on economic growth and poverty. Nevertheless, empirical evidence on the relationship between human capital and economic growth has



also been somewhat mixed. For an example, Bils and Klenow (2000) argue that schooling may have only a limited impact on growth. Caselli, Esquivel and Lefort (1996) and Islam (1995) in their panel data studies have also failed to find significance of schooling in standard growth regressions. Sachs and Warner (1995) find a positive, but still insignificant impact of both primary and secondary education on growth, while Romer (1989) find no significant effect for literacy rates. Pritchett (2001) claimed that the weak institutional framework for and low quality and excess supply of schooling in developing countries are all accountable for the lack of an empirical link between changes in educational attainment and economic growth.

Equally important form of human capital for economic growth is health, which can directly augment labor force productivity by enhancing their physical capacities, such as strength and endurance, as well as their mental aptitude, such as cognitive performance and reasoning ability. Unfortunately, few studies attempt to examine the effect of health capital on economic growth and poverty. Health influences economic wellbeing via many channels such as labor productivity lost to sickness and disease, often leading societies to be locked into “poverty traps” due to poor health. Enhancement of health in a country will encourage individuals to have more saving through reduction of morbidity, mortality and increase of life expectancy, which in turn will indirectly enhance labor force productivity and economic growth (Weil, 2007).

It is important to recognize that poor health is an element of poverty itself. Poor health interacts with low income to constrain the ability of the poor to attain adequate nutrition and to learn, gain knowledge, and enhance their capabilities. Susceptibility to diseases and illness makes the poor vulnerable to morbidity, disability, and premature mortality, leading them to increased state of powerlessness. Furthermore, ill health may push some households that are above an income-defined poverty line to fall below it. Households naturally fall into poverty when the prices to be paid for health services are too high; when income earners lose substantial income earning work time due to poor health, disability, or caring for others who fall sick; or when income earners die prematurely. Increased risks of premature death also lead families to increase fertility to ensure the survival of a target-size family. This puts mothers’ health at risk and takes them out of the workforce more than otherwise would be the case. Thus health status is itself an indicator of poverty in multiple dimensions and good health is a protector of income or wealth.

The literature on the relationship between health and growth has grown over time. There are many channels that have been identified in arguing that health matters for growth (Aghion and Howitt, 1998). Mankiw-Romer-Weil (1992) and Lucas (1988), suggests that health should be viewed as a regular factor of production, and accordingly output growth should be correlated with the rate of improvement of health. According to Lopez, Rivera and Currais (2005), good health a crucial element for overall wellbeing and human development. Based on economic grounds, good health raises levels of human capital, and this has a positive effect on individual productivity and economic growth rates. Issa (2005), confirms the role of human capital as an important factor input

that directly stimulates growth and an also as an effective tool that reduces mortality and fertility, and thereby contributing indirectly to the economic growth process.

The significance of health capital for a country's economic growth via their effects on labor market participation, worker productivity, savings, fertility, and population age structure has been well documented in the literature. Knowles and Owens (1995, 1997) included health capital in Mankiw, Romer and Weil (1992) augmented Solow economic growth model, and find that per-capita income growth had a more robust relation with health than with the education variable. Barro (1999) and Bloom *et al.* (2004) find life expectancy at birth to be a positive and significant determinant of economic growth rates. Bhargava *et al.* (2001) find human capital as proxied by the adult survival rate has a significant effect on economic growth particularly in the poorer countries McDonald and Roberts (2002) develop an augmented Solow model that incorporates both health and education capital, and found the coefficient on health capital to be significant for the full sample. But when the sample is disaggregated by LDCs and OECD countries, health capital has a positive and significant effect on economic growth only in the LDCs but not the OECD group. Cole and Neumayer (2006) found poor health to be a key factor in reducing aggregate productivity, thus to explain the existence of persistent underdevelopment in many regions of the world.

As an important element of human capital, health capital can affect productivity through the ability of firms to innovate and adopt new technologies and through labour productivity. A healthy workforce has a larger capacity to produce, while being additionally productive. For an example workers that are mentally and physically fit are less likely to be absent from work. Moreover, healthy workers are likely to be more willing to acquire education and skills because of an increase in return from education. Also there is a large number of studies which suggest that healthier children have better cognitive abilities (Morley and Lucas, 1997; Watanbe *et al.*, 2005). Disease environment can also affect the development of institutions. Acemoglu *et al.* (2001) argue that higher mortality rate of European settlers in tropical countries induced them to develop exploitative institutions in these countries.

One of the key objectives of this study is to include health capital in a well-specified aggregate production function in an attempt to test for the existence of an effect of health on growth and poverty, and to gage its significance. In this regard, we will utilize primarily four indicators that capture and represent both the common causes of poor health and the status of the health service and system: prevalence of water-borne diseases, skilled birth attendance, immunization rate, and the incidence of self-medication. The prevalence of water-borne diseases will be captured by the incidence of diarrhea. In developing countries, waterborne diseases are a major problem which contributes to the vicious circle that people have to face every day. Waterborne disease make many people weak and as a result are more susceptible to other infections as well. Their physical capacity decreases and they cannot work and provide their families with money and food. A lack of sufficient nutritional food weakens people, especially children, even further. They become even more susceptible to diseases. Children run

behind at school, because they cannot be educated when they are ill. In this manner waterborne diseases frustrate the lives and economic development of many people in developing countries. During natural disasters such floods the likelihood of people getting infected with waterborne diseases rises, especially when water treatment and sewages no longer function well. Thus the treatment of drinking water, sewage, waste and sewage water and education on personal and food hygiene are important elements of country's human development strategy.

We measure the level of health system coverage through indicators of immunization and skilled birth attendance. Higher immunization coverage is generally found to decrease mortality rates and reduce the risk of disease spread. Much of the rest of child mortality worldwide is accounted for by vaccine preventable diseases - most notably diphtheria, tetanus, and measles (Murray and Lopez, 1996). Vaccines exist for many diseases that drive families or individuals into poverty. Many diseases such as measles, polio, serious forms of tuberculosis, diphtheria, tetanus, and pertussis which are covered by vaccines can be killers and can be costly to treat even when they are not fatal. Some leave their victims disabled (polio, tuberculosis) and, hence, much more vulnerable to poverty, since their income-earning potential is limited. Thus, many of these preventable illnesses become a cause of poverty due to lost income and output. Hamoudi and Sachs (1999) found increased immunization rates to have a very strong positive impact on overall economic growth.

