HOW EDUCATION BREAKS THE CYCLE OF POVERTY: AN INTER-REGIONAL STUDY OF INDONESIAN HOUSEHOLDS

By

MASNIARITTA POHAN

Sarjana Ekonomi
Universitas Katolik Parahyangan
Bandung, Indonesia
2000

Magister Sains Perencanaan dan Kebijakan Publik
Universitas Indonesia
Depok, Indonesia
2003

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Dissertation Approved:

Dr. Jeffrey D. Vitale

Dissertation Adviser

Dr. Brian D. Adam

Dr. Arthur L. Stoecker

Dr. Keith D. Willett

Name: MASNIARITTA POHAN

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Abstract: The positive contribution of human capital to income has long been studied and shown to be significant. This study shows the importance of public spending on education in order to accelerate growth and reduce poverty. Results suggest that government expenditure on education programs can help overcome negative family socioeconomic conditions, leading to intergenerational improvement of income.

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CHAPTER I

INTRODUCTION

1.1. Background

This thesis focuses on the correlation between education improvement, poverty reduction, and national economic growth. Using Indonesia as a case study, it is aimed at shedding light on policies developing countries should implement in order to promote economic performance.

1.1.1. The Global Problem of Poverty

Poverty is a disadvantage to society. It constrains people's spending ability (Attanasio and Szèkely, 2004), lowers market potential which makes investment unprofitable (Cheng and Kwan, 2000), and lowers government's tax revenue. Government tax revenue only represents 7% of GDP in the Sub-Saharan Africa compared to 22% in industrial countries (Auriol and Warlters, 2005). Difference in lifestyle makes poverty definitions change overtime and across societies (Haughton and Khandker, 2009). World Bank (2012) generalizes this definition and defines poverty as a minimal state of wellbeing below which individuals do not have enough resources or capacity to satisfy their basic needs. Currently, the World Bank places the poverty line at $1.25 per person per day. Beyond the aforementioned negative impact on macroeconomic indicators, poverty is a social issue. It limits individuals' ability to attain a minimum acceptable way of life that includes proper housing, education, and health (Huston, 2011)..

A society with rampant poverty is more likely to exhibit low education, malnutrition, poor sanitation (Pakpahan et.al, 1995; Sudaryanto and Rusastra, 2006 ; Ahmed et.al 2007) and relatively low economic growth. To show the impacts of poverty on the international economy, some socioeconomic indicators from different countries are presented using reports from The World Bank (2012). It was reported that Burkina Faso had merely 63.2% of its primary school-aged children enrolled in school in 2011 compared to Australia or Japan which had 99% and 100% enrollment respectively even back in 1981. Based on WHO's definition of malnutrition, there were 29.1% undernourished children in Nepal in 2011. In 2010, only 17% of Burkina Faso population had access to proper sanitation while an advanced economy like Canada had 100% access to sanitation. From 2008 – 2011 Burkina Faso's economy grew approximately 5.2%, Nepal's economy grew 4.8% compared to Indonesia that grew almost 6% (The World Bank, 2012).

Following graphs represent relationships between a country's income, level of education, health, and poverty. Education is represented by number of secondary school age children enrolled in secondary education (Figure 1.1.), health is represented by percentage of population with improved sanitation facilities (Figure 1.2.), poverty is represented by the percentage of a country's population living below the $1.25/day poverty line (Figure 1.3.), and in all figures income will be represented by a country's current per capita GDP (World Bank, 2012).

Figure 1.1. Education and National Income

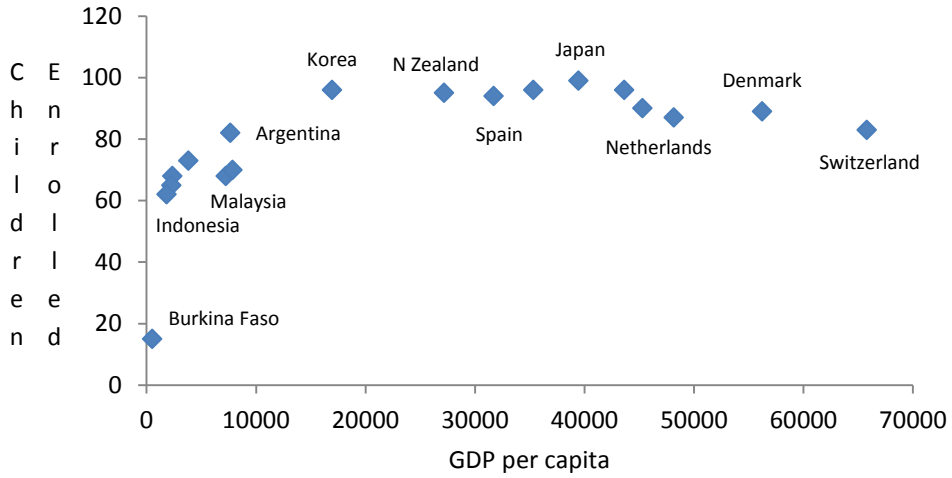


Figure 1.2. Proper Sanitation (% of population) and National Income

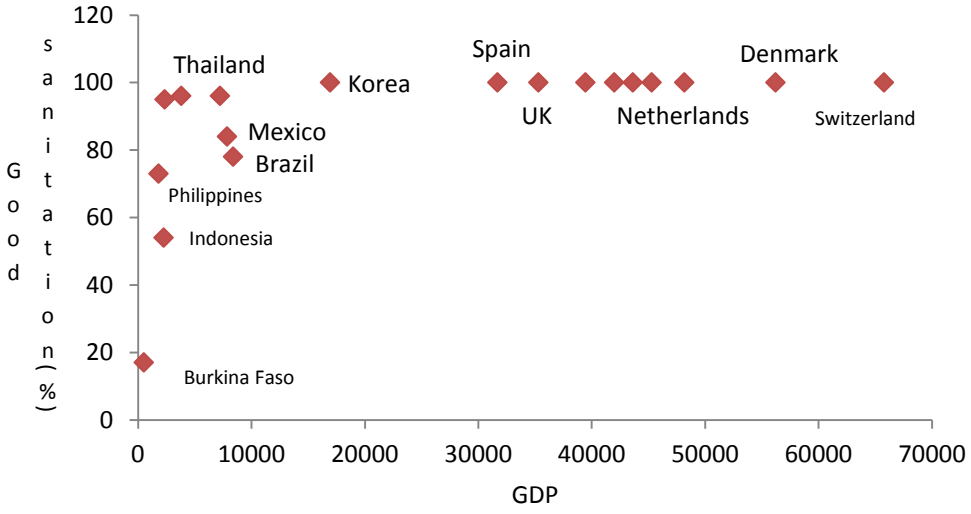


Figure 1.3. Population Living Below $1.25/day and National Income

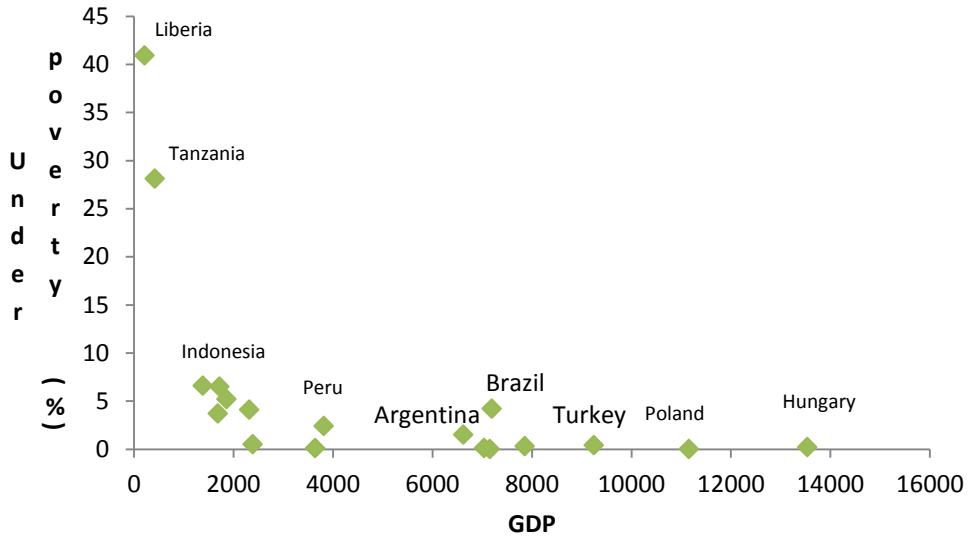


Figure 1.3 and World Bank's (2012) report jointly imply countries with good economic performance are associated with low poverty rates. High economic growth is then necessary for the attempt of poverty reduction.

1.1.2. Economic Growth and The Impoverished

The development economic literature provides multiple theories for improving economic growth such as industrialization and trade liberalization (Todaro, 1999). Empirical studies suggest that these scenarios when taken individually are often not as "pro poor" as intended (Foster and Rosenzweig, 2003). Yao (1997) reported that despite its significant contribution to China's rapid economic growth, industrialization was accompanied by increased inter-regional income inequality. Income distribution in rural China had become more skewed since economic reform. Over half of the national income inequality was due to inter-zonal inequality and the remaining three-fourths was due to inter-provincial inequality. The ratio between urban and rural gross output value among regions in China went up quite significantly from a range of 0.335-0.544 in 1986 to a range of 0.496-0.711 in 1992. Using rural income data and two alternative Gini coefficient decomposition methods, it was found that income inequality increased significantly in the period of 1986-1992 (Yao, 1997).

Furthermore, evidence from examination of specific developing countries following trade liberalization and from cross-country studies does not suggest that trade liberalization generally reduces inequality in poor countries. While the rate of foreign direct investment in Mexico went from 1.4% to 9.8% after it joined GATT in 1985, the wage rate gap worsened. The white-collar real hourly wages increased by 13.4% while blue-collar wages decreased by 14.0% (Feliciano, 2001). These reports suggest that industrialization and trade induced economic growth but often did not benefit all levels of a society equally.

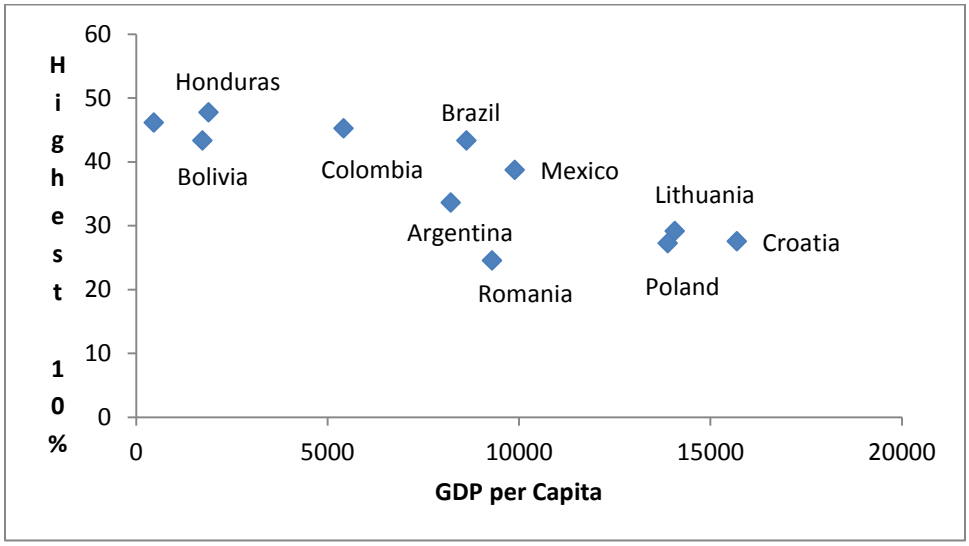
Economically, inequality itself may or may not be a bad thing, but problems of inequality arise when only a few people in a population are wealthy and many people are poor, and those that are poor have little opportunity for improvement. .

In the context of the above articles, inequality is a problem since there are only about 20-25% of the Chinese people living in urban China and benefiting from the industrialization (Yao, 1997). For Mexico, the wage gap also causes a problem since blue collar workers composed almost 65% of the employment (Feliciano, 2001).

Traditionally, equality is considered as a social issue instead of economic. However, classical development literature such as Kuznets, suggests differently. Better income distribution is correlated with higher per capita income (Kuznets, 1955). Evidence from developed economies supports Kuznet's idea. The income share held by the highest 10% of the population was slightly below 30% in 2000 for the US and for the Netherlands it was 23% in 1999, while in lower income countries such as Brazil or Colombia, the percentages are 47.7% in 2001 and 46.1% in 2002 respectively (World Bank, 2012). These findings suggest that equality is often found in conjunction with good economic performance (Figure 1.4).

It was shown in Figure 1.3 that higher income is associated with lower poverty. When this relationship is combined with Kuznets' idea, it can be suggested that economic growth, poverty reduction, and income redistribution are all correlated with one another.

Figure 1.4. Ten Percent Highest Income Share and National Income

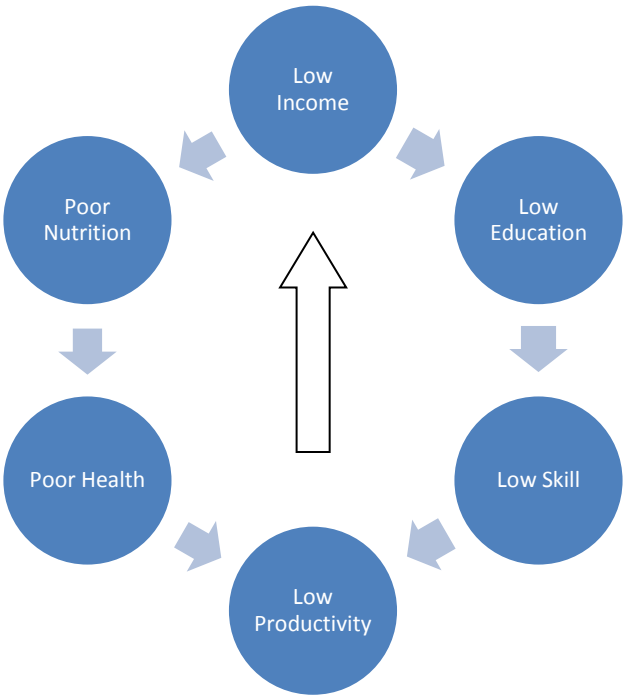


1.1.3. Income Redistribution Aspect of Human Capital

There are policy options to create more equal income distribution. One would be wealth transfer from the rich to the poor through taxation. However, such redistribution usually comes at a substantial cost in terms of misallocated resources and aggregate income losses which is unsustainable both politically and economically (Bardhan, 1996). Another policy option is through human capital improvement that will allow poor individuals to overcome the vicious cycle of poverty (Figure 1.5).

The poverty cycle can be viewed from two directions. On one side, the poverty cycle is created and perpetuated by liquidity constraints that limit households' ability to attain necessary level of education (Barham et al., 1995). Education raises cognitive and non-cognitive skill, increasing output given any combination of inputs (Appleton and Balihuta, 1996). Skillful workers are more likely to transfer from one job to another with ease (Stiglitz, 1975). Low education is associated with low skill and low productivity which is associated with lower wages (Juhn et al., 1993).

Figure 1.5 The Vicious Cycle of Poverty



The other side of the poverty cycle shows a two-way relationship between chronic poverty and malnutrition. Poor individuals or individuals born into a poor household are more likely to exhibit malnutrition. Chronic energy deficiency among mothers adversely affects their children (Radhakrishna et al. 2004). Undernourished children will intuitively grow up to be relatively less healthy than the well-nourished ones. When these previously undernourished children enter the workforce as adults they are less productive as well. Healthier workers have fewer days of illness-related absence from work and have less limitation due to health problem (Meerding, 2005). In turn, inadequate education and poor quality health cycles back, trapping impoverished households in low income (Ezeala-Harrison, 1996; World Health Organization 1998, 2001; Farmer, 2001; and Jong-Wook, 2003).

The positive contribution of human capital to economic development has been studied and found to be significant. Health quality contributes to the quality of labor force. There was found to be a robust relationship between life expectancy, a proxy for health capital stock, and income per capita (Knowles and Owen, 1995). World Bank (1993) reported that healthier individuals will improve economic growth through reduction of productivity loss, better usage of natural resources, increased school enrollment, and more productive alternative use of resources that would have been spent on health maintenance.

For instance, the prevention of deformity caused by leprosy would have added approximately $130 million to India's 1985 GDP. Sri-Lanka's near eradication of malaria increased the country's income by 9% due to the increase of land productivity. A study in Nepal had found that the probability of attending school was only 5% for undernourished children compared to 27% of those at the mean. In the US, it was estimated that a $220 million investment made over the course of fifteen years to eradicate polio would have prevented 220,000 cases and saved $320 million - $1.3 billion in annual treatment costs (The World Bank, 1993). Sachs (2003) reported that higher health quality

dramatically increases returns on foreign investments and lowers transaction costs of international trade, migration, and tourism.

Todaro (1999) suggested that the level of human resources is the central driving force in the achievement of economic development. Weakness in educational levels and human resources endowment has been one of the major constraints to the economic development of the LDC's (Ezeala-Harrison, 1996). Benhabib and Spiegel's 1994 study showed that education increased economic productivity through technological advancement. Education allows developing nations to accelerate their "catch-up" effect to advanced countries through innovating domestically, which eventually increases income. A percentage increase in human capital, measured by years of schooling, was found to increase GDP by 0.128. Moreover, Ros (2000) suggested that the substantial East Asian miracles of countries such as Korea and Taiwan were explained by their favorable human capital accumulation. Bose et.al (2007) study used a panel data of 30 developing countries such as India, Bangladesh, Ghana, Kenya, Morocco, Guatemala, Indonesia, and Thailand within the period of 1970 – 1990. It was found that there was a significant positive relationship between government spending in education and a country's growth. Government's education investment (e.g. school provisions) led to a 1.5% increase in GDP, government's total expenditure on education (e.g. school provisions, teachers' salary) leads to 0.68% increase in GDP, and both were significant at 1% level (Bose et.al, 2007).

But most importantly, the advantage of education compared to other economic policies such as industrialization and trade liberalization, is that education reduces the gap between income groups. Sylwester's multiple studies reported that public education expenditures were positively associated with a long term growth, though the contemporaneous effect was negative. Cross sectional study on Sub Saharan Africa, Latin America, and East Asia countries found that an increase in public expenditure in education lead to significantly faster growth ($p < 0.05$) by an average of 0.6442 (Sylwester, 2000). Furthermore, public education expenditure was also reported to be associated with

a decline of income inequality within a country as measured by Gini coefficient. By including OECD, East Asia, Latin America, and East Asia countries, it was found that an increase in the average number of years of schooling within the adult population will significantly decrease the inequality by 2.02 points (Sylwester, 2002).

As mentioned in the previous section, higher income is associated with lower poverty. Therefore, it is important to understand the necessary "ingredients" (as Stiglitz called it) for a rapid growth. Krugman (1994) and Young (1993, 1995) reported that high levels of investment and heavy expenditures on education explained most of the East Asian miracles. Stiglitz (1996) reported that one of the important factors that explained the success of East Asian Miracles is the enormous investment in human capital which reflects their stress on education. Stiglitz went further to suggest that the East Asian economies underwent active policies to promote equality. This action is believed to be one of the reasons why East Asian Miracles could defy the Kuznets curve of increasing inequality as income grows. In later years, these policies showed consistent contribution to economic growth. One of these policies was ensuring universal education which simultaneously promoted productivity, increases growth, and greater equality (Stiglitz, 1996). Combining Stiglitz' report and Sywester's findings, higher quality human capital can then be suggested to have a double role. It directly increases productivity that will lead to higher income, and also indirectly increases growth through reduction in the relative size of poor population. Higher growth helps poverty reduction that perpetuates better economic performance

1.1.4. Poverty Alleviation and Indonesia's Economy

Indonesia is an example of a country that significantly reduced poverty ($1.25 per day) from 15.6% in 1990 to 6% in 2002 and 3.3% in 2010 (World Bank, 2012). This figure is substantially better than countries such as Burkina Faso (from 34.7% in 1994 to 14.7% in 2009), Kenya (from 9.4% in 1994 to 16.9% in 2005) or the Sub-Saharan Africa region (from 22.4% in 2005 to 20.6% in 2008). Almost concurrently, Indonesia's government increased the share of education expenditure on

its budget from 11.5% in 2001 to 21.2% in 2009. Kenya on the other hand, reduced the proportion of government's education expenditure from 22.6% in 2001 to 17.2% in 2010. Although many factors may have contributed to Indonesia's economic growth, these numbers support the idea that policies, especially those aimed at overcoming education constraints, can potentially help making education more affordable for poor households. Better education can increase household income and eventually contributes to increasing economic growth.

Indonesia's achievement is interesting to study in order to determine the relationship between education, income growth, and poverty alleviation in the context of development. One of the reasons is that despite its considerable achievements in cutting the percentage of population living below poverty line by more than half from 17.40% in 1993 to 7.80% in 2002 (Ferreira and Ravallion, 2008) and increasing the number of Indonesians having high school diploma or above from 5,312 in 2000 to 10,989 in 2007 (Indonesia Family Life Survey - RAND Corporation, 1997- 2007) Indonesia's economic performance shows a noticeable inequality as shown in Table 1.1 (www.bps.go.id).

Table 1.1. Human Development Index Indicators of Selected Indonesian Provinces in 2007

	N Sumatra	Jakarta	S Kalimantan	W Sulawesi	S Sulawesi
GRDP	20	63	4	0.7	7.7
Illiteracy	3.27	1.24	5.95	13.60	13.76
People in Poverty	13.90	4.61	7.01	19.03	14.11
Clean water	49.85	49.27	54.87	41.02	47.12

GRDP is Gross Regional Domestic Product, measured in billions of dollars; Illiteracy is measured by percentage of population aged 15 or above who are illiterate; Poverty is measured by percentage of population living under the $1.25 line; Clean Water is measured by percentage of household having access to clean water

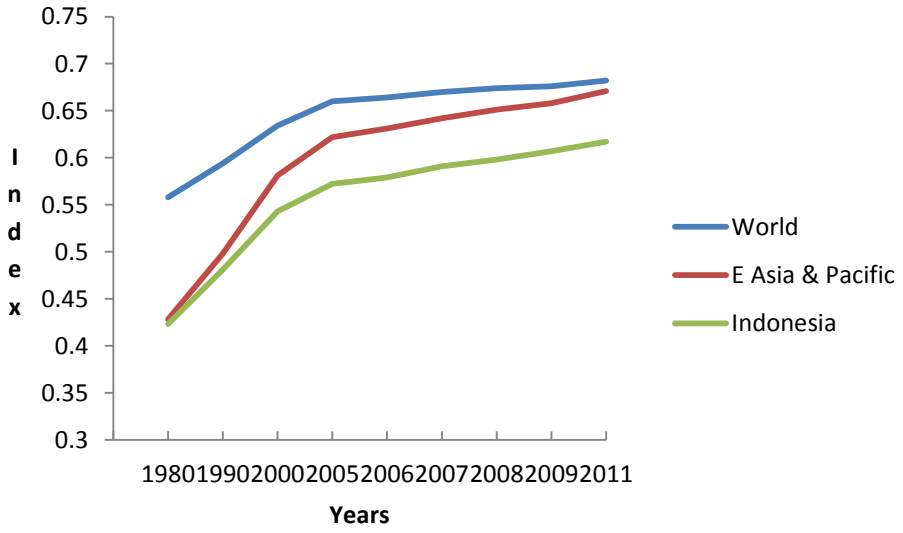
Source: Statistics Indonesia (www.bps.go.id)

As reported by UNDP (2012), Indonesia's socioeconomic condition is still significantly worse than the rest of the world and its regional counterparts (Figure 1.6). Kuznet's theory, along with Stiglitz and Sylwester's finding, suggest that better human capital helps income redistribution and hence accelerates growth. It is then inquired if Indonesia should invest in human capital improvement in order to increase growth and catch-up with its regional counterparts. Because Indonesia's rich resources have not been well developed, the country is highly resource constrained,

and it is important to identify a successful development strategy that makes the best use of its limited resources. This strategy should not only boost short run growth but more importantly sustain long run development through alleviating poverty and disparity reduction. This leads to the question of whether or not government intervention in education can help increase economic growth while reducing inter-regional income disparity. Consequently, this thesis is trying to answer:

(1) did better education and health increase Indonesian households income? (2) did better education and health help Indonesia break the cycle of poverty? (3) did public spending effectively increase Indonesia's household education and health quality? (4) What are (if any) the policy implications of Indonesia's regional income disparity?

Figure 1.6. International Human Development Index Comparison



Source: http://hdrstats.undp.org/en/countries/profiles/IDN.html

1.2. Study Objective

In order to answer the research questions posed above, the objective of this thesis therefore is first of all to explain Indonesia's household income. The second objective is to show whether public spending can effectively increase Indonesia's household level of education and health. Lastly, it is intended to determine whether income disparities call for "tailor-made" development policies.

Specifically, there are several hypotheses to be tested/investigated: (1) Different personal income level is caused by differences in education attainment and health quality either individually or simultaneously, (2) The ability to break the cycle of poverty is explained by education and/or health, (3) The difference in household education level and health quality is can be altered by public spending, and (4) The effectiveness of public spending in health and education will be altered by geographical characteristics.

1.3. Study Contribution

Studies regarding the dynamics of income are common. Benhabib and Spiegel (1994), Lucas (1990), Rivera and Currais (1999) and Bose et al. (2007) are a few examples of such research. However, the majority of them are done at country level instead of individual household level where they compare countries' performance given their human capital availability. This thesis is of importance because it focuses on household level income instead of aggregate. It also consistently tracks the same individuals across time in order to have better description of their personal economic progress.

Furthermore, it is an attempt to shed light on recommended policies to address the intergenerational aspect of income. Children's socio-economic condition impacts their income as adults. Treating 1997 as the base year, this thesis aims to determine the impact of public spending on children's education and health which eventually predicts their income as adults. An intergenerational analysis of human capital is needed because there is an endogeneity problem in explaining the relationship between education and health with income. As suggested by, among others, Benhabib and Spiegel (1994), Todaro (1999) and Bose et.al (2007) better education increases income. But on the other hand, income also predicts education attainment as suggested by Barham (1995) and Blanden (2005).

Referring to what Meer et al. (2003) reported, there is an endogeneity problem to wealth-health relationship. Richer people can afford better health care. On the other hand, healthier people can be more productive and hence can generate more wealth. The research concluded that the connection between wealth and health is not driven by short run changes in wealth. In summary, it implies that the relationship between health and income can be better explained using a lagged variable instead of treating all of them contemporaneously.

The existence of endogeneity is usually addressed by using an instrumental variable like Meer did. In this thesis a different approach is taken. The reason is because in order for a variable to be treated as a valid instrumental variable it has to be correlated with the independent variable(s), but uncorrelated with the dependent variable. In this case, if parent's income is treated as an instrumental variable to predict children's future income as adults through human capital accumulation, then parent's income needs to have no correlation with children's income which is hard to guarantee (Bedi and Gaston, 1999).

Instead, this thesis estimates contemporaneous relationship between individual's education and health with income. The process of human capital accumulation happens over time and is explained by a child's socioeconomic background and potentially public spending in education and health. Hence, this thesis tries to explain how family income affects an individual child's human capital accumulation process takes place over time and how it eventually affects his/her income as an adult.

1.4. Study Organization

The thesis will be organized as follows. Chapter II provides a literature review regarding the relationship between personal income, educational attainment, health quality, and family characteristics, as well as the theoretical background of models used in this research. Chapter III provides the methodology that will be used in order to answer the study objectives and hypotheses.

Chapter IV provides the results found in the models employed in attempts to shed light on the relationships between personal income and family characteristics. Chapter V concludes the study and provides policy implications as well as policy recommendations that can be deduced from this study. Data used in this study comes from three waves of Indonesian Family Life Survey (IFLS) conducted by The RAND Corporation in 1997, 2000, and 2007.

The survey involves individuals from 13 Indonesian provinces.

CHAPTER II

REVIEW OF LITERATURE

2.1. Intergenerational Aspect of Income

As suggested by Jenkins (2000) there is a time dimension to income growth. Using a logit model, he found that the probability of an individual entering or exiting poverty depends, among other things, on whether that individual was poor one period before. Using data from the British Household Panel Survey during 1991-1996, he grouped income levels using needs-adjusted income into <£0.5 weekly, £0.5-0.75 weekly, £0.75-1.00 weekly, £1.0-1.25 weekly, £1.25-1.50 weekly, and above £1.5 weekly. He found that the majority of households who were previously poor will remain poor the next period or at best moved up one level to the next higher income group. Of those who were poor in 1991, 53.2% remained poor in 1992. Even after three years, there was still a significant portion, 34.9%,who remained poor. On the other hand, those who are previously rich will remain rich even until the end of the study period. Up to almost 90% of rich households in 1991 remained rich in 1992 and even until 1996 almost 80% remained rich. The need for government intervention is then realized in order to intervene in the cycle, overcome the challenge and bring changes to the society.

It is realized that income growth also has an intergenerational aspect. A person born into a more endowed family is exposed to more available resources that will allow higher personal quality. Eventually, this will allow him/her to engage into higher-paying jobs that normally require higher skills.

Solon (1992) conducted research on how a son's income is related to his father's income. He employed the model $y_{1i} = \rho y_{0i} + \varepsilon_i$ where y_{1i} is the log of annual earning of the son in family i, y_{0i} is the log annual earning for his father, and ρ represents the true population correlation between y_{1i} and y_{0i}. In this study, sons are those individuals who are children in 1968 and reported positive income in 1985. This restriction assures that those who are included in the study are at least 25 years old. The model was first estimated using year-to-year measurements, and then replicated using two, three, four and five year averages. The result showed that for all measurements, the percentage increase in the father's income is significantly correlated with the increase in the son's income. Using year-to-year measurements, a one percent increase in the father's income will lead to an increase in the son's income of 0.386%, 0.271%, 0.326%, 0.285% and 0.247% for years 1967-1971 respectively. When we take the two year average, a percentage increase in the father's 1967-1968 average income will lead to a 0.425% increase in the son's income. The coefficients for 1968-1969, 1969-1970, and 1970-7971 are 0.425%, 0.365%, and 0.336% respectively.

Another study is by Fields et al. (2003) about household income dynamics in Indonesia, Spain, Venezuela and South Africa. They used location, household head age, household head education and household demographic such as number of children or household head gender as independent variables. It was found that initial income level was extremely important in explaining the change of income. The next important variables were change in employment status and change in number of children. In this study, household head's education attainment was not playing a significant role as was found in many other studies. The reason is that they are

measuring per capita income instead of the income magnitude which is highly dependent on the number of individuals supported by the household head. In all cases, initial income will lead to more income and is significant at the 5% level. In Indonesia, it leads to 0.052% change in per capita income. In South Africa, Spain and Venezuela it leads to 0.099%, 0.025% and 0.112% respectively. Higher household education leads to 0.015% higher income in Indonesia and was significant. It also leads to higher income in the other 3 countries but was not significant.

As mentioned before, a family's socioeconomic status plays a role in explaining a child's expected income as an adult. Blau (1999) did a study on the effect of family income on the cognitive, social, and behavioral development of young children. This link is one of the key factors determining the link between incomes of different generations within families. It also investigated the effects of parental investment behavior. The data used were obtained from the National Longitudinal Survey of Youth (NLSY) from 1979-1991. A child's development was indicated by his or her mathematics and reading scores, vocabulary tests, verbal memory, as well as their behavior problems such as index, motor, and social development. He differentiated income as current income and permanent income, after adjusting for price index. It was found that the impacts of both current and permanent income on cognitive scores are positive and statistically significant. An increase in current income is estimated to increase math scores by 0.203 points, increase reading ability by 0.189 points, increase vocabulary tests by 0.262 points and verbal memory by 0.069 points. Permanent income increases math scores by 0.4 points, reading scores by 0.368, verbal by 0.517 points and memory tests by 0.146 points.

2.2. Intergenerational Aspect of Education and Public Spending Impact on Education

Bedi and Gaston (1999) used an IV estimation to estimate the returns to education in Honduras. The study was motivated by the fact that educational outcomes are not assigned randomly across the population, instead years of education may be determined through a process

of self-selection. This means that reliance on OLS might cause an incorrect estimate. Hence, an IV estimate was employed instead with "School Availability" being the instrumental variable. One important note was, in order for school availability to be a valid instrument for years of schooling, it must influence the educational decision but be uncorrelated with the unobserved factors influencing earnings. The study suggested three alternative schooling models: continuous schooling, tobit model for schooling, and ordered probit for schooling. The first model suggested that school availability will increase earnings through instrumenting years of schooling by 0.169 and was significant at 10% level. The tobit model resulted in an increase of relative odds of having schooling by 1.13 when there were schools available and the coefficient was significant at the 5% level. Lastly, the ordered probit model suggested that school availability increases the relative odds of an individual to attain a higher level of education, which is to move from one schooling level to the next, by 1.11 and also significant at 5% level.