We use the skilled birth attendance rate to capture the level of health system coverage and also to proxy for the maternal mortality rate. It is established that one primary reason for the high levels of maternal mortality is that too few births take place in the presence of skilled attendants. We also used the incidence of self-medication to link with poverty and welfare, because people are forced to self-medicate for treatment of diseases due to financial constraints and poor access to medical facilities, although medical experts have warned of serious health problems from this practice. It is believed that the majority of the people belonging to poor regions even avoid visiting public hospitals, as they cannot afford travelling and medicines costs. Sometimes, people even consume antibiotic medicines based on old prescriptions, which increases the risk of developing other harmful diseases (Chang and Trivedi, 2003).

#### 4. ANALYTICAL AND CONCEPTUAL FRAMEWORK

Theoretical underpinning for our analysis is the augmented neoclassical growth model. Our analysis closely follow recent advances cross country growth modelling approaches, particularly starting with Mankiw, Romer and Weil (1992), Islam (1995) and Caselli, Esquivel and Lefort (1996). Firstly a canonical Neoclassical Solow model is assumed and a production function in Cobb-Douglas framework at time  $t$  is given by:

$$Y(t) = K(t)^\alpha (A(t)L(t))^{1-\alpha}, \quad (1)$$

where  $Y$  is output,  $K$  is capital,  $L$  is labour,  $A$  is technology,  $\alpha$  is the share of capital in total output.  $L$  and  $A$  are assumed to grow exogenously at rates  $n$  and  $g$  respectively, so that

$$L(t) = L(0)e^{nt}, \quad (2)$$

$$A(t) = A(0)e^{gt}. \quad (3)$$

Letting  $y^*$  to be the steady-state level of income per capita and  $y$  as the actual income per capita at time  $t$ , the steady state approximation for the speed of convergence is given by:

$$\frac{d \ln y(t)}{dt} = \lambda [\ln(y^*) - \ln y(t)], \quad (4)$$

where  $\lambda$  is the rate of convergence, given by  $\lambda = (n + g + \delta)(1 - \alpha)$ . Finally, a districts growth rate can be approximated in the neighborhood of the steady state as:<sup>1</sup>

$$\begin{aligned} \ln(y_{i,t}) - \ln(y_{i,t-\tau}) &= -(1 - e^{-\lambda\tau}) \ln(y_{i,t-\tau}) + (1 - e^{-\lambda\tau}) \frac{\alpha}{1 - \alpha} \ln(s) \\ &\quad - (1 - e^{-\lambda\tau}) \frac{\alpha}{1 - \alpha} \ln(n + g + \delta), \end{aligned} \quad (5)$$

where  $s$  is the investment rate,  $\delta$  is the rate of depreciation of physical capital and  $\tau = t_2 - t_1$  in district  $i$ .

Next we use the Islam (1995) dynamic model to incorporate the accumulation of human capital to capture its explicit role of human capital in determining economic growth productivity. Re-writing the human capital augmented production function as:

$$Y(t) = K(t)^\alpha H(t)^\beta (A(t)L(t))^{(1-\alpha-\beta)}. \quad (6)$$

In the steady state:

$$\dot{k}(t) = s^k \tilde{y}(t) - (n + g + \delta) \tilde{k}(t), \quad (7)$$

$$\dot{h}(t) = s^h \tilde{y}(t) - (n + g + \delta) \tilde{h}(t), \quad (8)$$

<sup>1</sup> See, e.g., Barro and Sala-i-Martin (1995).

where  $\tilde{y} = Y/AL$ ,  $\tilde{k} = k/AL$ ,  $\tilde{h} = H/AL$  are quantities of per capita,  $s^k$  and  $s^h$  are physical and human capital respectively. Approximating around the steady state and rearranging we have:

$$\begin{aligned} \ln y(t_2) = & (1 - e^{-\lambda\tau}) \frac{\alpha}{1 - \alpha} \ln(s) - (1 - e^{-\lambda\tau}) \frac{\alpha}{1 - \alpha} \ln(n + g + \delta) \\ & + (1 - e^{-\lambda\tau}) \frac{\beta}{1 - \alpha} \ln(h) + e^{-\lambda\tau} \ln[y(t_1)] + (1 - e^{-\lambda\tau}) \ln[A(t_1)] + g(t_2 - t_1), \end{aligned} \quad (9)$$

where  $y = Y/L$ ,  $k = K/L$ ,  $h = H/L$  are quantities of per capita, and  $\lambda = (n + g + \delta) + (1 - \alpha - \beta)$ .

In summary, growth in output per capita in the augmented neoclassical model is a function of initial output, technological progress, the rate of investment in physical capital, the rate of investment in human capital, the depreciation rate of capital, the growth rate of the population, the share of physical capital in output, the share of human capital in output, and the rate of convergence to the steady-state. Higher physical investment and human capital will increase the growth rate of output per worker, while higher labor force growth, when adjusted for depreciation and technological progress, is expected to have a negative impact on growth in output per worker.

## 5. EMPIRICAL METHODOLOGY

We largely used panel fixed effects and GMM estimation methods and relied less on the cross-sectional analysis that is sometimes used in the economic growth literature. As Islam (1995) correctly stated, single cross-country growth regressions suffers omitted variable bias due to country-specific technical efficiency being unobservable. This unobservable technical efficiency is then most likely to be correlated with other growth determinants such as education and investment. Thus in such instances the standard least-squares estimator from cross-sectional data will not only be inefficient but also biased and inconsistent.

Mankiw *et al.* (1992) proposed the augmented Solow model, including human capital into the production function and solving the problem of excessive savings to income growth. Later Islam (1995) for the first time assembled the Solow model into a proper dynamic form empirically. Caselli *et al.* (1996) adopt Islam (1995) dynamic panel data framework and employed the Arellano and Bond (1991) Generalized Method of Moment (GMM), correcting the inconsistency problem. However Caselli *et al.* (1996), overlooked the cross-sectional autocorrelation among countries. Improving upon these previous studies, this paper applies the more efficient System-GMM method, but for comparative robustness purposes we will perform and report both the fixed effects and the Difference-GMM estimator employed by Caselli *et al.* (1996), Hoeffler (2002) and

Bond *et al.* (2001).

The regional per capita GDP growth equation we seek to estimate will broadly represent the augmented growth model, and can be expressed in the following form:

$$y_{i,t} = \gamma y_{i,t-1} + \sum_{j=1}^3 \varphi_j x_{it}^j + \eta_t + \mu_i + \varepsilon_{it}, \quad (10)$$

where  $y_{i,t} = \ln y_{it}$ ;  $y_{i,t-1} = \ln y_{it-1}$ ;  $x_{it}^1 = \ln s_{it}^k$ ;  $x_{it}^2 = \ln(n + g + \delta)$ ;  $x_{it}^3 = \ln s_{it}^h$ ;  $\eta_t = g(t_2 - \exp^{-\lambda t} t_1)$ ;  $\mu_i = (1 - \exp^{-\lambda t}) \ln A_i$ , and  $\varepsilon_{it}$  is the idiosyncratic error term mean zero. Existence of the lagged dependent variable  $y_{i,t}$  renders the classical Least Square Dummy Variable, estimator inconsistent for fixed  $T$  (Nickel, 1981; Judson and Owen, 1999). Among the various estimation techniques proposed to estimate the above model, we will focus more on GMM estimators of Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).

The standard GMM estimator of due to Arellano and Bond (1991) begins with first differencing growth equation in order to eliminate the fixed effects, where the transformed model is expressed as:

$$\Delta y_{i,t} = \Delta \gamma y_{i,t-1} + \varphi' \Delta x_{i,t} + \Delta \varepsilon_{i,t}. \quad (11)$$

Since the lagged difference in dependent variable is correlated with the error term, and that the explanatory variables are potentially endogenous, necessitates the use of instruments. Assuming that the error term is not serially correlated and that the lagged levels of the endogenous variables are uncorrelated with future error terms, the GMM difference estimator uses the lagged levels of the endogenous variables as instruments (for exogenous variables, their first differences serve as their own instruments). The following moment conditions are used to compute the difference estimator:

$$E(y_{i,t-s} \Delta \varepsilon_{i,t}) = 0, \text{ for } s \geq 2; t = 3, \dots, T, \quad (12)$$

$$E(x_{i,t-s} \Delta \varepsilon_{i,t}) = 0, \text{ for } s \geq 2; t = 3, \dots, T. \quad (13)$$

The GMM approach uses all available lags of the dependent and the exogenous variables to form an optimal instrumental variable matrix  $Z = [Z_1, \dots, Z_N]$ .

$$Z_i = \begin{bmatrix} y_{i1} x_{i1} \dots x_{i3} & 0 & 0 \\ 0 & y_{i1} y_{i2} x_{i1} \dots x_{i4} & 0 \\ 0 & 0 & y_{i1} \dots y_{iT-2}, x_{i1} \dots x_{iT} \end{bmatrix}. \quad (14)$$

Bond *et al.* (2001) found that the first-differenced GMM estimator is subject to a large downward finite sample bias particularly when the number of time series observations is small, as the lagged levels of variables tend to serve as weak instruments for subsequent first-differences. Instead, they advocated using a system GMM estimator with superior finite sample property developed by Arellano and Bover (1995) and Blundell and Bond (1998). The system GMM estimator combines the equations in first-differences with suitably lagged levels as instruments, with an additional set of equations in levels with suitably lagged first-differences as instruments. The moment conditions for the regression in levels are:

$$E[\Delta y_{i,t-s}(\mu_i + \Delta \varepsilon_{it})] = 0, \text{ for } s = 1, \quad (15)$$

$$E[\Delta x_{i,t-s}(\mu_i + \Delta \varepsilon_{it})] = 0, \text{ for } s = 1. \quad (16)$$

By augmenting the original equation in levels to the system, Arellano and Bover (1995) and Blundell and Bond (1998) found remarkable improvements in efficiency and sizable reduction in finite sample bias through exploiting these additional moment conditions. Thus in this study, the panel-data system GMM estimator will be the favored estimation method, with two specification tests: Arellano-Bond test that the error term of the difference equation is not serially correlated, and the Sargan test that the instruments are valid (in the context of system GMM, this is the Hansen J test, which is robust to heteroskedasticity and autocorrelation within panels).

Departing from the neoclassical Solow-Swan framework, we will also adopt a more general Barro-style specifications for both growth and poverty, which can be expressed respectively in the standard panel regression form as:

$$\ln y_{i,t} = (1 + \beta) \ln y_{i,t-1} + \Psi X_{i,t-1} + \eta_i + \zeta_t + v_{i,t}, \quad (17)$$

$$\ln p_{i,t} = (1 + \beta) \ln p_{i,t-1} + \Psi X_{i,t-1} + \eta_i + \zeta_t + v_{i,t}, \quad (18)$$

where  $\eta_i$  is a district-specific fixed effect that allows for all unobservable heterogeneity across regions, and  $\zeta_t$  is a period-specific shock common to all districts.  $X_i$  will be a vector of variables that represents a wide array of growth and poverty auxiliary determinants that allows for predictable heterogeneity of each region's steady state. Apart from the education and health indicators, key additional auxiliary variables that will be considered are initial income and poverty, mean household income, inequality, inflation, total government revenue, general purpose local transfers (DAU), total government spending, public social protection expenditure and unemployment rate.

Initial income and poverty are expected to capture income convergence and persistence (or inertia) in impoverishment respectively. The literature has found that

growth in average income is correlated with reductions in the incidence and depth of poverty. Ravallion and Chen (1997) found that poverty declines to be strongly correlated with growth in mean incomes. Dollar and Kraay (2002) also find that “growth is good for the poor”: in a sample of 92 countries, over four decades, the mean incomes of the poorest 20% of the population grew on average at the same rate as overall mean incomes. State-level public expenditures and social safety nets are expected to directly affect the welfare and income generating capacity of the poor. Since large public expenditures do not always automatically translate into large outlays for social services, we include the ratio of social protection expenditure separately in the regression specification. The rate of inflation is also included and treated as a regressive tax, which erodes the purchasing power of the poor and distorts productive investment decisions in the economy. How much poverty rises with inflation will ultimately depend on the consumption expenditure pattern of the poor and their ability to ‘smooth’ consumption through dissaving and borrowing.

## 6. DATA

Data used in this study largely cover about 300 Indonesian districts for the period 2001 to 2012, except for regional output and public expenditure data that are available only until 2010/2011. In constructing the district panel, data from various sources were utilized, which includes: 1) Susenas-BPS, 2) The Indonesian Sub-National Growth and Governance Dataset from the Institute of Development Studies, 3) Fiscal data - Regional Financial Information System, Directorate General of Fiscal Balance, Ministry of Finance, 4) World Bank. The National Socioeconomic Survey (*Survei Sosial Ekonomi Nasional* or SUSENAS) is the main source of data for poverty, inequality, socio-economic, and human capital variables that capture the status of health and education levels of each district overtime.

The two income proxies that will be used are regional real GDP per capita ( $GDPPC_{i,t}$ ) and real household expenditure per capita ( $Mean\ Income_{i,t}$ ). To investigate the impact of education capital on growth and poverty, we utilize data on three indicators: gross secondary school enrollment ratio ( $h_{it}^{gersec}$ ), share of population with secondary education ( $h_{it}^{popsharesec}$ ) and years of schooling ( $h_{it}^{eduyears}$ ). Similarly to examine the impact of health on growth and poverty, we will utilize four indicators that capture and represent both the common causes of poor health and the status of the health service and system: prevalence of water-borne diseases ( $waterbornedisease_{it}$ ) in each district is proxied by the incidence of diarrhea, the incidence of non-immunized children ( $Poorimmunization_{it}$ ), coverage of skilled birth attendance at delivery ( $Skillbirthattendance_{it}$ ), and the incidence of self-medication ( $Selfmedication_{it}$ ) among the general population in each region.