Crosnoe et al. (2002) studied the relationship between economic disadvantage, family dynamics, and adolescent enrollment in higher education. The study started off by acknowledging the abundance of literature showing the inverse relationship between family income and children's enrollment in higher education but not necessarily the mechanism behind it in a long term frame work. In order to show this relationship, they conducted their research using data from a 7-year study of low-income families in inner-city Philadelphia. In this study they also account for factors such as family size, family structure and education that contribute to an overall disadvantage. They suggested that economic disadvantage contributes to low educational attainment since it shapes parents' assessment of the future. Low income parents usually focus on the social psychological aspect instead of the opportunity of education. Their results showed that amongst children from under privileged families, less than half (48.9%) of young adults were enrolled or had graduated from 2-4 year colleges. The economic disadvantage also significantly predicts later enrollment in higher education by 0.33 and was significant at the 1% level. Parents'

perceived efficacy increases enrollment by 0.3 although not statistically significant. Furthermore, an increase in parents' assessment of adolescents' educational chances will indeed increase enrollment by 0.66 and was statistically significant at 1% level.

Jolliffe (2002) tried to investigate whether an increase in one's income is owed to a specific household member using data of Ghanaian households. Income equation was specified as $\ln(Y_j) = \alpha_0 + \alpha_1 \boldsymbol{X}_j + \sum_i \beta_i S_{ij} + \varepsilon_j$, where j denotes households and i denotes whether the individual has minimum, average, or maximum education within the household. Using a weak-link model, he found that minimum level of education was significantly leading to 0.016 increase in household income. Furthermore, using data of households with three or more adults, it was found that household head education will increase household income by 0.037 and it was highly statistically significant. The maximum education level of adult household member will increase income by 0.047, while the minimum adult education will increase household income by 0.038 but both are statistically significant at 1% level.

Blanden et al.'s study (2005) was aimed at investigating the intergenerational mobility in society as a measure of the extent of equality of economic and social opportunity. Their key findings were (1) there is an increasing relationship between family income and educational attainment between cohorts. The reason was that additional opportunities to stay in education at both age 16 and age 18 disproportionally benefited those from better economic backgrounds. (2) There is a narrowing gap between the staying rates at age 16 between rich and poor children. This means that the gap between the proportion of poor children and the proportion of rich children who stay enrolled by the time they reach the age of 16 is getting smaller. However, there is a further widening in the inequality of access to higher education. By taking the most intuitive approach of seeing where children from the most and least affluent families end up in the earnings as adults, Blanden et al. (2005) showed the intergenerational mobility of income. In Britain, children who were born in 1970 to the poorest group families were most likely to stay in

that group for 30 years while 40% of children born to the richest family groups were found to also stay in that group in the same time period. Realizing that sons' education varies according to parents' income, they showed that education explains around 35-40 percent of intergenerational coefficient. An increase in intergenerational mobility is explained by both an increase in sensitivity of education to parental income and educational attainment, and by an increase in the link between parents' incomes and sons' earning. Educational inequality has risen in all periods. Young people from the poorest income groups have increased their graduation rate by only 3% between 1981 – 1990s while those who were born to richer families increase graduation rate by 26% within the same time frame. On a different note, Blau (1999) found that all test scores are positively related with parents' education although not all were statistically significant. Mothers' education is significantly increasing vocabulary tests score, while fathers' education increases scores for math, reading and also vocabulary tests.

Yoav Ganzach's study (2000) was aimed at examining the interactions between parents' education, cognitive ability and educational expectations in determining children's educational attainment. Using the data from that National Longitudinal Survey of Youth on 8,570 Americans who were born between 1957 and 1964, in general the study planned to report the ability of more educated parents to create a social and physical environment that facilitates learning. Among others, one purpose of this article is to show that children's educational attainment is a function of parents' expectation which is formed by their educational attainment. The study found that parents' education strongly influences educational expectations and attainment.

A study by Debbie Hahs-Vaughn (2004) was aimed at investigating the impact of parents' education on students in higher education. Acknowledging the fact that students from low income homes are less likely to attend 4-year education institutions, attend full time, enroll directly after high school, and complete college, the study was aimed at determining the impact of parents' education on college students' ongoing process. Students whose parents have attained no

more than high school diploma are the least likely to aspire to a bachelor's degree and the least likely to be college qualified. First generation students, those whose parents are not college graduates, often do not use their high school years to prepare for college and hence are not prepared to pursue college education and often attend less prestigious institutions. Data from Beginning Postsecondary Students Longitudinal Study from 1990, 1992, and 1994 was used to see what factors are the most influential in the success of first generation students, students not coming from parents with a college education. She broke the analysis into three broad categories: prior college enrollment (includes preparation and planning for college), during college enrollment, and after leaving college. It was found that pre-collegiate traits were a stronger influence for non-first generation students (0.66 compared to 0.42 for first generation students) and on educational outcomes (0.75 compared to 0.28 for first generation students).

Other than education, it is also been believed that healthier individuals will be more likely to achieve higher educational attainment. Better health and nutrition are positively associated with gains in schooling in many areas; enrollment at younger ages, less grade repetition, more grades completed, less absenteeism, and better performance on test scores. Jere Behrman (1996) studied literature on the impact of health and nutrition on education attainment. It is specifically aimed at analyzing the magnitude of the effect of health and nutrition on schooling realizing that studies based on past data cannot provide much insight into what the effect might be if the incentives change a great deal as a result of educational reforms. An explicit framework has the advantage of clarifying which conditions reflect the effect of health and nutrition on education. He reported other previous studies by Soemantri et al. who assessed the effect of iron deficiency on children's cognitive development and school performance and found that iron supplements had significant positive effects on children.

Several studies tried to look at the education problem from a different perspective. Specifically, these studies analyzed the impact of school availability on school-age children's

enrollment. Filmer (2004) studied the impact of primary and secondary school availability on children enrollment in 21 poor countries. The study was conducted through a simulation of the impact of lowering the average distance between a child and the school on school enrollment using data from Demographic and Health Surveys (DHS) carried out in the 1990s. The results imply that although increasing school availability can be a tool for increasing enrollment, it cannot typically be expected to have a large effect. One of the main costs of schooling is the time spent traveling to school. This time can be used neither for productive activities nor for leisure. The value of travel time will depend on the individual child's opportunity cost of time. If primary school age girls look after their siblings, freeing up their mothers to engage in higher productivity activities, then time lost could be valued quite highly. Also, traveling long distance on foot might pose more of a personal safety issue for young girls than for young boys which might lead to enrollment of girls to be more sensitive to travel time than that of boys. In most cases, sensitivity to distance to the nearest primary schools is negative and was significant at 1% level. For instance, in Niger additional distance by one kilometer will reduce enrollment to primary school by 0.031 and to secondary school by 0.001. In Chad, an additional kilometer will reduce primary school enrollment by 0.017. In Zimbabwe, an additional kilometer to primary school will decrease enrollment by 0.005 and secondary school by 0.003. When the results from the simulation of setting distance to schools to zero was compared to the actual enrollment, it was found that the association was very weak. The plot of simulated enrollment and actual enrollment mostly were located on the 45-degree line which means simulated and actual result were the same. This plot suggested that even making the schools very close to where the children were at did not significantly increase school enrollment in most countries except for Chad, Benin, and Cameroon.

Lavy (1996) carried out a study on school supply constraints on educational outcome in rural Ghana. The study was motivated by the fact that many studies fail to acknowledge the

possibility that prices for all schooling affect the decision to attend any one schooling level. As previously suggested by Ben-Porath (1967) and Heckman (1976) individuals (parents) maximize the present value of their lifetime utility. Hence, deciding the optimal level of their human capital stock. This means deciding the optimal timing at which one should quit school and start renting out one's human capital in the labor market. The optimal number of years of schooling increases with the return to human capital and decreases with the cost of schooling. Difficult access to schools (e.g. distance to the nearest school, boarding fees) is very real for many rural households in Africa and represents real supply constraints on the level of schooling attended. Using data from Living Standards Survey in Ghana from 1987-1988 the study estimated the reduced-form demand for schooling as

$$Schooling_i = f(r_i, Z_{li}, Z_{hi}, Z_{ci})$$

where schooling is the number of years of schooling completed; r is the individual's rate of return to schooling; Z_{li}represents individual's characteristics such as age and gender; Z_{hi} represents household characteristics such as parental education; and Z_{ci}represents school characteristics (i.e. school quality). Rate of return itself was made as a function of a vector of the whole path of school fees and other direct costs, and characteristics of local labor markets that affect the rate of return. Using a logit model, the result suggested that for those aged 5-12 years old, female students are less likely to indicate that they ever attended school by 0.446. As the individual gets older the probability of going to school an individual indicates increases by 0.414. Both coefficients were statistically significant at 1% level. An increase in family income also significantly increases the probability of an individual to indicate going to school by 0.252 and was significant at 5% level. Father's education increases enrollment by 0.666 and mother's by 0.979, both were significant at 1% level. Distance to primary school decreases enrollment by 0.117, middle school by 0.098, and secondary school by 0.019. They were significant at 10% level and 1% level respectively.

Further, an ordered probit model was employed in order to investigate the impact of the same explanatory variables on the grade level of schooling attained. The results showed that for children aged 5-12 years old, the event of moving up to the next year of schooling is less likely to happen for girls by 0.75 and this partial effect was significant at 1% level. For children aged 9-12 the coefficient was even bigger, at 0.354 which means 0.7 less likely to take place and still significant at 1% level. For children aged 5-12 and 9-12, parents' income was not a significant predictor for additional grade level attained. Having a father who is a primary school graduate will increase the relative odds of children aged 5-12 to attain the next year of schooling (grade leve) by 1.4 and aged 9-12 by 2.1; both were significant at 1% level. Having a mother who is a primary school graduate will increase the relative odds of children aged 5-12 to attain the next higher grade by 1.6 and significant at 1% level. For children aged 9-12 the relative odds increases by 1.5, but is significant at only the 10% level. Distance still resulted in less probability of attaining the next grade level. Distance to primary school decreases the relative odds of attaining the next grade by 0.95 and 0.99 for children aged 5-12 and 9-12, respectively, but neither was statistically significant. Distance to middle school decreases the relative odds for both groups by 0.95 and 0.92; both were statistically significant at 1% level. Finally, distance to secondary school decreases the relative odds by 0.98 for children aged 5-12 and was significant at 1% level. For children aged 9-12 it decreases the relative odds by 0.99 and was significant at 5% level.

In some countries, school participation is affected by some features of the schools as well. Such findings were reported by Dréze and Kingdon (2001) who studied school participation in rural India. They based their analysis of the determinants of school participation on a survey of schooling in north India using PROBE (Public Report on Basic Education) survey. The study focused on school participation as a household decision. Each household will weigh the benefit and cost of schooling including direct and opportunity costs of schooling. The cost-benefit framework suggests that school participation is positively related to variables that enhance the

perceived benefits (or reduce the costs) of education. School quality has a positive effect on initial school participation and it also has a positive effect on further investment in education including keeping the child enrolled to attend the next grade. In this particular study's context, the variables of importance at the school level are student-teacher ratio, physical facilities, teacher attendance rates, provision of mid-day meals, severity of physical punishment, classroom activity levels, and teacher-parent cooperation.

Since the dependent variable was school enrollment, a probit or logit model was employed. The first noticeable result was the consistently lower result for a gender dummy variable, indicating that there was a gender bias towards school enrollment. For children age 5-18 years old, father's and mother's education resulted in positive coefficients 0.112 and 0.136 respectively and significant at 5% level. This means that an additional year of mother's years of education makes the event of children to be enrolled in school 1.15 times more likely to happen. An additional year of father's years of education makes the event of a child being enrolled in school 1.12 times more likely to happen.

Children who came from families with a casual labor occupation were 0.89 times less likely to be enrolled in school since the coefficient was -0.123, although this estimate was not statistically significant. Casual labor are those who are hired only when there is an excessive quantity of harvest, especially in farming. They are part time, supplementary workers hired only "on demand." On the other hand, children from families with regular wages did not have a significant advantage either though the coefficient showed a result of -0.009 which corresponds to the event of a child being enrolled in school 0.99 times less likely to happen.

Family's ownership of made the event of a child to be enrolled in school 1.03 times more likely to happen and was significant at 5% level. For children age 5-12 years old, the proportion of parents' education impact changed. Mother's education remained a larger factor having a

coefficient of 0.128 compared to 0.114 of father's education though both were significant at 5% level. Which means an additional year in mother's years of education made the event of a child to be enrolled in school 1.14 times more likely to happen. An additional increase in father's year of education made the event of a child being enrolled in school 1.12 times more likely to happen. Among the school level characteristics that were included in the estimation, mid-day meal provision made the event of a child's enrollment 1.1 times more likely to happen, though this estimate was but not statistically significant. For children aged 5-18, lunch provision made the event of enrollment 0.91 times less likely to happen though this estimate was not significant either.

Bedi and Gaston (1999) used and Instrumental Variable estimation to estimate the returns to education in Honduras. The study was motivated by the fact that educational outcome are not distributed randomly across the population, instead years of education may be determined through a process of self-selection. This means that reliance on OLS might cause an incorrect estimate. Hence, an Instrumental Variable estimate was employed instead with "School Availability" being the instrumental variable. One important note was, in order for a school availability to be a valid instrument for years of schooling, it must influence educational decision but be uncorrelated with the unobserved factors influencing earnings.

The study suggested three alternative schooling models namely continuous schooling, tobit model for schooling, and ordered probit for schooling. The first model suggested that school availability will increase earnings through instrumenting years of schooling by 0.169 and was significant at 10% level. Tobit model resulted in an increase of probability of having schooling by 0.124 when there were schools available and the coefficient was significant at 5% level. Lastly, the ordered probit suggested that school availability increases the probability of an individual to attain higher level of education, which is to move from one schooling level to the next, by 0.106 and also significant at 5% level.

2.3. Intergenerational Aspect of Health and Public Spending Impact of Health

Meer et al. (2003) reported their study research on the wealth-health nexus. It was realized that there is an endogeneity problem to this relationship since richer people can afford better health care but at the same time, healthier people can be more productive and hence can generate more wealth. In order to address this endogeneity, an instrumental variable technique was employed on estimating a probit model of an individual being healthy. Using data from the Panel Study of Income Dynamics from 1984, 1989 and 1994, they found that a change in wealth resulted in the coefficient of 0.0484. Since it is a probit model, the interpretation is that an increase in wealth over a 5 year period by a million dollars made the event of being in good health at the end of the period 1.05 times more likely to happen. After accounting for the endogeneity, initial level of wealth also plays a significant role in determining one's health status. An increase in initial wealth makes the event of a person being in a good health 1.6 times more likely to happen (exp(0.4781)).

McDonough et al.'s (1997) study was aimed at examining the association between individuals' household income trajectories and mortality. Caution was taken regarding the appropriate measurement of income; it was motivated by prior studies that found that cross sectional measurement may underestimate the effect of income on health. Prior studies found a consistent nonlinear effect where income beyond the median level had diminishing effects on health. It was acknowledged that income has an inverse relationship with mortality; however the impact might be stronger in a certain age group than in others.

Social groups might also govern the impact of income on mortality. Women are considered to live longer; the innate biological difference between races is also expected to alter the impact of income on mortality. Their data came from a PSID interview from 1968 to 1989 of individuals aged 45 or older in the middle of the 10-year period. Multiyear income was measured using three versions of household income: income at t_{-5} (five years before the start of the

observations), income at t_{-1}, and the income average of the five yearly observations. The income level was then categorized into (1) persistent low income (less than $20,000 for 4-5 years and never more than 70,000); (2) transitory low income (less than $20,000 for 1-3 years and never more than 70,000); (3) transitory high income (more than $70,000 for 1-3 years and never less than 20,000); (4) persistent high income (more than $70,000 for 4-5 years and never less than $20,000); and (5) all others. It was found that, as many other studies found, income has a strong inverse relationship with mortality and it was particularly noticeable among those whose annual income was less than $30,000 and the impact decreases along with rising income levels.

Moreover, Adriana Lleras-Muney's (2005) study which was aimed explaining the relationship between education and mortality rate hypothesized that education increases health because it makes people better decision makers and/or more educated people have better information about health. She specifically studied the impact of instituting a compulsory schooling law on individual's health. The first result was that compulsory schooling increased years of schooling by 5%. Using data from the US census 0f 1960, 1970, and 1980 she created synthetic cohorts to investigate this relationship. Her research showed that there is enough evidence to believe that compulsory schooling lowered mortality; mortality rate drops for the first cohort affected by the law. On each category of child education law, compulsory education increased years of schooling by at least 30% and each is significant at 5% level. Eventually, education law was found to lead to lower mortality rate by 0.017% but was not statistically significant when calculated using NHEFS data. However, when calculated using US Census data, compulsory schooling led to 0.037% decrease in the mortality rate of children aged 10 or less and was statistically significant at 5% level.