Finally on the macroeconomic front, seven control variables will be used to capture real and fiscal sector conditions, labor markets and price levels: total government revenue-to-GDP (*Revratio*), DAU transfer revenue per capita (*DAUPC*), total government expenditure-to-GDP (*EX Pratio*), capital expenditure-to-GDP ( $S_{it}$ ), ratio of social protection spending-to-GDP (*SPEX Pratio*), unemployment rate (*Unemprate*) and change in general price level (*Inflation*).

## 7. ESTIMATION RESULTS

We first test how well the Indonesian data fits against the predictions of the augmented neoclassical growth model. We employ four alternative estimators: pooled OLS, within-group, difference and system GMM, to gage the performance of the data in the neoclassical growth framework. All within-group regressions include district-specific and time-invariant fixed effects. As highlighted by Lorentzen, McMillan and Wacziarg (2008) in cross-country growth regressions, we too will abstain from attaching any definitive interpretations to partial correlations causally, recognizing the fact that causality might run both ways, especially with the OLS estimator. Instead, the attention will be on partial associations and whether the estimated coefficients are big enough to depict a picture that can account for a large portion of cross-regional differences in economic performance.

Table 2 presents the estimates from the basic neoclassical growth model and the augmented Solow model with education capital. Education capital at the district level is captured by three variables: gross secondary school enrollment ratio, share of population with secondary education and years of education. The four sub-columns presents the estimates from pooled-OLS (POLS), within-group (WG), difference-GMM (Diff-GMM) and system GMM (Sys-GMM) respectively. Firstly for the canonical neoclassical model, it is evident from Table 2 that the coefficient on lagged output has the expected negative sign, and is strongly significant for all of the four different estimators. Thus, after controlling for other factors, initially poorer districts tend to grow faster, and is consistent with augmented Solow model. The estimated coefficients on the investment rate and the rate of population growth are also statistically significant with proper signs, and are thus consistent with the predictions of the neoclassical growth model. Overall, all of these confirm the principle neoclassical growth paradigm results that, lower initial income and population growth rates, and higher investment rates are to be associated with an increase in long-run per capita output growth.



**Table 2.** Neoclassical Model Augmented with Education Capital (continued)

	Dependent Variable: $\Delta Y_{it}$							
	DIFF-GMM				SYS-GMM			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$\ln(Y_{i,t-1})$	-0.045** (0.018)	-0.274*** (0.093)	-0.368** (0.162)	-0.033*** (0.013)	-0.081** (0.038)	-0.069*** (0.027)	-0.042* (0.022)	-0.014** (0.006)
$\ln(n_{it} + g + \delta)$	-0.029*** (0.011)	-0.034*** (0.011)	-0.023* (0.012)	-0.062*** (0.024)	-0.036*** (0.010)	-0.020* (0.012)	-0.034*** (0.007)	-0.058*** (0.011)
$\ln(S_{it})$	0.015*** (0.004)	0.044*** (0.013)	0.050*** (0.017)	0.007** (0.003)	0.017*** (0.005)	0.017*** (0.004)	0.014*** (0.005)	0.007** (0.003)
$\ln(h_{it}^{gersec})$		0.065** (0.029)				0.062** (0.025)		
$\ln(h_{it}^{popsharesec})$			0.116* (0.060)				0.044* (0.023)	
$\ln(h_{it}^{edinears})$				0.050** (0.023)				0.029*** (0.009)
Constant					0.709 (0.568)	0.623 (0.438)	0.255 (0.376)	-0.143 (0.161)
Observations	2032	2211	2211	2211	2317	2211	2211	2039
R-Squared								
Hansen Test	0.108	0.154	0.333	0.126	0.161	0.138	0.140	0.282
AR(1)	0.000514	0.000536	6.65e-05	0.00579	0.0292	0.000991	0.00118	0.00652
AR(2)	0.383	0.987	0.863	0.308	0.597	0.985	0.550	0.278

**Table 3.** Baseline Neoclassical Model Augmented with Health Capital

	Dependent Variable: $\Delta Y_{it}$									
	WG					System-GMM				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
$\ln(Y_{i,t-1})$	-0.422*** (0.019)	-0.365*** (0.022)	-0.540*** (0.027)	-0.451*** (0.023)	-0.431*** (0.048)	-0.081** (0.038)	-0.179*** (0.017)	-0.148*** (0.019)	-0.190*** (0.018)	-0.425*** (0.051)
$\ln(n_{it} + g + \delta)$	-0.027*** (0.005)	-0.032*** (0.006)	-0.016** (0.007)	-0.025*** (0.007)	-0.032*** (0.008)	-0.035*** (0.010)	-0.160*** (0.012)	-0.162*** (0.015)	-0.142*** (0.014)	-0.186*** (0.019)
$\ln(S_{it})$	0.051*** (0.004)	0.054*** (0.005)	0.057*** (0.006)	0.016* (0.009)	0.018 (0.012)	0.017*** (0.005)	0.045*** (0.005)	0.044*** (0.007)	0.053*** (0.006)	0.101*** (0.017)
$\ln(\text{Skillbirthattende}_{it})$		0.011* (0.006)					0.066*** (0.008)			
$\ln(\text{Poorimmunization}_{it})$			-0.061*** (0.019)					-0.087*** (0.025)		
$\ln(\text{Selfmedication}_{it})$				-0.040 (0.028)					-0.096*** (0.031)	
$\ln(\text{waterbornediseases}_{it})$					-0.009** (0.004)					-0.050*** (0.009)
Constant	5.007*** (0.266)	4.082*** (0.320)	6.689*** (0.374)	6.344*** (0.412)	6.026*** (0.691)	0.709 (0.568)	1.178*** (0.205)	0.682*** (0.220)	1.144*** (0.200)	3.108*** (0.397)
Observations	2317	2135	2135	2135	2135	2317	2135	2135	2135	2135
R-Squared	0.258	0.234	0.311	0.273	0.286					
Hansen Test						0.161	0.193	0.184	0.165	0.169
AR(1)						0.0292	0	0	0	5.96e-07
AR(2)						0.597	0.284	0.355	0.259	0.253

Next, results for the neoclassical model augmented with education-capital variables in Table 2 suggest that for all four estimators, gross secondary enrollment rates to have a positive and significant effect on the growth rate of output per-capita. The share of population with secondary education in each district also exhibits a significant positive role in regional growth. As expected the coefficients for the years of schooling too are positive and statistically significant. A comparison of the coefficients across the four estimators indicate that the magnitude of system GMM estimates to be higher relative to simple pooled-OLS. Furthermore, statistical significance is also higher for the years of education variable relative to enrollment and share of population with secondary education in all four estimators. In all GMM regressions, the Sargan/Hansen test does not reject the validity of the over-identifying restrictions. The Arellano-Bond test also accepts the hypothesis of no autocorrelation of the second order. GMM estimator is consistent only when second-order correlation is not significant although first-order correlation need not be zero (Nkurunziza and Bates, 2003). Therefore, both the serial correlation and the Sargan/Hansen test support the validity of all GMM estimates.

Next, Table 3 presents the results for the neoclassical growth model augmented by several indicators capturing the population's health and status of the health service and system of each district. The table also presents our preferred GMM coefficient estimates of the growth equation and the fixed-effects estimates for the purpose of comparison. The diagnostic statistics for the GMM estimates indicate that the model is well specified and fits the data relatively well. In particular, there is no second order serial correlation, and the Hansen test statistic, which is a joint test of identification and model specification, indicates that the model is well specified with the appropriate instrument vector.

Both, within-group and dynamic panel system-GMM coefficient estimates for all health variables are significant and have the expected signs, except for self-medication which appears insignificant with the Within-Group estimator. This result is consistent with other previous studies such as and Cole and Neumayer (2006), where increased prevalence of waterborne diseases like diarrhea tends to have a significant negative association with economic growth. Skilled birth attendance rate is statistically significant for both estimators and exhibits a positive impact on growth. Growth also tends to be lower for districts that lack immunization coverage and for those that have high self-medication rates. Overall, independent of the estimation method, we find a fairly robust association of health capital with district economic performance. Further, levels of significance and the magnitudes of our coefficient estimates reinforce findings at cross-country level (Lorentzen, McMillan and Wacziarg, 2008; Bloom, Canning, and Sevilla, 2004; Mankiw-Romer-Weil, 1992; Lucas, 1988), namely that health seems to have an important effect on growth.

For the poverty-human capital model, Table 4 to Table 7 present the Within-Group and System-GMM estimation results for the district level poverty specifications. Tables 4 and Table 7 presents the fixed effects and system GMM results for baseline poverty human capital model respectively. Table 5 and Table 6 gives the fixed effects and

system GMM results respectively for the extended specification with additional economic controls respectively.

**Table 4.** Baseline Poverty-Human Capital Model – Fixed Effects

	Dependent Variable: $\ln(PHI)$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(PHI_{i,t-1})$	0.460*** (0.016)	0.418*** (0.017)	0.459*** (0.016)	0.699*** (0.021)	0.263*** (0.021)	-0.039* (0.023)
$\ln(Mean\ Income_{i,t})$	-0.184*** (0.008)	-0.182*** (0.008)	-0.179*** (0.008)	-0.105*** (0.011)	-0.276*** (0.010)	-0.385*** (0.011)
$\ln(Gini_{i,t})$		0.042* (0.023)				
$\ln(h_{it}^{eduyears})$			-0.037* (0.019)			
$\ln(Poorimmunization_{it})$				0.024*** (0.003)		
$\ln(waterbornediseases_{it})$					0.013** (0.005)	
$\ln(Sillbirthattendance_{it})$						-0.030*** (0.011)
Constant	1.243*** (0.081)	1.203*** (0.105)	1.234*** (0.082)	0.762*** (0.119)	2.088*** (0.109)	2.862*** (0.133)
Observations	2524	2295	2524	2524	2524	2524
R-Squared	0.622	0.540	0.623	0.687	0.556	0.532

Firstly we include lagged poverty, mean household income and later per capita GDP to capture persistence effects (inertia) and to examine trickle-down effects: whether increases in average living standards have translated into poverty reduction. The coefficient for lagged poverty is significant and positive for all specifications under both the fixed effect and GMM estimators, highlighting the tendency towards poverty persistence where poor districts have some socio-economic traits that makes them stay poor. Our estimates also yield a significantly negative coefficient for mean income thus suggesting that poverty is intimately linked to the average income of the population. Next the coefficient for per capita GDP is significant and negative in Table 5 and Table 6 for both the fixed effects and system GMM estimators, reflecting effectiveness of economic growth in alleviating impoverishment across districts in Indonesia. Inequality elasticity of poverty also appears to be positive and significant, revealing how poverty reducing growth effects can be easily diluted by high levels of inequality across districts. Across all specifications and estimators, we find that increased education capital to be associated with a lower level of district poverty.

**Table 5.** Poverty-Human Capital Model Augmented with Other Economic Variables – Fixed Effects Estimates

	Dependent Variable: $\ln(PHI)$									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\ln(PHI_{i,t-1})$	0.456*** (0.016)	0.439*** (0.018)	0.437*** (0.018)	0.688*** (0.024)	0.493*** (0.018)	0.491*** (0.019)	0.419*** (0.020)	0.408*** (0.022)	0.200*** (0.028)	0.414*** (0.017)
$\ln(\text{Mean Income}_{i,t})$	-0.173*** (0.008)	-0.171*** (0.009)	-0.166*** (0.009)	-0.100*** (0.012)	-0.148*** (0.009)	-0.151*** (0.010)	-0.126*** (0.010)	-0.154*** (0.011)	-0.430*** (0.016)	-0.173*** (0.009)
$\ln(GDP\text{PC}_{i,t})$	-0.068*** (0.022)	-0.059*** (0.023)	-0.056** (0.023)	-0.061** (0.030)	-0.075*** (0.022)	-0.048** (0.022)	-0.084*** (0.024)	-0.057** (0.025)	-0.107*** (0.039)	-0.062*** (0.023)
Inflation		0.264*** (0.070)	0.269*** (0.070)	0.188** (0.083)	0.351*** (0.071)	0.334*** (0.072)	0.317*** (0.071)	0.354*** (0.087)	0.378*** (0.089)	0.359*** (0.071)
$\ln(h_{it}^{\text{eduyears}})$			-0.037* (0.020)							
$\ln(\text{Poornimmunization}_{it})$				0.022*** (0.004)						
$\text{Revratio}_{i,t-1}$					-0.263*** (0.064)					
$\ln(DAUPC_{i,t-1})$						-0.018*** (0.006)				
$\text{EX Pr atio}_{i,t-1}$							-0.365*** (0.057)			
$\text{SPEX Pr atio}_{i,t-1}$								-3.057** (1.481)		
UNEMP RATE									1.392*** (0.267)	







According to Tables 3-7, both fixed effects and System-GMM results indicate that districts with low standard of living are the ones with poor immunization coverage and high prevalence of water-borne diseases such as diarrhea. This highlights the fact that that poorer regions tend to be more precarious, with less sanitary environments and limited access to healthcare, which contribute to the increasingly poorer health, lower productivity and income. Similarly our results from Tables 3-7 suggest that poorer districts to be strongly linked with lower access to skilled birth attendance during birth delivery.