When investigating the new pattern of relationship between income and health, Ettner (1996) employed both ordinary and Instrumental Variable estimates to show that income significantly improves mental and physical health but increases the prevalence of alcohol

consumption. Using depressive symptoms, number of bed days, average daily alcohol consumption and alcoholic behaviors from National Survey of Families and Households as health status measurements, it was found that income has a strong positive association with self-assessed health status and a strong negative association with depressive symptoms, work limitations, functional limitations, and bed days. An increase of income by $2,843-$5,030 (one standard deviation away) would reduce number of bed days by 0.26. Based on the IV estimates, increasing monthly income by one standard deviation would cause the event of functional limitations to be 0.49 times less likely to happen. It would reduce the quarterly bed days by 0.75 bed day per quarter, and reduce weekly depressive symptom-days by 3.82 days per week during the previous four months.

Elo and Preston (1996) examined the magnitude of educational mortality along with a broader set of demographic and socioeconomic variables within a multivariate framework using data from the United States' National Longitudinal Mortality Survey from 1979-1985. The data were broken down according to age groups and gender. Summary statistics showed that in all cases, college graduates have lower mortality rates than high school graduates, though there was an exception in that high school graduates, who have higher mortality rates than those who did not complete high school. The ratio among older males was also higher than older females (1.46 times compared to 1.38 times).

They continued with multivariate analysis by distinguishing between socioeconomic characteristics acquired at birth such as race, region of birth, and year of birth, and characteristics that are evaluated during the interview such as family income, marital status, metropolitan residence and number of household members. Mortality rates were estimated using a log-linear function of relative probability of dying as a function of age, region, race, and educational attainment. For both males and females, those with at least 16 years of education (college graduates) are less likely to die between the ages of 25-64.

For males, the event of college graduates to die between the ages of 25-64 is 0.76 times less likely to happen than the event of non-college graduates to die within the same age range. The event of college graduate males dying between the ages of 65-89 is 0.8 times less likely to happen than the event of non-college graduate males dying in that age range.; both were significant at the 1% level. For females, education did not have a significant impact for younger individuals. For older individuals, the event of college graduate females to die between the ages of 65-89 is 0.83 times less likely to happen than the event of females who are not college graduates to die within that age range. Also as expected, richer individuals tend to live longer for both males and females in all cases at 1% significance level. The event of richer males dying between the ages of 25-64 is 0.73 times less likely to happen than the event of poorer males dying within that age range. The event of richer males dying between the ages of 65-89 is 0.88 times less likely to happen than the event of poorer males dying within that age range. The event of richer females dying between the ages of 25-64 is 0.96 times less likely to happen than the event of poorer females dying within those ages.

Flores et al. (1999) studied the relationship between ethnicity, family income and parental education on children's health status prompted by the realization of the lack of studies dedicated to explaining the interrelationship between those variables. Using data from National Health Interview Survey (NHIS) of specific individuals from their birth to 17 years of age, they tried to investigate the existence of health difference due to family income and parental education. It was found that non-White individuals are roughly 50% more likely to be in a suboptimal health condition category with 5% significance level. As expected, suboptimal health quality status was directly associated with lower income and parental education.

Contoyannis et al. (2004) studied the dynamics of health in the British household to explore the consequences of the health-related attrition, specifically the relationship between self-assessed health and socioeconomic status. They used data from British Household Pane Survey from 1991-1999. In their analysis, they proposed a model where current health status is a function

of a constant, last period's health status, and a vector of explanatory variables which includes income, age and marital status. For men, income will increase health status consistently though not statistically significant. The older an individual is, the more likely he or she is to have a lower health status, which is mostly intuitive, though, again, not statistically significant. Marital status is associated with higher health status with coefficients ranging from 0.041 to 0.074 and mostly significant at 5% level except for year 1993. This means that the event of single men having a high quality of health is 0.93-0.96 less likely to happen than the event of married men to having high quality of health. Furthermore, education level also was found to be positively correlated with health quality status. Men who have at least a university degree were found to be significantly healthier than those who do not. For women, a similar pattern was found although income was found to be significantly improving health in years 1993-1995 with coefficients 0.026, 0.027, and 0.025 respectively. Since the coefficients are near to zero, the relative odds are approximately one, which implies approximately equal probability. This means that the probability of a woman who earns a one percent increase in income to have improved health is approximately the same as those who do not earn additional income. In other years, higher income is associated with better health – the coefficients range from 0.0009 to 0.02 but are not statistically significant. This also means that the probability of a woman who earns a one percent increase in income to have better health is approximately the same as those who do not earn additional income. Older women tend to get healthier though that is not statistically significant. Married women also were found to be healthier than single women and the coefficients range from 0.044 to 0.075 and mostly were statistically significant at 5% level. This means that the event of single women having a high quality of health is 0.93-0.96 times less likely to happen than the event of married women to have high quality of health. More educated women were also found to be more likely to have better health quality status with coefficients ranging between 0.084 to 0.180, all being statistically significant at a 5% level. Since the coefficient is close to zero, the relative odds value is close to one. This means that the event of a woman with a college

degree to have a high quality of health is approximately 1.09 times more likely to happen than the event of a woman without a college degree to have a high quality of health.

An article by Case et al. (2004) attempted to explain the relationship between childhood health and circumstances and their adult health and economic status. In their study, they acknowledged the difficulty of tracking individuals from childhood into adulthood. Hence, they employed a reduced form model to try to explain the associations between childhood health and circumstances and educational attainment, adult health and socioeconomic status. Overall, their findings suggested that individuals born into poorer families experienced poorer health (even experiencing poor uterine environments) and lower human capital and eventually led to lower income as they grew. They found that a poor health condition at age 7 is associated with 0.3 fewer exams passed by age 16.

A poor condition at age 16 reduced academic performance by 0.2 number of exams passed by the time the child reaches the age of 16. A poor health condition at age 7 reduced health quality until age 42, but a poor health condition at age 16 reduced health quality throughout the person's life and was significant for individuals age 23 to 42. Family income at age 16 became a larger and more significant predictor of health status in adulthood. At age 23, family income at 16 had a coefficient of -0.069 but this was not statistically significant. Again, since the coefficient is near to zero, the relative odds is approximately one, which implies approximately equal probability. This means that the probability of a child who comes from a richer family having high quality health is approximately the same as those who do not earn as much.

However, the impact increased in absolute value and significance along with age, so at age 33 the coefficient was -0.135 and at age 42 it was -0.143. This means that the event of a child from a richer family being in a condition of poor quality health at the age of 33 is 0.87 times less likely than the event of a child from a poorer family being in poor quality health. The event of a child from a richer family being in poor quality of health at the age of 42 is 0.87 times less likely

than the event of a child from a poorer family to be in poor quality health. The research concluded that childhood health condition affects later adult health quality.

Kruk and Freedman (2008) conducted a literature study on health system performance in developing countries based on indicators currently used to measure performance using online medical and public health databases. Specifically, it measured health quality based on effectiveness, equity and efficiency. Broadly speaking, effectiveness captures concepts of access to care and quality of care, which should lead to health status improvement and patient satisfaction. Some indicators necessary for this measurement are availability of physicians, nurses and hospitals per 1,000 people and basic comprehensive emergency obstetric care facilities per 500,000 people. "Equity" includes access for disadvantaged groups, equality for disadvantaged groups and participation/accountability, all of which should lead to health status improvement for disadvantaged groups, fair financing, and risk protection. Measurement indicators include mortality rates for the lowest income quintile, proportion of government health financing that reaches the poorest income quintile, and utilization of essential health services by disadvantaged groups. Efficiency captures the adequacy of funding, cost and productivity, and administrative efficiency which should lead to maximizing the value of resources. Measurement indicators include per capita health care spending, costs per case treated, average length of stay, and health worker attrition rates.

Das et al.'s study (2008) was a descriptive report of their assessment of the quality of medical advice in low income countries. Specifically, they used survey results from Tanzania, India, Indonesia, and Paraguay. In Tanzania, Paraguay, and Indonesia the samples include health professionals who practice in Western-style health facilities. The study discovered how doctors treat their patients using a vignette approach and direct observations. A vignette approach is basically undergone by providing doctors with hypothetical cases and assessing their responses. By looking at these responses, they were able to figure out that (1) the quality of care in low-income countries was very low, (2) low competence was compounded due to low effort from

doctors which led to doctors providing lower standards of care for their patients, (3) the poor are particularly disadvantaged, and (4) efforts of training doctors were unlikely to succeed since doctors often exerted little effort.

Smith et al. (2005) tried to explain the reasons why child malnutrition is lower in rural areas by using evidence from 36 developing countries. The study was motivated by the fact that urban poverty and malnutrition has been increasing both in absolute and in relative terms. Data from nine countries showed that both the number of underweight preschoolers and the share of urban preschoolers in overall numbers of underweight children have been increasing in the past 10-15 years. Although childhood malnutrition has typically been a less severe problem in urban areas, the rapid urbanization in developing countries raises concerns regarding increasing rates of urban malnutrition.

Due to the importance of designing a suitable policy, understanding the determinants of childhood malnutrition in both areas is a crucial matter. Using data coming from Demographic and Health Surveys (DHS) conducted during 1990-1998, the study focused on countries in three regions: South Asia, Sub-Saharan Africa, and Latin American and the Caribbean. Their estimation involved explanatory variables which are both proximal and socioeconomic. Proximal variables refer to biological functions, maternal practices related to food intake, health and caregiving. The socioeconomic variables included women's education and status, societal gender equality, household health environment, and household economic status.

The result showed that woman's education levels played a crucial role in predicting malnutrition. In South Asia, the children of women with primary education had lower child malnutrition as measured by the increase in height for age. Children of mothers with primary education were 0.255 centimeter taller in rural areas and 0.143 centimeter taller in urban areas. Both coefficients were statistically significant at least at 10% level. Children of women with

secondary education were 0.463 centimeters taller in rural areas and 0.421 centimeters taller in urban areas, also statistically significant at the 10% level or less. Gender equality also led to higher body mass index by exactly the same coefficient in both rural and in urban areas. However, the coefficient was significant for rural but not urban areas.

In general, household health facilities led to better body mass index as well. In Sub-Saharan Africa, children of women with primary education had 0.114 kg/m^2 higher body mass index for both urban and rural areas; the coeffients are statistically significant. Gender equality was associated with a statistically significant 0.003 kg/m^2 decrease in body mass index in urban areas, but with a 0.001 kg/m^2 increase in body mass index in rural areas, although this latter coefficient was not statistically significant. All of the household health facilities were associated with statistically significant increases in body mass index for urban areas but not for rural areas. In the Latin America/Caribbean region, a woman's education remained an important predictor of child's body mass index. Women's primary school education was associated with increased children's body mass index by 0.171 kg/m^2 in rural areas and 0.172 kg/m^2 in urban areas with both coefficients being statistically significant at 10% level or less. Women's secondary education was associated with a 0.496 kg/m^2 increase in children's body mass index in rural areas and 0.399 kg/m^2 in urban areas; again, both were statistically significant. Gender equality was not associated with any significant changes in children's body mass index. Most household health facilities were associated with an increase in children's body mass index for both urban and rural areas. The coefficients were statistically significant.

2.4. Econometrics Theory Review

Theoretically, estimation on dependent variables using OLS is based on the assumption that the errors are normally distributed with mean zero and variance σ^2 also known as homoscedasticity assumption. When this assumption is violated, then the estimation will suffer

from a problem called heteroskedasticity. Heteroskedasticity can cause estimation from OLS model to be potentially inefficient though not necessarily biased or inconsistent (White, 1980). However, as suggested by Hayes and Cai (2007) severe heteroskedasticity can still cause biasedness and inconsistency. Saniter (2012) tried to estimate the heterogeneous returns to education in Germany using conditional heteroskedasticity. Return to education was defined as the extra amount of wage income a randomly selected individual receives from an additional year of education. The wage income estimation was structured as a function of years of education and a vector of other explanatory variables. Specifically, the model took form as

$$W_i = X_i\beta + \delta S_i + u_i$$

$$S_i = X_i\varphi + \upsilon_i \text{ and } u_i = \lambda\upsilon_i + e_i$$

where W_i = log of hourly wage of the ith individual

X_i = a vector of exogenous regressors for the ith individual

S_i = years of education of the ith individual

It was suspected that there was an endogeneity bias caused by omitted variables hence the regressors are collinear and OLS estimation is infeasible. Instead of pursuing an IV estimate, this research used the Klein and Vella (KV) approach through imposing a constant restriction on variance to ensure identification of heteroskedasticity. One major concern of emphasis was the consideration that the valid IV instrument should be uncorrelated with the error terms in order for it to possess a sufficient explanatory power.

The main advantage of the KV approach compared to the IV approach is that it does not present the problem of identification. Using data from German Socio-Economic Panel Study (SOEP) this study specifically employed a semiparametric least squares (SLS). Acknowledging the high probability of heteroskedasticity, a robust standard error was chosen for the estimation. The result of using OLS estimation, reported that the probability that an older individual will attain an additional year of education increased by 0.371, significant at the 1% level. Female students had 0.175 fewer years of education and the coefficient was significant at the 5% level.

Individuals living in rural areas would have 0.424 fewer years of education and the coefficient was significant at the 1% level.

As realized in many studies, heteroskedasticity problem is the violation of the OLS assumption of constant error variance which implies that the variance of errors is unrelated to any predictor or any linear combination of the predictors. Such violation can arise from a misspecification of a model caused by, for instance, failure to include necessary information. Although generally will cause only inefficiency, a severe heteroskedasticity problem might cause a model's estimate to be biased and inconsistent as well. Detection of heteroskedasticity can be carried out by several methods namely, plotting the model errors against the estimates, running the LM test, or conducting the Goldfeld-Quandt test.

To correct heteroskedasticity, one can transform the model into a non-linear function by using a log transformation, a quadratic, or a reciprocal function. Also, estimation can be updated into weighted least squares (WLS), generalized least squares (GLS), or estimated generalized least squares (EGLS). A study by Hayes and Cai (2007) was aimed at explaining the relationship between a seventh-grade students' grade (GPA) and their IQ, gender, and self-concept. The study estimated a model using a heteroskedasticity-consistent standard error estimator (HCSE) in OLS regression. This is an estimation of OLS that does not assume homoskedasticity. The benefit of conducting this estimation is that it requires neither knowledge about nor a model of the functional form of the heteroskedasticity such as ones required by WLS.

It was found that an increase in IQ by one unit will increase GPA by 0.0864 points and was statistically significant at the 1% level. Male individuals will tend to have lower GPA by 0.5460 but not statistically significant. A unit increase in Piers-Harris children's self-concept scale of behavior will increase GPA 0.1692 and was significant at 5% level. Piers-Harris scale is a self-concept scale developed by Ellen Piers and Dale Harris on how children aged 7-18 assessed

themselves based on, among others, behavior, popularity, and anxiety. An increase in popularity scale will increase GPA by 0.1790 though not statistically significant and lastly, an increase in anxiety scale will decrease GPA by 0.0607 also not statistically significant.

As suggested by Menard (2002) there are many methods for representing measures of ordinal scales. The first method will is to treat it as a continuous variable. In this method OLS regression is widely used and is the one that makes the most sense when the dependent variable has five or more categories. The use of OLS in this case will not distort the result substantially. A second method is to treat it as categorical data, i.e. employing a multinomial logit model. This option will not result in a biased estimation though it will increase the insignificance of the estimation coefficient. Careful judgment is required in order to pick the correct model. An ordered logit model is a model in which a dependent variable is an observed ordinal variable, Y. In turn, Y is a function of a continuous, unobserved, latent variable Y* whose values will determine the order of variable Y. The latent variable Y* has numerous threshold points that govern the cut-off of each level. The value of the observed dependent variable will depend on whether or not each of these thresholds is crossed. Specifically, for an M level of ordered dependent variable, there will be M-1 cut-off values such that $Y_i = 1 \; if \; Y_i^* \; \leq \; \kappa_1$

$$Y_i = 2 \; if \; \kappa_1 \leq Y_i^* \; \leq \; \kappa_2$$

$$Y_i = 3 \; if \; \kappa_2 \leq Y_i^* \; \leq \; \kappa_3$$

$$Y_i = M - 1 \; if \; Y_i^* \; \geq \; \kappa_{M-1}$$

In turn, the value of Y* is estimated using

$$Y_i^* = \sum_{k=1}^{K} \beta_k X_{ki} + \varepsilon_i = Z_i + \varepsilon_i$$

$$P(Y = 1) = \frac{1}{1 + \exp(Z_i - \kappa_1)}$$

$$P(Y = 2) = \frac{1}{1 + \exp(Z_i - \kappa_2)} - \frac{1}{1 + \exp(Z_i - \kappa_1)}$$

$$P(Y = 3) = \frac{1}{1 + \exp(Z_i - \kappa_3)} - \frac{1}{1 + \exp(Z_i - \kappa_2)}$$

$$P(Y = M - 1) = 1 - \frac{1}{1 + \exp(Z_i - \kappa_{M-1})}$$

The estimates will provide both the overall impact of the chosen explanatory variables as well as the marginal impact given by the individual coefficient. Ordered logit estimation will provide a likelihood ratio test which follows a chi-squared distribution with k degrees of freedom, where k is the number of independent variables. When the chi-squared value exceeds the critical value, then it is concluded that there is at least one variable that has a non-zero impact on how an observation moves from one level to the next. The McFadden Pseudo-R^2 provides a measure of goodness of fit, and the individual coefficients provide the marginal impact of a change in the independent value on the probability of an observation to move from one level to the next.