**Table 7.** Baseline Poverty-Human Capital Model – System GMM Estimates

	Dependent Variable: $\ln(PHI)$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(PHI_{i,t-1})$	0.774*** (0.079)	0.746*** (0.088)	0.842*** (0.060)	0.977*** (0.020)	0.767*** (0.036)	0.723*** (0.068)
$\ln(\text{Mean Income}_{i,t})$	-0.114*** (0.029)	-0.137*** (0.027)	-0.078*** (0.023)	-0.019 (0.016)	-0.119*** (0.015)	-0.083*** (0.018)
$\ln(\text{Gini}_{i,t})$		0.154*** (0.047)				
$\ln(h_{it}^{\text{eduyears}})$			-0.071*** (0.026)			
$\ln(\text{Poorimmunization}_{it})$				0.048*** (0.005)		
$\ln(\text{waterbornediseases}_{it})$					0.044** (0.021)	
$\ln(\text{Sillbirthattendance}_{it})$						-0.136*** (0.051)
Constant	0.953*** (0.229)	1.392*** (0.208)	0.748*** (0.186)	0.266 (.173)	1.184*** (0.159)	0.363* (0.214)
Observations	2524	2295	2524	1694	1948	2419
Hansen Test	0.174	0.316	0.284	0.172	0.264	0.562
AR(1)	0.0133	0.0164	0.0188	0	0	0.0209
AR(2)	0.581	0.665	0.476	0.0139	0.157	0.563

Inflation is found to have a significant poverty-increasing effect. System-GMM results also suggest that the impact of inflation becomes insignificant after controlling for the district-level unemployment rate. Results for total government expenditure and spending on social protection are statistically significant, and exhibit powerfully poverty-reducing impacts in both the fixed-effect and GMM estimators. This result is consistent with other accounts in the literature such as by Barro and Sala-i-Martin (1995)

and Soares *et al.* (2006). Results also suggest that employment remains to be significant factor in reducing the district level poverty rate.

## 8. CONCLUSION AND POLICY IMPLICATIONS

Despite the vast empirical literature on testing the neoclassical model of economic growth using cross-country data, very few studies exist at the sub-national level. We attempt to fill this gap by utilizing panel data over the 2002-2012 period, a modified neoclassical growth equation, and a dynamic panel estimator to investigate the effect of both health and education capital on economic growth and poverty at the district level in Indonesia. Secondly, whilst most existing cross-country studies tend to concentrate only on education as a measure of human capital, we expand the analysis and probe the effects of health capital as well. As far as we are aware, no study has directly and comprehensively examined the impacts of health on growth and poverty at the subnational level. Thus, this study is the first of its kind at the subnational level and our findings will be particularly relevant in understanding the role of both health and education capital in accelerating growth and poverty reduction efforts.

The empirical findings are broadly encouraging. Firstly, nullifying any doubts on the reliability of Indonesian sub-national data, our results suggest that the neoclassical model augmented by both health and education capital to provide a fairly good account of cross-district variation in economic growth and poverty in Indonesia. We find that the results on conditional convergence, physical capital investment rate, and population growth to confirm the theoretical predictions of the augmented neoclassical model. Economic growth was found to play vital role in reducing Indonesian poverty, reinforces the importance of attaining higher rates of economic growth. We find that education human capital has a relatively large and statistically significant positive effect on the growth rate of per capita income. We find the growth impact of education human capital to be much larger than the growth impact of physical capital investment. This may imply that the reliance only on increased physical capital investment as a mean to accelerate growth in Indonesia may not be the most appropriate policy and strategy. Findings from the poverty-human capital model also found that districts with low levels of education to be characterized by higher levels of poverty.

In the course of examining the association between health and economic performance, we utilized four indicators that capture and represent both the common causes of poor health and the status of the health service and system: prevalence of water-borne diseases, skilled birth attendance, immunization rate, and the incidence of self-medication. Findings from the study reveal that the linkages of health to poverty reduction and to long-term economic growth in Indonesia are powerful, and much stronger than is generally understood. Results indicated that health disparities are mostly related to location, and typically the less healthy are those living in the poorest districts and regions.

Our results suggest that poor regions often do not have the same opportunity as the non-poor regions to benefit from the protection of immunizations. Thus, their capabilities are lowered by poor health and furthermore, they have a reduced ability to benefit from capacity building educational opportunities. Estimates from district-level poverty regressions suggest that, generally the different types of disparities overlap and interact. Poorer districts with less educated also likely to be those without adequate immunization coverage. As a result, improvements in just one aspect of their lives might not make much difference to their health. The benefits of better access to health services, for example, might still be outweighed by the effects of low income or the lack of education. But in some cases, even a single factor could become a stumbling block. In some districts, for example, just improving the level of income could on its own lift the health standard of the whole region. Overall our results are consistent with the view that investment in human capital today will contribute to lower poverty tomorrow, not only through the expected impact on growth rates, but also by increasing the poverty-reducing power of growth.

One of our most important and robust findings concerns the positive role of public spending on social protection in reducing poverty. Thus it should be noted that poverty rates might have declined continuously in recent years, reflecting both the increase in the rate of economic growth and also partly due to the ongoing expansion of in social protection with improved poverty targeting. In the absence of these transfer programs, and together with the rising trend in inequality, the incidence of poverty in Indonesia would have been much higher than that of today.

There are both research and policy implications emanating from our results. Firstly, regional disparities in human and physical capital were found to be major hindrance to income and output growth. Minimization regional imbalances require a set of prudential economic policies such as: developing infrastructure in less developed regions, stimulating private sector investment to develop the regional characteristic industries, provision of additional fiscal transfers to local governments in due consideration of disparities and lagging characteristics and augmenting the administrative capabilities of local government bodies by strengthening the human resource capacities.

Investment was proven to play an important role in overcoming spatial disparities, and hence, incentives such as preferential tax and land-use policies are necessary to attract foreign direct investment to backward regions. With respect to our findings on social protection, an important lesson that can be learned from this sub-national level study is that well planned expansions in public social protection spending to play a vital role in the government's fight against poverty. Sensible monetary and labor market policies may not do any harm to the poor, in particular, managing inflation and job-creation efforts are likely to make a substantial contribution to contemporaneous poverty reduction efforts at the local and central government level in Indonesia. Additionally, inequality reducing distributionally-aware public policy will generate many positive contributions to growth and poverty reduction.