Crawford et.al (1998) provided a similar yet simpler interpretation of multinomial and ordered logit models. Multinomial logit models estimate the probability that a dependent variable Y takes on any of J mutually exclusive and exhaustive values as a function of some explanatory variables represented by the vector **x**. Multinomial logit models assume that the outcomes of the

dependent variable display no natural ordering. For example, the probability of a randomly selected individual to like the color green, red, or blue. Formally, the estimation is written as

$$P(Y = j|x) = \frac{e^{\boldsymbol{\beta}'_j \boldsymbol{x}}}{\sum_{k=1}^{J} e^{\boldsymbol{\beta}'_j \boldsymbol{x}}}$$

Similar to ordered logit models, multinomial logit models will report a likelihood ratio value, the McFadden Pseudo-R^2 value, and the marginal effect of an individual explanatory variable.

The interpretation of the model coefficients will be the change in probability of a randomly selected individual to move from one category to another due to a unit change in each of the explanatory variable. Unlike the multinomial logit model, an ordered logit model assumes that the qualitative dependent variable such as level of education is not only categorical but also naturally and meaningfully ordered. Despite the difference in interpretation, both models assume the existence of the unobserved utility level which is a function of the selected explanatory variables.

Using data from Australian educational attainment, an example of the implementation of these two models was provided. The explanatory variables chosen were place of birth (Australia or other), single parent family, mother's education, father's education, and number of siblings. The multinomial logit model reported that being born in Australia makes the event of a child to be in 8th 4.2 times more likely to happen, the event of a child to be in the 9th grade 0.93 times less likely to happen, the event of a child to be in the 10th grade 1.34 times more likely to happen, the event of a child to be in the 11th grade 1.25 times more likely to happen, and the event of a child to be in the 12th grade 1.15 times more likely to happen.

The ordered logit model reported that being born in Australia will make the event of a child to move from one level of education to the next 0.92 times less likely to happen. Mother's university education makes the event of a child to be in the 8th grade 1.03 times more likely to

happen, the event of a child to be in the 9th grade 0.06 less likely to happen, the event of a child to be in the 10th grade 0.13 less likely to happen, in the 11th grade 0.34 times less likely to happen, and in the 12th grade 0.49 times less likely to happen. The ordered logit estimation reported that having a mother who has a university education will make the event of a child to move from one educational level to the next 2.37 times more likely to happen. Father's university education will make the probability of a child to be in the 8th grade 0.32 times less likely to happen, in the 9th grade 0.14 times less likely to happen, in the 10th grade 0.13 times less likely to happen, in the 11th grade 0.32 times less likely to happen, and in the 12 grade by 0.53 times less likely to happen. The ordered logit model reported that father's university education will make the event of a child to move from one education level to the next 2.81 times more likely to happen.

Sawkins (2002) conducted a study to examine the determinants of the performance in Scottish secondary schools. His study was motivated by the desire to eliminate the problem of social exclusion and the recognition of the importance of education as a key driver in international competitiveness and thereby economic success. The dependent variable is the performance of schools measured by the percentage of students gaining five or more Standard Grades at Credit Level. Given the inherently ordered dependent variable, an ordered logit model was employed. In the first period which is the year 1993-1994, the probability of school having a high percentage of students gaining five or more credit levels is increased by 0.474% when the school is Roman Catholic based, but was not statistically significant. A unit increase in the proportion of S6 students will increase the school performance by 34.414% and was significant at the 1% level. An increase in the student-teacher ratio increases school performance by 0.607% and was highly significant. In the second study period 1998-1999, the probability of a school having a higher percentage of students gaining five or more credit levels is increased by 1.135% and is statistically significant at the 1% level. A unit increase in the proportion of S6 students

increases school performance by 25.954% and was also significant at the 1% level. An increase in the student-teacher ratio increases school performance by 0.369% and was highly significant.

CHAPTER III

METHODOLOGY

In this chapter, the methodology of estimating the intergenerational relationships between parents' income, children's human capital accumulation as represented by their education and health, and children's income as adults will be discussed. Estimation procedures begin with theoretical models attained from economic theory followed by empirical models as representation of the reduced form which then gives way to the estimation models employed in this thesis.

3.1. Income Estimation Model

a. Theoretical Model Foundation

Solow (1956) suggested that a country's growth depends on the availability of capital stock growth. Defining capital stock growth over time equation as

$$\dot{K} = \frac{dK}{dt} = sF(K,L) \tag{3.1.}$$

where K is capital stock, L is labor, s is the marginal propensity to save, and F(K,L) is the production function as a function of capital and labor. Labor availability at a given time is $L_t = L_0\, e^{nt}$ where L_0 is the initial labor availability and n is the population growth rate.

Further, it was defined that the capital-labor ratio as being $r = K_t/L_t$ and hence $K_t = rL_t = rL_0\, e^{nt}$.

Since each element will be a function of time, then a derivative with respect to time can be performed to arrive at

$$\dot{K} = \frac{dK}{dt} = \frac{dr}{dt} L_o e^{nt} + nrL_0 e^{nt}$$

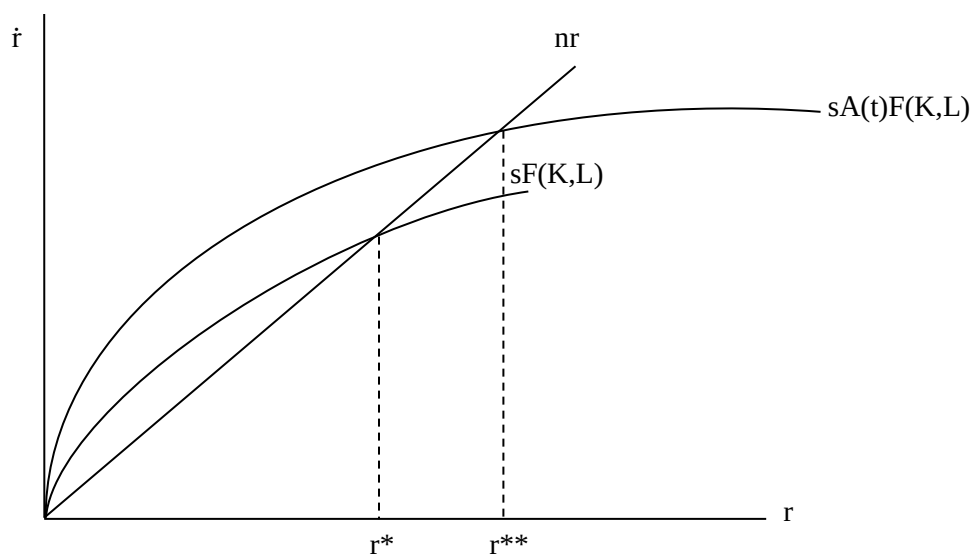
$$= (nr + \dot{r})\, L_o e^{nt} \qquad (3.2)$$

Since r = K/L, it follows that the growth rate of r will be the ratio between the rate of growth of K and L. Mathematically, it can be represented by

$$\frac{\dot{r}}{r} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} \qquad (3.3)$$

So in order to get to the point of steady state growth where warranted growth rate is equal to the natural growth rate, $\frac{\dot{r}}{r}$ needs to be equal to zero. This means that the capital growth rate should be equal to the growth rate of labor, which is defined as population growth. The condition is depicted as point r* (Figure 3.1).

Figure 3.1. Solow Growth Model



Later in the article, Solow suggested an extension to the initial model and included the presence of technology. The production function was then altered into Y = A(t)F(K,L). With the addition of technology, changes in production function are no longer arbitrary over time. The presence of technology will boost the production function vertically and consequently alters r* to r**. It is further implied that with the presence of technology, the capital-labor ratio will grow without limit. Using only capital and labor as explanatory variables, Solow's model failed to explain the existence and growth of technology over time. (Solow, 1956).

Lucas (1988) noted that neoclassical economic theory such as Solow's is directed more towards the main features of advanced economies such as the US. Hence, it does not provide an adequate theory of economic development for purpose of comparison. Lucas opened the argument of development scenarios by comparing economic growth of India and Indonesia and posed a question of what the Indian government could have done to make them grow as fast as Indonesia. The article was mainly comparing models which then were compared to the evidence. The models in question included one emphasizing physical capital accumulation and technological change and a model emphasizing human capital accumulation through schooling that will increase labor skill.

The article highlighted the failure of neoclassical approach of growth and development to take into account the rate of change in technology which represents the stock of useful knowledge and focused mainly on the level of technology instead. Lucas defined human capital as the general skill level of individuals and subsequently readjusted the labor variable to effective labor, which includes labor's skill level, fraction of non-leisure time dedicated to work, and the amount of labor itself. Specifically, effective labor is represented by the following equation

$$N^e = \int_0^\infty u(h)N(h)h\,dh \tag{3.4}$$

where N^e is effective labor, $u(h)$ is time dedicated to work as a function of skill, $N(h)$ is total labor as a function of skill and h is labor skill. Consequently, altering the production function

from the neoclassical production function of Y = A(t)F(K,L) into $Y = AK(t)^{\beta}[u(t)h(t)N(t)]^{1-\beta}h_a^{\gamma}$ where K(t) is physical capital accumulation at any given time, u(t) is the time dedicated to work at any given time, h(t) is the level of skill that labor have at any point in time, and N is the level of total labor. Lucas also included the variable of external effects of human capital, intended to capture the external benefit the society as a whole reaps from individual's decision of human capital accumulation. Lucas believed that the engine of growth is human capital and acknowledged the role of education in forming it. With the new production function, labor is composed of skillful workers (human capital) instead of merely number of workers. Human capital accumulation includes improvement of skill over time which contributes to the process of a country's growth. Mathematically, when considering the income equation $Y = AK(t)^{\beta}[u(t)h(t)N(t)]^{1-\beta}h_a^{\gamma}$ and taking a total derivative of it

$$dY = dA + \beta K(t)^{1-\beta}\frac{dK}{dt} + (1-\beta)[u(t)h(t)N(t)]^{-\beta}\frac{du}{dt} + (1-\beta)[u(t)h(t)N(t)]^{-\beta}\frac{dh}{dt}$$

$$+ (1-\beta)[u(t)h(t)N(t)]^{-\beta}\frac{dN}{dt} + dh_a \qquad (3.5)$$

Given that $0 \leq \beta \leq 1$, the second through fourth terms in the above equation will be positive, implying that human capital will increase income for any level and increase in physical capital. Even further, it was argued that the effects of human capital go beyond the individual or his/her immediate family (Lucas, 1988).

The increase in production due to better or more human capital is transferred to individual income. Microeconomics define firm's maximization decision as

$$\pi = py(x_1, x_2, \dots, x_n) - r_1x_1 - r_2x_2 \dots - r_nx_n - b \qquad (3.6)$$

where π is firm's profit, p is output price, y is output level, x's are types of inputs used in production, r's are the price or the corresponding inputs, and b is fixed cost (Beatty et.al, 2009).

Or more generally,

$$\pi = py(x_i) - r_i x_i - b \quad ; \qquad i = 1, 2, 3, \ldots, n \tag{3.7}$$

In a perfectly competitive market where prices are given first order condition implies that

$$\frac{d\pi}{dx_i} = p\frac{\partial y}{\partial x_i} - r_i = 0$$

$$r_i = p\frac{\partial y}{\partial x_i}$$

$$\frac{r_i}{p} = \frac{\partial y}{\partial x_i} \qquad ; \forall i \tag{3.8}$$

Assuming that the bordered Hessian matrix for second order condition is satisfied, it follows that the sufficient condition for profit maximization is met. This condition implies that firms should operate in such a way that marginal productivity of an input is exactly the same as the cost of attaining it.

Without changing the generality of the condition, it is realized that perfect competition is hardly found in reality. Assuming that a firm is operating in a competitive output market but have some monopsonist power the profit function becomes

$$\pi = py(x_i) - r_i(py(x_i))x_i - b \tag{3.9}$$

It follows that after taking total differentiation of the profit function, the first order condition becomes

$$d\pi = dp + \frac{\partial y}{\partial x_i}dx_i - \left[\frac{\partial r_i}{\partial p}dp + \frac{\partial r_i}{\partial y}\frac{\partial y}{\partial x_i}dx_i\right]x_i - r_i dx_i = 0$$

$$\left.\frac{d\pi}{dx_i}\right|_{dp=0} = \frac{\partial y}{\partial x_i} - \left(\frac{\partial r_i}{\partial y}\frac{\partial y}{\partial x_i}\right)x_i - r_i = 0$$

$$r_i = \frac{\partial y}{\partial x_i} - \left(\frac{\partial r_i}{\partial y}\frac{\partial y}{\partial x_i}\right)x_i \tag{3.10}$$

So treating labor as x_i, it can be inferred that

$$\mathrm{w} = \frac{\partial y}{\partial L} - \left(\frac{\partial w}{\partial y}\frac{\partial y}{\partial L}\right)L$$

where w is the wage rate, y is amount of output produced, and L is the number of workers employed. In other words, the non perfect competition wage rate received by workers will depend on the firms' revenue/output. This exercise shows the relationship between increased human capital, generated revenue by firms, and higher wage earned by individuals.

b. Empirical Model Foundation

Education is hypothesized to help increase individual income both directly and indirectly. When estimating their model of human capital impact on income, Benhabib and Spiegel (1994) used a Cobb-Douglas production function. The function was re-specified in order to capture the role of education in increasing technology and defined income as $Y_t = A_t(H_t)K_t^{\alpha}L_t^{\beta}H_t^{\gamma}\varepsilon_t$, where A_t represents a technological shifter as a function of human capital, K_t represents physical capital, L_t represents labor, H_t represents human capital measured by the enrollment in primary, secondary, and tertiary education, and ε_t captures the error terms. Using a double log estimation, a percentage increase in human capital as measured by years of schooling was found to lead to a 0.11% increase in income growth and was significant at the 1% level due to the additional indirect impact of education on income.

Jolliffe (2002) investigated whether education explains relative differences in an individual's income in Ghanaian households. Income estimation was specified in the following equation:

$$\ln(\boldsymbol{Y}_j) = \alpha_0 + \alpha_1\boldsymbol{X}_j + \sum_i \beta_i \boldsymbol{S}_{ij} + \varepsilon_j \qquad i \in \{min, avg, max\} \qquad (3.11)$$

where $\ln(\boldsymbol{Y}_j)$ is the vector of log transformation of the total income for household j, $\mathbf{S}_{min,j}$, $\mathbf{S}_{avg,j}$, and $\mathbf{S}_{max,j}$ are vectors of the minimum, average, and maximum level of schooling of individual i within household j respectively, **X** denotes a vector of household characteristics such as median level of education, number of females and number of males. It was found that acquiring the minimum level of education led to a 0.016% increase in household income, but was not

statistically significant. Household head education will increase household income by 0.037% and it was highly statistically significant at the 1% level. A one level increase in the maximum education level of the adult household member with the most education is associated with a 0.047% increase in income.. An increase in the minimum adult education level by the person in the household with the least education increases household income by 0.038%. Both results are statistically significant at the 1% level.

It is realized that income growth also has an intergenerational aspect. Solon (1992) conducted research on how a son's income is related to his father's income. The result showed that for all measurements, the percentage increase in a father's income is significantly correlated with the increase in the son's income. Using year to year measurements, a one-percent increase in father's income is associated with an increase in the son's income of 0.386%, 0.271%, 0.326%, 0.285% and 0.247% for the years 1967-1971, respectively. When we take the two-year average, a one-percent increase in the father's 1967-1968 average income is associated with a 0.425% increase in the son's income. The coefficients for 1968-1969, 1969-1970, and 1970-7971 are 0.425%, 0.365%, and 0.336%, respectively.

As mentioned in chapter 1, health quality contributes to the quality of labor force through reduction of productivity loss, better usage of natural resources, increased school enrollment, and more productive alternative use of resources that would have been spent on health maintenance. The prevention of deformity caused by leprosy would have added approximately $130 million to India's 1985 GDP. Sri-Lanka's near eradication of malaria increased the country's income by 9% due to theincrease in land productivity. In the US, it was estimated that a $220 million investment made over the course of fifteen years to eradicate polio would have prevented 220,000 cases and saved $320 million - $1.3 billion in annual treatment costs (The World Bank, 1993). Finally, higher health quality was suggested to dramatically increase returns on foreign investments and lowers transaction costs of international trade, migration, and tourism (Sachs, 2003).

c. Income Estimation Method

From equation (3.6) it is understood that a firm's compensation of an individual relates directly to the profit maximization process. Equation (3.6) is then modified to

$$\pi = py(K, L, H(E, S, T)) - rK - wL - r_h(E, S, T)h - b \tag{3.12}$$

where p is output price, y is quantity of production, K is physical capital, L is number of labor employed, and H is the level of human capital which is a function of experience (E), education (S), and health (T), r is compensation for physical capital, w is wage which is the compensation for labor and r_h is the compensation for human capital accumulation which is again the function of experience, education, and health assuming some monopsonist power of the firm. For the sole purpose of this thesis, level of capital and labor employed will be treated as a constant and their impact on wage determination will not be further pursued. Hence, the profit maximization process of a firm becomes

$$\pi = pA\, g(H(E, S, T)) - r_h(H)H(E, S, T) - b \tag{3.13}$$

where A is the common term for physical capital and labor, and all compensation other than compensation for better human capital is now captured by the fixed cost term, b. It follows that the first order conditions require

$$\frac{d\pi}{de} = pA\frac{\partial g}{\partial H}\frac{\partial H}{\partial e} - \frac{\partial H}{\partial e}r_h = 0$$

$$\frac{d\pi}{ds} = pA\frac{\partial g}{\partial H}\frac{\partial H}{\partial s} - \frac{\partial H}{\partial s}r_h = 0$$

$$\frac{d\pi}{dt} = pA\frac{\partial g}{\partial H}\frac{\partial H}{\partial t} - \frac{\partial H}{\partial t}r_h = 0$$

In any case of the above equations, it is implied that compensation owed to additional human capital is governed by the value of marginal productivity of human capital (MVP_H). Referring

back to equation (3.5) it is understood that $\frac{\partial g}{\partial H}$ is an increasing function, implying that more educated and healthier workers receive higher compensation.

Motivated by this exercise and previous empirical findings, in this thesis income is hypothesized to be a reduced form function of age, education, and health as an indirect impact of human capital on output. Or more specifically, it is represented by the following regression equation:

$$y_{0i} = \alpha_0 + \alpha_1 Age_{0i} + \alpha_2 Age_{0i}^2 + \sum_{s=3}^{6} \alpha_s \, Education_{0i} + \sum_{h=7}^{14} \alpha_h \, Health_{0i} + \alpha_{15} DUrban_{0i} + \varepsilon_{oi} \quad (3.14)$$

The year 1997 is treated as the base period for this thesis. Individuals are grouped into two age cohorts, one for parents and the other for children. Individuals categorized as parents are included in the estimation of income for the base year, 1997. All the socioeconomic characteristics such as education level and health quality for this category will be treated as exogenous variables and are considered as given. Individuals aged 5-15 in 1997 are categorized as children and are consistently tracked in subsequent periods, 2000 and 2007, to monitor the progress of their education and health statuses over time. The resulting data are used to test hypotheses that education and health have a significant, positive effect on adult income. Moreover, in order to avoid the simultaneity and misspecification problems, individuals in the children cohorts are limited to those who are not earning income.

The reason behind choosing the age range 5-15 is that individuals younger than 5 are not school age. It is intended to investigate children's education progress instead of enrollment in school. So the inclusion of children under school age is not relevant. On the other hand, according to the Ministry of Manpower Regulation of Indonesia No. PER-01/MEN/1987, only individuals older than 15 are allowed to work (as cited by US Department of Labor). Hence, individuals older than 15 in 1997 cannot be categorized as non- income earning children. Parents' education

attainment and health status are treated as exogenous since there are no data available on the parents' socioeconomic condition as children. Following Solon's indexing, y_{0i} represents income of parents, Age_{0i} represents the age of parents, $Education_{0i}$ represents the education attainment of parents, and $Health_{0i}$ represents health status index of parents. The variable Age is used as a representation of an individual's experience in order to avoid further endogeneity problems (Bedi and Gaston, 1999). Intuitively, older individuals will be more experienced than younger ones.

Furthermore, the inequality of firms' revenue might also contribute to the difference in wage received by workers. Data for firm level revenue across Indonesian regions are unavailable for this thesis; hence the Gross Regional Domestic Product figures are used as an approximation and are presented in Table 3.1 as reported by Statistics Indonesia (www.bps.co.id) and also included as estimator in the equation.

Table 3.1. Gross Regional Domestic Product

Region	GRDP in 2011 (Million Rupiahs)
Sumatera	1,417,063,262.40
Java	3,470,305,605.61
Bali	73,478,161.87
Kalimantan/ Borneo	574,726,226.84
Sulawesi	277,294,378.27
Nusa Tenggara	79,933,513.13
Maluku	15,654,859.75
Papua	112,538,071.70

As suggested by Greene (2008) in a general model such as the following

$$y_{it} = \boldsymbol{\beta}'_{it}\boldsymbol{X}_{it} + c_i + \varepsilon_{it} \tag{3.15}$$

where **X** is a vector of explanatory variables, c_i is the omitted/unobserved individual effects, and ε_{ir} is the composite error of both individuals and groups/category. In a general form of $E[c_i|\boldsymbol{X}_i] = h(\boldsymbol{X}_i)$, Since the conditional mean in each period is the same, it can be written that:

$$y_{it} = \boldsymbol{\beta}'_{it}\boldsymbol{X}_{it} + h(\boldsymbol{X}_i) + \varepsilon_{it} + [c_i - h(\boldsymbol{X}_i)] \tag{3.16}$$

By construction, the last term of the equation can be absorbed by the error term since it is uncorrelated with $\mathbf{X}_i$ and hence the above equation will boil down to the classical linear regression model

$$y_{it} = \boldsymbol{\beta}'_{it}\boldsymbol{X}_{it} + \boldsymbol{\alpha}_i + \varepsilon_{it} \tag{3.17}$$

Fixed effects arise from the assumption that Corr(c_i , $\boldsymbol{X}_{it}$) $\neq$ 0. The fixed effects formulation implies that differences across groups can be captured in the differences in the intercept. Each category's intercept is an unknown parameter to be estimated. Therefore, the fixed effects formulation allows the unobserved individual effects to be correlated with the included variables. The random effects, on the other hand, are based on the idea that the individual effects are strictly uncorrelated with the regressors. It might be appropriate then, to model the individual specific constant terms as randomly distributed across cross-sectional units. A modification to equation (3.16) can represent a random effect

$$y_{it} = \boldsymbol{\beta}'_{it}\boldsymbol{X}_{it} + (\alpha + u_i) + \varepsilon_{it} \tag{3.18}$$

Here, u_i represents the random heterogeneity specific to the ith observation and is constant through time. For example, it can be a random characteristic of the ith family. The payoff to this form is that it greatly reduces the number of parameters to be estimated. The cost is the possibility of inconsistency should the assumption turn out to be inappropriate. Although accounting for individual effect is costly in terms of degrees of freedom lost from a purely practical standpoint, there is little justification for treating the individual effects as uncorrelated with the other

regressors as is assumed in the random effects model. The random effects treatment may suffer from the inconsistency due to the correlation between included variables and the random effect (Greene, 2008). Inconsistency is a large sample property. When an estimator is inconsistent, it does not satisfy the convergence criteria, and hence it means that the estimator is not able to generate an estimate that is close enough to the true value of the parameter. Hence, no inference can be attained from an inconsistent estimator (Wackerly et.al, 2008).

A Hausman test is employed to investigate whether coefficients of our independent variables are the same regardless of taking any variable as a fixed effect. Specifically, we are testing the hypotheses

$$H_0: \beta^{FE} = \beta^{RE} \tag{3.19}$$

$$H_1: \beta^{FE} \neq \beta^{RE} \tag{3.20}$$

with the test statistic $H \sim \lambda^2$ (k) where k is a set of independent variables. If our H-test value is greater than our critical value then we conclude that Corr(ui, Xir)$\neq$0. In this case, a preliminary regression was conducted and resulted in λ^2=82.72 which is greater than our critical value of 23.68 and hence we conclude that fixed effect model is more appropriate than the random effects specification (Greene, 2008).

In this thesis, provinces are a priori considered as potentially being a fixed effect. The reason behind considering province as a fixed effect is because provinces are time invariant. Moreover, referring back to Table 1.1 combined with Greene's definition of fixed effects, it is believed that province is correlated with the other regressors such as education and health quality. And in relation to the study objective, it is important to understand whether or not it is reasonable to ignore provincial characteristics when evaluating policy effectiveness.

In order to avoid losing too many degrees of freedom, it is intended to represent the fixed effect in regions instead of provinces. The term region, however, will not be used as in a

geographical sense but economical instead. Jakarta, as the most developed and advanced province in Indonesia, will be used as a base to investigate whether households' income in each province is significantly different from those in Jakarta. To do so, a simple regression of household income on provinces was run. The estimation showed that some provinces have significantly higher household income than Jakarta, some provinces are approximately similar to Jakarta, and some provinces are significantly lower than Jakarta. Bali and Yogyakarta are the dominant international tourist attractions. The economic openness creates more job opportunities that allow individuals to generate higher income. Table 3.2 provides a description of the leading sectors in some provinces.

Table 3.2. Sectoral Distribution of Selected Indonesian Provinces

Sectoral Income (% GRDP)	North Sumatra 2008	Jakarta 2011	Makassar 2008	Bali 2011	Yogyakarta 2008
Agriculture	22.9169	0.0935	34.6623	17.3432	15.7310
Manufacturing	22.9573	15.6191	8.8615	8.9455	13.2862
Mining	1.3746	0.5230	5.1863	0.7343	0.7352
Tourism	19.0005	20.8058	15.7547	30.6213	19.2152

Source: Statistics Indonesia, www.bps.go.id

Provinces that show a significantly lower individual income than Jakarta are the less developed provinces. This resulted in provinces grouped into three regions. Group 1 is composed of provinces that are significantly poorer than Jakarta, namely North Sumatra, South Kalimantan, and West Nusa Tenggara. Group 2 is composed of West Sumatra, Lampung, Jakarta, West Java, Central Java and Makassar. Group 3 is composed of the richer provinces of South Sumatra, Yogyakarta, East Java and Bali. Table 3.3 reports the estimation results of the above discussion. Consequently, equation 3.14 is updated into

$$y_{0i} = \alpha_0 + \alpha_1 Age_{0i} + \alpha_2 Age_{0i}^2 + \sum_{s=3}^{6} \alpha_s \, Education_{0i} + \sum_{h=7}^{14} \alpha_h \, Health_{0i}$$

$$+ \ \alpha_{15} DUrban_{0i} \ + \sum_{r=1}^{2} \alpha_r \, DRegion_{0i} \ + \varepsilon_{oi} \qquad (3.21)$$

Table 3.3. Household Income Comparison to Jakarta

Province	Coefficient	t-value	P> | t |
North Sumatra	-77.2648	-1.80	0.073
West Sumatra	13.7490	0.29	0.773
South Sumatra	113.3759	2.11	0.035
Lampung	-20.2350	-0.36	0.721
West Java	-18.8182	-0.54	0.590
Central Java	-2.0317	-0.06	0.954
Yogyakarta	186.4501	4.56	0.000
East Java	123.8013	3.63	0.000
Bali	114.1032	2.79	0.005
South Kalimantan	-102.8752	-2.52	0.012
Makassar	-16.6273	-0.41	0.680
West Nusa Tenggara	-75.6105	-1.94	0.052

The same basic principle is used to estimate children's income as adults in 2007, but the cohort index is changed from zero to one. Parents' income is included in the estimation to investigate whether or not there is actually a relationship between children's current income and their parents' socioeconomic condition. Specifically, children's income as adults in 2007 is estimated using the following regression equation:

$$y_{1i} = \alpha_0 + \alpha_1 Age_{1i} + \alpha_2 Age_{1i}^2 + \sum_{s=3}^{6} \alpha_s \, Education_{1i} + \sum_{h=7}^{14} \alpha_h \, Health_{1i}$$

$$+ \sum_{r=15}^{16} \alpha_r \, DRegion_{1i} + \alpha_{17} y_{0i} + \varepsilon_{1i} \qquad (3.22)$$

where Age_1 represents age of the ith child in 2007, $Education_1$ is education level of the ith child in 2007, $Health_1$ is the health quality of the ith child in 2007, y_{0b} is income of the ith child parent in the base year 1997, and y_{0m} is income of the ith child parent in the mid-point year 2000.

As in any other regression estimation, there are potentially variables that are unobserved and unobservable which will be captured in the error term. Due to data limitations, variables such as productivity and personal ability are not included as regressors in the income estimation model. Although data on the number of hours spent on a particular job are available, it cannot be considered as a sufficient representation of productivity. On the same note, data on personal ability are difficult to measure and therefore not available.

3.2. Education Estimation Model

a. Theoretical Model Foundation

Going back to Lucas' updated version of income equation: $Y = AK(t)^{\beta}[u(t)h(t)N(t)]^{1-\beta} h_a^{\gamma}$, it was further specified that $1 - u(t)$ as the effort devoted to the accumulation of human capital which was the remainder of non-leisure time not used in production. Human capital accumulation was linked to the rate of change in its level, h(t). The relationship between the level of human capital already attained and the effort devoted to acquiring more was postulated as

$$\dot{h}(t) = h(t)\delta\,[1 - u(t)] \qquad (3.23)$$

this postulation implies that when there is no effort devoted to human capital accumulation, u(t)=1, then none accumulates. If all effort is devoted to capital accumulation, then human capital grows at its maximal rate, which is δ. This relationship is presented in order to shed light into the

idea that human capital is a social activity involving groups of people. For example, if none of human capital were passed on to younger generations, the household's stock would stay constant. In order to achieve improvement in human capital, then one needs to assume that the initial level each new member begins with is proportional to (not equal to) the level already attained by older members of the family.

The above elucidation leads to the notion that the level of human capital accumulation is a choice variable. The reason is because there is a trade-off between effort dedicated to accumulation and effort dedicated to productive activity. This implies that more effort dedicated to human capital accumulation will reduce level of current consumption. Ultimately, one needs to optimize the Hamiltonian equation

$$H(K,h,\theta_1,\theta_2,c,u) = \frac{N}{1-\sigma}(c^{1-\sigma}-1) + \theta_1\left[AK^{\beta}(uNh)^{1-\beta}h^{\gamma} - Nc\right] + \theta_2[\delta h(1-u)]$$

where N is the number of workers employed, σ is individuals' relative risk aversion of time, c is the level of consumption, θ_1 is value of increments to physical capital, θ_2 is value of increments to human capital, A is technological shifter, K is physical capital, u is effort dedicated to production, h is the level of labor skill, and (1-u) is the effort dedicated to human capital accumulation.

The first order conditions of this Hamiltonian equation are therefore:

$$\frac{\partial H}{\partial c} = c^{-\sigma} = \theta_1 \tag{3.24}$$

$$\frac{\partial H}{\partial u} = \theta_1(1-\beta)AK^{\beta}(uNh)^{-\beta}Nh^{1+\gamma} = \theta_2\delta h \tag{3.25}$$

Equilibrium conditions require that at the margin, goods must be equally valuable in their two uses – consumption and capital accumulation (eq.3.17), and time must be equally valuable in its two uses – production and human capital accumulation (eq. 3.18). This exercise shows that individual's/ family's decision to or not to accumulate human capital over time will depend on their relative risk aversion, relative value of physical and human capital, as well as level of output produced.

b. Empirical Model Foundation

Supporting Lucas' idea that human capital is an intergenerational, social process, Crosnoe et al. (2002) studied the relationship between economic disadvantage, family dynamics, and adolescent enrollment in higher education. The results of the study showed that among children from under-privileged families, less than half (48.9%) were enrolled or had graduated from 2-4 year college as young adults. Economic disadvantage also significantly predicts later enrollment in higher education during young adulthood with a coefficient of -0.33 and was significant at 1% level. This means that, the event of children from economically disadvantaged families to be enrolled in higher education is 0.72 times less likely to happen than the event of children from wealthier family to be enrolled in higher education during young adulthood.

Blanden et al.'s study (2005) investigated the extent of equality of economic and social opportunity. The following equation was used on education estimation

$$Ed_{ij}^{son} = \alpha_0 + \psi_j \ln Y_{ij}^{parents} + e_{ij} \tag{3.26}$$

where j refers to the generational cohorts, Ed_{ij}^{son} refers to the education attainment of the ith son in cohort j, and $\ln Y_{ij}^{parents}$ refers to the log of the ith parent income in cohort j. Key findings were that there is an increasing relationship between family income and educational attainment between cohorts and that there is a narrowing gap between the staying rates at age 16 between rich and poor children. However, there is a further widening in the inequality of access to higher education. Young people from the poorest income groups have increased their graduation rate by only 3% in 1981 – 1990s while those who were born to richer families increase graduation rate by 26% within the same time frame.