Persistence or the inertia effects of poverty found in this study also signifies the need

for policies such as improving the structural environment of markets, employment and security to avoid poverty traps across districts in Indonesia. The government should allocate funds to provide lagging districts and provinces with sufficient resources to “catch up” with the leading regions. Central government transfers should ensure that spending results in more equitable access to services. Transfers, potentially the Special Allocation Fund (DAK) could be increased or better aligned with poverty and to the degree of lack of access.

Education capital being associated with higher rates regional economic growth rates and lower poverty highlights the importance of policies related to schooling and learning. Enrolment is still particularly low in secondary education and efforts are needed to further enhance the quality of teaching. Since Indonesia has already achieved very high primary rates, the current development challenge should be placing more emphasize on improving the quality of education throughout the system and increasing enrollment rates for junior secondary education. With robust community-based monitoring systems in place, the government’s new policy of providing supplementary financial incentives for teachers working in remote schools is expected to improve the quality of services significantly, and in turn will contribute to the long-run efforts in poverty reduction and growth in the country.

Indonesia will need to at least sustain current levels of education spending in relation to GDP over the longer term to accomplish long-lasting improvements in learning outcomes. Measures need to be also taken to urgently inject the needed investments to renovate school buildings and other assets that have deteriorated badly over the years. Strengthening the management and governance of district education systems will also assist to minimize education inequalities. It will aid the Indonesia central government in laying the groundwork that guarantees no child is left behind along the development process. At the macro-level our results suggests that Indonesia should also take steps to stem the tide of this massive ‘brain drain’ that have long continued to exist. Concerted efforts by the government to attract the expertise of these émigrés back home will no doubt foster the growth and development process.

Powerful linkages of health to poverty reduction and to long-term economic growth in Indonesia underscores the importance health policies at the regional and national levels. Improving the health and longevity of the poor is an end to itself, and thus needs to be identified as a fundamental goal of economic development in Indonesia. The status of health in poor low-income districts stands as a stark barrier to economic growth and therefore must be addressed front and centre in any comprehensive development strategy, at least at the district level in Indonesia. Our findings provide enough consideration for including immunizations as a major element in all poverty reduction strategies in any region. Taken together, our results strongly indicate that expansions in health system coverage lead, on average, to an increase in per capita income and lower poverty across Indonesia. But at the same time, local government’s also needs to undertake a more integrated approach, looking beyond health to address many other inter-twined issues such as poverty, unemployment, nutrition, water supplies and sanitation, and women’s

empowerment. Findings from the study underline the importance of improving its quality and effectiveness health services - by strengthening the governance of health systems and ensuring sufficient trained staff, better infrastructure along with access to improved water supplies and sanitation. Finally, one last principle message that emerges from the study is that if the Indonesian government is to reduce welfare disparities and raise standards of health and education they will have to focus much more sharply on the needs of the poor and vulnerable.

#### REFERENCES

- Acemoglu, D., S. Johnson, and J. Robinson (2001), "The Colonial Origins of Coparative Development: An Emprical Investigation," *American Economic Review*, 91, 1369-1401.
- Aghion, P., and P. Howit (1998), *Endogenous Growth Theory*, Cambridge, MA: MIT Press.
- Arellano, M., and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *The Review of Economic Studies*, 58(April), 277-297.
- Arellano, M., and O. Bover (1995), "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, 68, 29-51.
- Baldi, G. (2013), "Physical and Human Capital Accumulation and the Evolution of Income and Inequality," *Journal of Economic Development*, 38(3), 57-83.
- Balisacan, A.M., E.M. Pernia, and A. Asra (2003), "Revisiting Growth and Poverty Reduction in Indonesia: What do Subnational Data Show?" *Bulletin of Indonesian Economic Studies*, 39, 329-351.
- Barro, R.J. (1991), "Economic Growth in a Cross-Section of Countries," *Quarterly Journal of Economics*, 106, 407-443.
- \_\_\_\_ (1997), *Determinants of Economic Growth: A Cross-Country Study*, MIT Press, Cambridge, U.S.A.
- \_\_\_\_ (1999), "Human Capital and Growth in Cross-Country Regressions," *Swedish Economic Policy Review*, 6(2), 237-277.
- Barro, R.J., and X. Sala-i-Martin (1995), *Economic Growth*, New York: McGraw Hill.
- Bhargava, A., D. Jamison, L. Lau, and C. Murray (2001), "Modelling the Effects of Health on Economic Growth," *Journal of Health Economics*, 718, 1-18.
- Bils, M., and P.J. Klenow (2000), "Does Schooling Cause Growth?" *American Economic Review*, 90(5), 1160-1183.
- Bloom, D.E., D. Canning, and J. Sevilla (2004), "The Effect of Health on Economic Growth: A Production Function Approach," *World Development*, XXXII, 1-13.
- Blundell, R., and S. Bond (1998), "Initial Conditions and Moment Restrictions in

- Dynamic Panel Data Models,” *Journal of Econometrics*, Elsevier, 87(1).
- Bond, S.R., A. Hoeffler, and J. Temple (2001), “GMM Estimation of Empirical Growth Models,” Economics Papers, 2001-W21, Economics Group, Nuffield College, Oxford, England: University of Oxford.
- Caselli, F., G. Esquivel, and F. Lefort (1996), “Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics,” *Journal of Economic Growth*, 1, 363-389.
- Chang F.R., and P.K. Trivedi (2003), “Economics of Self-Medication: Theory and Evidence,” *Health Economics*, 12, 721-739.
- Cole, A.M., and E. Neumayer (2006), “The Impact of Poor Health on Total Factor Productivity,” *Journal of Development Studies*, 42(6), 918-938.
- Dollar, D., and A. Kraay (2002), “Growth is Good for the Poor,” *Journal of Economic Growth*, 7, 195-225.
- Garcia, J.G., and L. Soelistianingsih (1998), “Why Do the Differences in Provincial Income Persists in Indonesia?” *Bulletin of Indonesian Economic Studies*, 34, 95-120.
- Hall, R.E., and C.I. Jones (1999), “Why do Some Countries Produce So Much More Output per Worker than Others?” *Quarterly Journal of Economics*, 114(1), 83-116.
- Hamoudi, A., and J. Sachs (1999), “Economic Consequences of Health Status: A Review of the Evidence,” Working Paper, 30, Harvard Center for International Development, Cambridge, MA.
- Handa, S. (2007), “Convergence in Indonesian Regional Income Disparity: Using Markov Transition Matrix Approach,” report of ICSEAD Research Project (06-03) *Comparative Analysis of Urban and Rural Disparity and Decentralization in Indonesia and China*, 91-106.
- Hoeffler, A. (2002), “The Augmented Solow Model and the African Growth Debate,” *Oxford Bulletin of Economics and Statistics*, 64(2), 135-158.
- Islam, N. (1995), “Growth Empirics: A Panel Data Approach,” *The Quarterly Journal of Economics*, 110(4), 1127-1170.
- Issa, H. (2005), “Human Capital Demographic Transition and Economic Growth,” *Journal of Economic Development*, 30(2), 49-65.
- Judson, R.A., and A.L. Owen (1999), “Estimating Dynamic Panel Data Models: A Guide for Macroeconomists,” *Economics Letters*, 65, 9-15.
- Kim, S., and Y. Kim (2000), “Growth Gains from Trade and Education,” *Journal of International Economics*, 5(2), 519-545.
- Knowles, S., and P.D. Owen (1995), “Health Capital and Cross-Country Variation in Income Per Capita in the Mankiw-Romer-Weil Model,” *Economic Letters*, 48, 99-106.
- \_\_\_\_\_ (1997), “Education and Health in an Effective-Labour Empirical Growth Model,” *Economic Record*, 73, 314-328.
- Lopez, C., B. Rivera, and L. Currais (2005), *Health and Economic Growth, Findings and Policy Implication*, London: MIT Press Cambridge.
- Lorentzen, P., J. McMillan, and R. Wacziarg (2008), “Death and Development,” *Journal*