Also, on the same note as Lucas' suggestion that each new member of the family begins human capital accumulation proportional to (not equal to) the level already attained by older

members of the family Ganzach's (2000) study gave support to equation 3.16. The study was aimed at examining the interactions between parents' education, cognitive ability and educational expectations in determining children's educational attainment. The study found that parents' education strongly influence educational expectations and attainment (Ganzach, 2000). In 2004 Hahs-Vaughn investigated the impact of parents' education on students in higher education. It was found that pre-collegiate traits were a stronger influence for non-first generation students (0.66 compared to 0.42 for first generation students) and on educational outcomes (0.75 compared to 0.28 for first generation students). Lavy (1996) also found that the father's education increases enrollment by 0.666 and mother's education by 0.979, both being significant at the 1% significance level. In addition, a healthier workforce should be related to better quality labor force through the human capital accumulation process. Better health and nutrition are positively associated with gains in schooling in many areas; enrollment at younger ages, less grade repetition, more grades completed, less absenteeism, and better performance on test scores (Behrman, 1996)

c. Education Estimation Method

Motivated by the first order condition exercise from Lucas' Hamiltonian equation and the above empirical findings, it is realized that human capital accumulation is an intergenerational, social process that depends on an individual's relative risk aversion, relative value of physical and human capital, as well as level of output produced. At a family level, it is understood that the optimization process is most likely done by parents, the decision makers in the family. Hence, in this thesis children's education is estimated as a reduced form function of parents' income, parents' education, and health.

In 1997, the data about children employment consisted of household members aged 5-15, which is the age range for children to be enrolled in at least elementary school through junior high or high school. For simplicity of investigating the intergenerational dynamics of income and

education, it is assumed that all school aged children are not working. So income that is involved in the equation will be parents' income and it will also be treated as an exogenous variable. The health variable will be treated as a continuous variable in the regression analysis. The main consideration was that there were only three levels of educational attainment for children in 1997: elementary school, junior high school, and high school. Inclusion of all 9 scales of health status into the estimation causes the model to have too many independent variables, which will cause the model to lose too many degrees of freedom. In medical-related field studies, the treatment of ordered categorical variables as continuous variables is common. The necessary condition is that as long as it is an ordered categorical variable, it is acceptable to treat them as continuous (Flegal et al. 2000, Krzanowski 1980, Kenchaiah et al. 2002).

Considering the nature of the dependent variable, an ordered logit model will be employed. Ordered logit models are employed to report the relationships between dependent variables measured in an ordinal scale with their explanatory variables. While treating them as merely categorical variables and hence employing multinomial logistic regression will not result in a biased estimation, failure to acknowledge the ordinal nature of the variables might lead to an increase of risk of getting insignificant results (Menard, 2002). In this case, the aim is to estimate the relationship between children's education with their explanatory variables. We would like to find out the marginal effect of variables on changing the probability of individuals attaining a certain level of education.

To further evaluate the impact of development policy through public spending in education, the above model will be expanded to include the availability of schools. As suggested by Dreze and Kingdon (2001), Lavy (1996) and Filmer (2004) education attainment is also a function of school availability. The further away the school is the less likely children in school age range will be enrolled in school. This is due to the fact that greater distance to school implies higher cost, both explicit (e.g. transportation) and implicit (e.g. opportunity cost of school related

time). Hence, the updated education attainment estimation will be represented by the following model, where $Distance_{1i}$ represents the distance one must take to get from home to the relevant school. Still noting the fixed effects specification, education attainment estimation will also include regional categories as explanatory variables. Specifically, education attainment estimation will be represented as:

$$P(Ed_{1i}=k)= \alpha_0+\alpha_1 Age_{1i} + \alpha_2 Y_{0i}+ \alpha_3 Y_{0i}^2+ \alpha_3 D\ Urban_{1i}+ \alpha_4 Health_{1i} + \sum_{r=8}^{9} \alpha_r\ Region_{1i}+\alpha_{10} Distance_{1i}+ \varepsilon_{1i} \quad (3.27)$$

3.3. Health Estimation Model

a. Theoretical Model Foundation

Health quality is not commonly cited as a choice variable, since it is not something one can choose but rather innate to each individual to some degree. However, what one can do to maintain or even improve health quality is a choice variable. The household allocation of healthcare facilities and/or treatment can therefore be considered a consumption that will increase one's utility but that is constrained by spending ability. In addition, consumption of healthcare is based on the motivation to increase health. So the level of health after the consumption of healthcare should be greater than the initial health quality; this requirement is captured in equation (3.24). Mathematically, it can be represented by the following constrained optimization process:

$$Max\ U(c_i, h) \quad ; i = 1, 2, 3, \ldots, n \quad (3.28)$$

$$s.t.\ \ p_i c_i + p_h h \ \leq M \quad (3.29)$$

$$\bar{h} - h \quad \leq 0 \quad (3.30)$$

$$L = U(c_i, h) + \lambda_1 (M - p_i c_i - p_h h) + \lambda_2 (\bar{h} - h) \quad (3.31)$$

where c_i represents the consumption of the ith consumption good, h is healthcare, p_i and p_h are prices of consumption goods and healthcare respectively, M is income/expenditure to be spent on consumption goods and health, λ_1 is the shadow price of income, and λ_2 is the shadow price for health quality level. It follows that the first order conditions are:

$$\frac{\partial U}{\partial c_i} - \lambda_1 p_i = 0 \tag{3.32}$$

$$\frac{\partial U}{\partial h} - \lambda_1 p_h - \lambda_2 = 0 \tag{3.33}$$

An optimal decision requires that at the margin, the above equations hold with strict equality and result in

$$\frac{\partial U/\partial h}{\partial U/c_i} = \frac{MU_h}{MU_{c_i}} = \frac{p_h}{p_{c_i}} + \frac{\lambda_2}{\lambda_1 p_{c_i}} \tag{3.34}$$

This equation implies that the optimal consumption of healthcare will depend on relative prices between consumption goods and healthcare as well as the relative shadow price between income constraint and health quality constraint. While relative prices of goods and health are given and will most likely be equal to all individuals, relative shadow prices can be different from one individual to the next.

This exercise is in alignment with Rosenzweig's study which modeled health as a part of an individual utility function $U = U(X_i, Y_j, H)$; $i = 1, 2, \ldots, n$; $j = n+1, \ldots, m$ where X and Y are goods that affect child health, and H is child health. H is further defined as $H = \Gamma(Y_j, I_k, \mu)$ where I_k represents non-utility augmenting health input, and μ represents family-specific health endowments known to the family but not controlled by them such as genetic traits or environmental factors such as the negative effects on fetal growth of the mother's smoking habit. Utility maximization was also governed by budget constraint

$$F = \sum_t Z_t p_t$$

Optimization exercise of the above function led to the reduced-form demand function for health as:

$$H = \psi(p, F, \mu) \tag{3.35}$$

Once again, it shows that an optimal consumption of health related goods will be a function of the prices of goods consumed, level of income, and family-specific characteristics.

b. Empirical Model Foundation

In support of the above optimizations, there are several empirical studies that reported that health quality status of an individual is governed by family income and socioeconomic characteristics. It is acknowledged that there probably are numerous studies regarding the impact of healthcare price on healthcare consumption. However, since the optimization process is not the main interest of this thesis, the impact of relative prices is a consideration that is not going to be pursued further. Rather, empirical model support will be focused more on the relationships between income and households characteristics and health. In addition, price of a good can have a lesser impact vis a vis income. Individuals can still purchase healthcare as long as it is affordable. Household/family socioeconomic characteristic is also considered crucial since it governs the family's preference and potentially their relative shadow prices.

Rivera and Currais' (1999) study on the economic growth and health relationship was motivated by World Bank's report in 1993 that health helps promote income growth. Health reduces production loss, allowing the use of more natural resources; increases school enrollment, and allows better allocation of resources. However, they also realized that health conditions will also be governed by a person's income. Their intuition was confirmed by their study that health and income are affecting each other. In 2007 Kiuila and Mieszkowski study was aimed at analyzing the effects of socioeconomic status on mortality and self-reported health. They found

that the relationship between mortality and indicators such as education and income diminishes with age.

Llears-Muney (2005) conducted a research that was aimed at determining the existence of causal relationship between education and mortality. The estimation was shown as

$$H_i = X_i\beta + E_i\pi + \varepsilon_i \tag{3.36}$$

Where H_i represents health quality and E_i represents education level for the ith individual. It was prompted by the notion that education increases health either through creating better decision makers and/or through providing better information regarding health or simply because poor health results in little education. They approached this issue by investigating whether or not a government policy that makes schooling compulsory actually leads to a lower rate of mortality. Using US' census data from three decades, 1960, 1970, and 1980, it was found that states which made education compulsory have lower rates of mortality and a 1-year increase in compulsory education can lead to a decrease in the probability of dying at the age of 10 or younger by 1.1%. Also, following Das et.al (2008) we took into account whether or not outpatient healthcare facilities are available especially those that perform western (modern) style of care.

c. Health Estimation Method

Motivated by these findings the health estimation equation for children in 1997, 2000, 2007 will be mathematically represented as

$$Health = f(\, income, age, smoking\ habit, location, sanitation, education, health\ facilities)$$

Or more specifically, the estimation will be written as follows

$$P(HH_{1i} = 1) = \alpha_0 + \alpha_1 Y_{0i} + \alpha_2 Age_{1i} + \alpha_3 Smoke_{1i} + \alpha_4 DUrban_{1i} + \sum_{s=5}^{6} \alpha_s\, Sanitation_{1i} + \sum_{e=7}^{8} \alpha_e\, Education_{1i} + \varepsilon_{1i} \tag{3.37}$$

where: $Health_{1i}$ = Health quality of the ith child;

Y_{0i} = annual parent income of the ith child;

Ed_t^j = education attainment of the ith child;

Age_t^j = Age of the ith child;

San_t^j = Sanitation facilities available for the ith child;

$Smoke_t^j$ = Smoking habits of the ith child;

Loc_t^j = Indicator variable of whether the ith child lives in an urban area;

The most substantial limitation of the health estimation in this thesis is the fact that health quality is measured in Likert scale as indicated by the interviewer instead of actual medical examination. This type of measurement is not only unscientific but also potentially subjective. Medical examination of health quality will be captured in the error term as an unobserved variable. Furthermore, a person's innate health resistance may influence one's health quality as well. The exposure to nicotine or poor water quality might influence people differently. However, personal health resistance is not only unavailable in the data set but also difficult to measure. Hence, it will be captured in the error term as unobservable.

3.4. Variable Description

Based on the economic theory that output is a function of capital, as well as previous studies which suggested that output is a function of both physical and human capital, this thesis investigates the impacts of selected human capital variables on the differences in income. Specifically, the impact of education, health, experience, and location on individual's income will be estimated. Realizing the interrelated nature of income, it also investigates variables that might explain different educational attainment and health quality across regions. Table 3.1 provides detailed information describing the investigated variables and their definitions.

Table 3.4. List of Investigated Variables

Variable Name	Definition
Income	Individual's annual salary (in Indonesian Rupiah)
Age	Individual's age at the time of the survey
Education	Educational attainment of household member (level of schooling) • Elementary School • Junior High School (General & Vocational) • High School (General & Vocational) • Associate Degree • Bachelors Degree • Graduate School (only available in 2000 & 2007 surveys)
Distance to School	Time required to reach the school they are currently attending (in minutes)
Health	Health quality assessed by the interviewer (in 1-9 Likert Scale)
Distance to Hospital	Time required to reach the nearest modern approach health facility
Urban	Indicator variable whether an individual lives in an urban area
Region 1	Region composed of provinces with significantly lower household income than Jakarta. Namely, South Sumatera, West Nusa Tenggara, South Kalimantan, and Makassar.
Region2	Region composed of provinces with insignificantly different household income than Jakarta. Namely, West Sumatra, Lampung, Jakarta, West Java, and Central Java.
Region 3	Region composed of provinces with significantly higher household income than Jakarta. Namely South Sumatra, Yogyakarta, East Java, and Bali.

CHAPTER IV

FINDINGS AND MODEL INTERPRETATION

In this chapter, estimation results will be presented for intra-household income. Models are presented for cohort 0 (parents), its relationship to cohort 1's (children's) education attainment and health quality, and eventually how this relationship potentially affects cohort 1's income.

4.1. Indonesian Household Income Estimation

4.1.1. Cohort 0 Income Estimation

The first income estimation is for parents in 1997. For this equation, parents' education and health quality are treated as exogenous variables as specified by equation 3.14.

$$y_{0i} = \alpha_0 + \alpha_1 Age_{0i} + \alpha_2 Age_{0i}^2 + \sum_{s=3}^{6} \alpha_s \, Education_{0i} + \sum_{h=7}^{14} \alpha_h \, Health_{0i} + \alpha_{15} DUrban_{0i} + \varepsilon_{0i}$$

The model R^2 is 0.2359. Hausman test for geographical fixed effect resulted in λ^2=82.72 which was higher than the critical value of 23.68. Hence, equation 3.14 is updated to include regions as suggested by equation 3.21.

$$y_{0i} = \alpha_0 + \alpha_1 Age_{0i} + \alpha_2 Age_{0i}^2 + \sum_{s=3}^{6} \alpha_s \, Education_{0i} + \sum_{h=7}^{14} \alpha_h \, Health_{0i} + \alpha_{15} DUrban_{0i} + \sum_{r=16}^{17} \alpha_r \, DRegion_{0i} + \varepsilon_{oi}$$

The model after inclusion of regional categories showed an increase in goodness of fit from 0.2359 to 0.2479.

It reports that older individuals will earn higher income (perhaps due to better experience) and it was significant at 5% level. It is realized that in reality firms/employers may have some monopsonistic power. This allows them to exercise wage discrimination towards workers based on their age for numerous reasons, one of which may be because older workers are expected to have more experience and hence are more productive which justifies higher payment. Since exact explanations of wage discrimination cannot be justified by data used in this thesis, it will not be pursued further. A negative sign on the quadratic term suggests that the impact of experience on income exhibits diminishing returns. Higher education had a positive relationship with individual's higher income and was statistically significant. A typical individual with Junior High School education is expected to earn $52.80 more annually compared to those with Elementary School education. Those with High School education are expected to earn $292.36 more annually compared to those with Elementary School education. Those with an Associate Degree and a University degree are expected to earn $480.23 and $819.21, respectively, more annually compared to those with only Elementary School education.

Healthier individuals are also expected to earn more annually which is represented by positive and significant coefficients of health quality. Again, since health quality is presented as a Likert-scale instead of a continuous value, health index = 1 is removed from the equation and treated as reference point. Individuals with health index = 2 are, on average, earning $10.35 more annually than those with health index = 1. Except for health index = 9, all the health indices show positive coefficients and all are significant at 5% level. In addition, individuals living in the urban areas are expected to earn $13.96 more annually than those living in the rural areas, but the coefficient is not statistically significant. Graphical representation is shown in figures 4.1 and 4.2.