- of Economic Growth*, 13(2), 81-124.
- Lucas, R. (1988), "On the Mechanics of Economic Development," *Journal of Monetary Economics*, 22(1), 3-42.
- Maksymenko, S., and M. Rabbani (2011), "Economic Reforms, Human Capital, and Economic Growth in India and South Korea: A Cointegration Analysis," *Journal of Economic Development*, 36(2), 39-59.
- Manning, C. (1997), "Regional Labour Markets During Deregulation in Indonesia," World Bank Policy Research Working Paper, 1728.
- Mankiw, N.G., D. Romer, and D.N. Weil (1992), "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics*, 107, 407-437.
- McDonald, S., and J. Roberts (2002), "Growth and Multiple Forms of Human Capital in an Augmented Solow Model: A Panel Data Investigation," *Economics Letters*, 74(2), 271-276.
- Miller, S.M., and M.P. Upadhyay (2000), "The Effects of Openness, Trade Orientation and Human Capital on Total Factor Productivity," *Journal of Development Economics*, 63, 399-423.
- Morley, R., and R. Lucas (1997), "Nutrition and Cognitive Development," *British Medical Bulletin*, 53(1), 123-134.
- Murray C.J.L., and A.D. Lopez (1996), *The Global Burden of Disease*, Boston: Harvard University Press.
- Nelson, R., and E. Phelps (1966), "Investment in Humans, Technological Diffusion, and Economic Growth," *American Economic Review: Papers and Proceedings*, 51(2), 69-75.
- Nickel, S. (1981), "Biases in Dynamic Models with Fixed Effects," *Econometrica*, 49, 1417-1426.
- Nkurunziza, J.D., and R.H. Bates (2003), "Political Institutions and Economic Growth in Africa," CSAE Working Paper.
- Pritchett, L. (2001), "Where Has All the Education Gone?" *The World Bank Economic Review*, 15(3), 367-391.
- Ravallion, M., and S. Chen (1997), "What Can New Survey Data Tell Us about Recent Changes in Distribution and Poverty?" *The World Bank Economic Review*, 11(2), 357-382.
- Resosudarmo, B.P., and Y. Vidyattama (2006), "Regional Income Disparity in Indonesia: A Panel Data Analysis," *ASEAN Economic Bulletin*, 23(1), 31-44
- Romer, P. (1989) "Human Capital and Growth: Theory and Evidence," Working Paper 3173, Cambridge, MA: National Bureau of Economic Research.
- \_\_\_\_ (1990), "Human Capital and Growth: Theory and Evidence," *Carnegie-Rochester Congerence Series on Public Policy*, 32, 251-286.
- Sachs, J., and A. Warner (1995), "Economic Reform and the Process of Global Integration," *Brookings Papers on Economic Activity*, 25, 1-95, 25th Anniversary Issue.
- Sahoo, P., R. Dash, and G. Nataraj (2012), "China's Growth Story: The Role of Physical



- and Social Infrastructure,” *Journal of Economic Development*, 37(1), 53-75.
- Sakamoto, H. (2007), “The Dynamics of Inter-Provincial Income Distribution in Indonesia,” Working Paper Series, 2007-25, Kitakyushu, Japan: The International Centre for the Study of East Asian Development.
- Sala-i-Martin, X. (1999), “I Just Run Two Million Regressions,” *American Economic Association Papers and Proceedings*, 87(2), 178-183.
- Schiff, M., and Y. Wang (2004), “Education, Governance and Trade-Related Technology Diffusion in Latin America,” IZA Discussion Paper, 1028, Bonn: IZA.
- Soares, S. (2006), “Análise de bem-estar e decomposição por fatores da queda na desigualdade entre 1995 – 2004,” *Econômica (Rio de Janeiro)*, 8(1), 83-115.
- Suryadarma, D., R.P. Artha, A. Suryahadi, and S. Sumarto (2005), “A Reassessment of Inequality and Its Role in Poverty Reduction in Indonesia,” Working Paper, SMERU Research Institute, Jakarta.
- Suryahadi, A., D. Suryadarma, and S. Sumarto (2009), “The Effects of Location and Sectoral Components of Economic Growth on Poverty: Evidence from Indonesia,” *Journal of Development Economics*, 89(1), 109-117.
- Suryahadi, A., G. Hadiwidjaja, and S. Sumarto (2012), “Economic Growth and Poverty Reduction in Indonesia Before and After the Asian Financial Crisis,” *Bulletin of Indonesian Economic Studies*, 48(2), 209-227.
- Timmer, P. (2004), “The Road to Pro-poor Growth: Indonesia’s Experience in Regional Perspective,” *Bulletin of Indonesian Economic Studies*, 40(2), 177-207.
- Temple, J. (1999a), “The New Growth Evidence,” *Journal of Economic Literature*, 37(1), 112-156.
- Watanabe, K., R. Flores, J. Fujiwar, and L.T.H. Tran (2005), “Early Childhood Development Interventions and Cognitive Development of Young Children in Rural Vietnam,” *Journal of Nutrition*, 135, 1918- 1925.
- Weil, D. (2007), “Accounting for the Effect of Health on Economic Growth,” *Quarterly Journal of Economics*, 122, 1265-1306.

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