Table 4.1. Explanatory Variables of Individual Income Estimation

	Coefficients	
Variables	(1)	(2)
Age	16.83**	49.20**
Age Squared	-0.17**	-
Junior High School	52.80**	168.90**
High School	292.36**	349.48**
Associate Degree	480.23**	198.87**
Bachelor's Degree	819.21**	321**
Graduate Degree	-	690.59**
Health index 2	10.35	-
Health index 3	171.73**	199.09**
Health index 4	135.62**	146.03
Health index 5	176.47**	321.22**
Health index 6	155.25**	288.84**
Health index 7	148.26**	448..79**
Health index 8	204.71**	333.84**
Health index 9	1,222.22	-
Urban setting	13.09	231.74**
Region 1	-4.05	-40.54
Region 3	100.89**	32.40
Cohort 0 Income 1997	-	2.42e-5
Cohort 0 Income 2000	-	4.04e-6
*** significant at 5%	$R^2 = 0.2479$	$R^2 = 0.1544$

Column (1) is the cohort 0 income estimation in 1997
Column (2) is the cohort 1 income estimation in 2007

Figure 4.1. Expected Cohort 0 Income by Education Levels

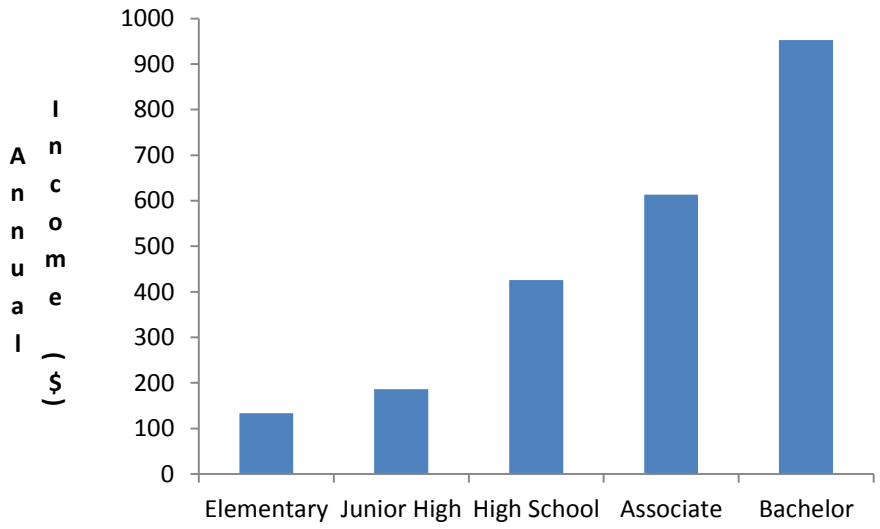
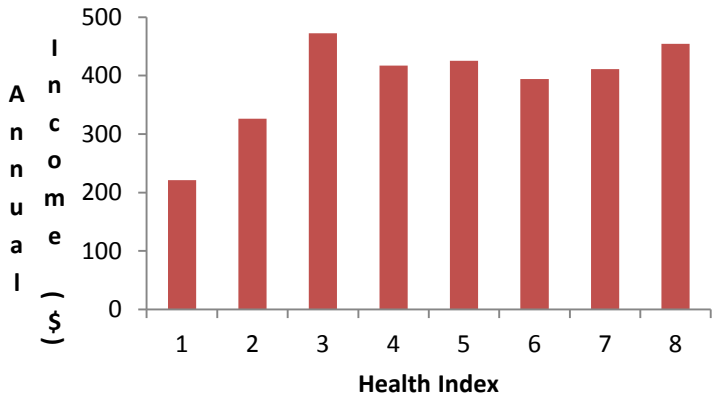


Figure 4.2. Expected Cohort 0 Income by Health Quality



An important thing to highlight is the impact of the inclusion of regional variables. As discussed in chapter 3, regions are defined in terms of relative household income to Jakarta. Region 1 is composed of provinces with household income significantly lower than Jakarta namely, North Sumatra, South Kalimantan, and West Nusa Tenggara provinces. Region 2 is composed of provinces with household income not significantly different from Jakarta, namely West Sumatra, Lampung, Jakarta, West Java, Central Java and Makassar. Region 3 is composed of the richer provinces namely South Sumatra, Yogyakarta, East Java and Bali. It can be inferred that individuals living in region 3 are expected to earn $100.89 more annually than those living in region 2.

4.1.2. Cohort 1 Income Estimation

The next estimation is the income estimation in 2007 which only includes individuals who were categorized as non-income earning children in 1997 but now are aged 15-25 years old. The estimation is conducted following the model specification in equation 3.22:

$$y_{1i} = \alpha_0 + \alpha_1 Age_{1i} + \alpha_2 Age_{1i}^2 + \sum_{s=3}^{6} \alpha_s \, Education_{1i} + \sum_{h=7}^{14} \alpha_h \, Health_{1i}$$

$$+ \sum_{r=15}^{16} \alpha_r \, DRegion_{1i} \; + \; \alpha_{17} y_{0m} \; + \; \varepsilon_{1i}$$

Those who are still in school are excluded from the estimation. The estimation does not differentiate between those who are working part time from those working part time. Due to the age range, income estimation does not exhibit quadratic function with respect to age and hence the variable of "age squared" was not included. Treating health quality as an indicator variable instead of a continuous one increased the model fit (R^2) slightly from 0.1500 to 0.1544 without sacrificing the coefficients' signs and significance.

The estimation coefficients are reported on the second column of table 4.1. Among these young adults who are working, their income is positively related with experience and education. The result did not show that those who came from richer families significantly earn more income. An individual who is a year older will earn $49.20 more annually and it was statistically significant. Those with Elementary Education earn approximately $469.50 annually. A typical individual with Junior High School education is expected to earn $ 638.40. A typical high school graduate is expected to earn $818.98. An individual with associate degree education earns $668.37 annually. An individual with Bachelor's education or Graduate School education is expected to earn $790.50 and $1,160.09 respectively (Figure 4.3.).

As represented in figure 4.4, individuals with better health earn higher income. The least healthy individuals earn $569.63 annually. Level 3 individuals earn $768.72, level 4 earn $715.66, and level 5 earn $890.85. Individuals with health quality of level 6 earn $858.47, level 7 earn 1,018.42 and the highest level of health earn $903.47.

Figure 4.3. Expected Cohort 1 Income by Education Levels

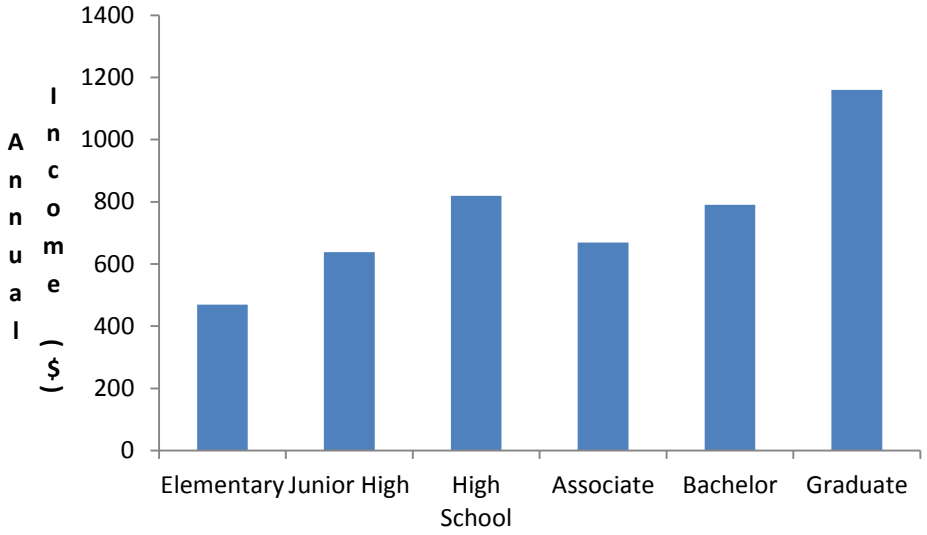
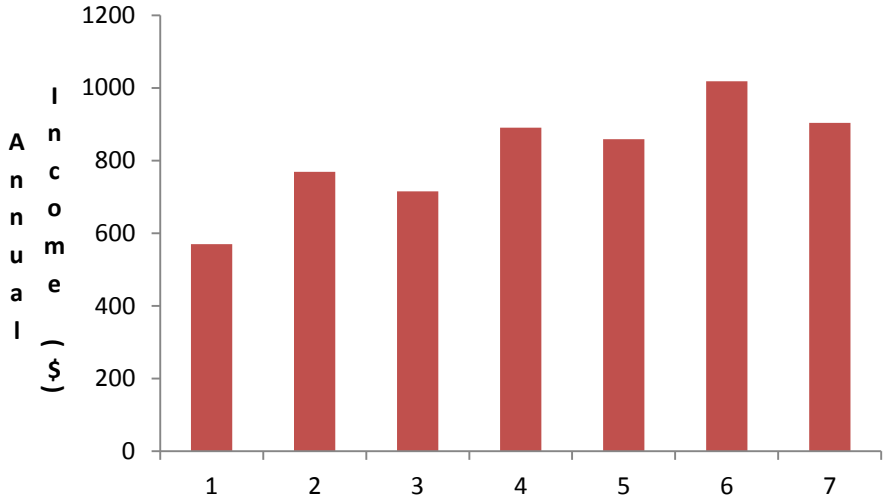


Figure 4.4. Expected Cohort 1 Income by Health Quality

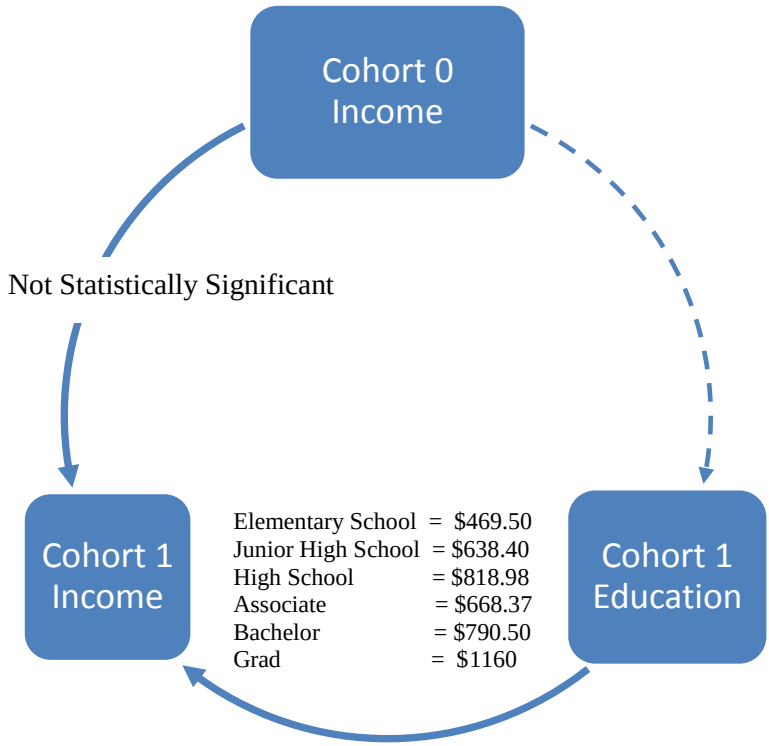


Living in urban areas will predictably result in higher income, though the coefficient was not statistically significant. Similarly, no region exhibited a statistically significant coefficient at any conventional levels. Parents' income for both 1997 and 2000 did not result in a significant coefficient.

Results from this section show that human capital significantly explains individual income. Higher education and better health led to higher income for both parents in 1997 and

children in 2007. Furthermore, parents' income does significantly increase individual's income directly. The direct relationship between parents' income and child's education is not estimated in this section, hence it is represented by a dotted line in the diagram below (Figure 4.4). In the next section, it will be represented how parents' income impact children human capital.

Figure 4.5. Explanatory Variables of Individual Income



4.2. Indonesian Household Education Estimation

4.2.1. Cohort 1 Education Attainment in 1997

On the estimation of cohort 1 education attainment, the initial estimation will be conducted for cohort 1 education attainment in 1997. As a reminder, individuals categorized as cohort 1 are those aged 5-15 in 1997 who are not earning income. Education attainment in 1997 is

also somewhat treated as a base, in sense that in 1997 government intervention is not included in the estimation. Specifically, the estimation followed equation 3.27.

$$P(Ed_{1i} = k) = \alpha_0 + \alpha_1 Age_{1i} + \alpha_2 Y_{0i} + \alpha_3 Y_{0i}^2 + \alpha_3 D\ Urban_{1i} + \alpha_4 Health_{1i} + \sum_{r=8}^{9} \alpha_r\ Region_{1i}$$

As reported in table 4.2. column 1, older children are more likely to be in higher level of education. Parents' income contemporaneously increases the probability of children moving from one education level to the next. The coefficient is 6.71e-7 which cannot be interpreted as merely partial effect (Greene, 2008). Rather, it is the change in the log of odds. The marginal effect of a variable is then supposed to be exp(β).

Since the measurement units for salary in Indonesia is in hundred thousands of Rupiah, the coefficient should be multiplied accordingly. So in this case the relative odds is exp(6.71e-2) = 1.07. Relative odds = 1.07 means it is 1.07 times more likely that a child will go to the next education level due to 100,000 Rupiah increase in parents' income from the mean value of $2,310,342. The significant negative number of the squared term suggests diminishing returns. Health coefficient was 1.0373 and statistically significant. Since exp(1.0373) = 2.82, it means that a children with better quality health is 2.82 times more likely to move to the next level of education. Children with high school graduate parents are almost 10 times more likely to move from one level of education to the next compared to those with elementary education parents.

4.2.2. Cohort 1 Education Attainment in 2000

The next estimation step is to investigate whether this relationship changes over time. The same estimation is conducted for these individuals in 2000. Children's education at any given time will not only depend on the contemporaneous effect of their parents' income. For instance, the probability of a child to be enrolled in high school will depend on whether or not the child was enrolled in elementary school and junior high school. Consequently, this depends on the level

of parents' income by the time they were in those previous levels of education. Hence, in the children's education estimation in year 2000 the variable of parents' income in 1997 was added. This inclusion increased the model's fit from 0.2846 to 0.3073. At the same time, it is realized that parents' income in both year 1997 and 2000 will potentially be correlated since one's income intuitively evolves over time. In order to test for that, Variance Inflation Factor (VIF) Test was conducted and resulted in VIF = 1.09. Since the variance inflation factor is less than 5, it is concluded that multicollinearity was not a problem. Additionally, in year 2000 government intervention is included as an explanatory variable.

Table 4.2. Explanatory Variables of Cohort 1 Education Attainment

Explanatory Variables	Coefficients	
	(1)	(2)
Age	1.1600**	0.7122**
Cohort 0 Income 1997	6.71e-7**	2.09e-7**
Squared of Cohort 0 Income 1997	-7.38e-15**	-3.66e-15**
Cohort 0 Income 2000	-	4.86e-8**
Squared of Cohort 0 Income 2000	-	-2.26e-15**
Health	1.0373**	0.0955**
Urban Setting	-0.2473	0.4169**
Region 1	-0.4459	-0.0527
Region 3	-1.6651**	0.6160**
Cohort 0 Junior High School	-0.0346	0.8329**
Cohort 0 High School	2.3863**	1.0789**
Cohort 0 Associate Degree	-1.2764**	1.0573**
Cohort 0 Bachelors	-1.4033**	1.6701**
Cohort 0 Grad School	N/A	0.2181
Elementary School Distance	0.0596	-0.0544**
Junior High School Distance	-0.0346	-0.0064**
High School Distance	0.0213	0.0024**
University Distance	-	0.0145**
** significant at 5% level	R^2 = 0.2900	R^2= 0.3519

Column (1) reports Education Estimation for Children in 1997
Column (2) reports Education Estimation for Children in 2000

As reported in table 4.2 column 2, education attainment estimation of children in 2000 showed that parents' income significantly affects probability of attaining higher level of education. It is 1.03 and 1.01 more likely a child will go from one level of education to the next due to a small increase in lagged and contemporaneous parents' income from the mean which is

$2,310,342 and $3,537,629 respectively. Coefficients of squared parent income for both contemporaneous and lagged came up negative and highly significant. This suggests diminishing returns. Older children were more likely to attain higher education level and the coefficient was statistically significant at 1% level. Healthier children were found to be more likely to move from one educational level to the next. The coefficient was statistically significant at 5% level. Children who live in urban areas were found more likely to move from one educational level to the next compared to their rural counterparts. Being in region 3 increased children's relative odds to move to the next educational level by exp(0.66333) = 1.94 and was significant.

Additionally, it is also realized that parental education might play a role in children's education attainment as suggested by Ganzach (2000) and Hahs-Vaugh (2004). In relation to the objective of assessing public spending contribution, a new variable "distance" is added to the equation. Since the data used is household level data, information regarding actual government expenditure is not available. The distance variable is used as a proxy to school availability. Hence, equation 3.27 is updated into:

$$P(Ed_{1i} = k) = \alpha_0 + \alpha_1 Age_{1i} + \alpha_2 Y_{0i} + \alpha_3 Y_{0i}^2 + \alpha_3 D\ Urban_{1i} + \alpha_4 Health_{1i} + \sum_{p=5}^{9} \alpha_p ParentEd_{0i}$$

$$+ \sum_{r=10}^{11} \alpha_r \text{Region}_{1i} + \alpha_{12} \text{Distance}_{1i} + \varepsilon_{1i}$$

Table 4.2. column 4 reports that inclusion of parental education and distance increases R^2 from 0.3073 to 0.3519. Parents' income maintains its sign and significance on the estimation of children's education. Given the coefficients reported above, an increase in contemporaneous and lagged parents' relatively retains their relative odds, which are 1.01 and 1.02, respectively. Having parents who have junior high school education will increase the log of odds ratio of children to be in higher level of education by exp(0.8329) = 2.30. This means that children with Junior High School education parents are 2.3 times as likely to move to the higher level of

education. Parents who are high school graduate will increase the probability by exp(1.0789) = 2.94. Children with parents having associate degree education are more likely to achieve a higher education by exp(1.0573) = 2.88. The children of parents with university degrees are 5.31 times more likely to pursue higher education (exp(1.6701) = 5.31), and children of parents with graduate degrees are an additional 1.24 times more likely (exp(0.2181) = 1.24).

In relation to the potential impact of public spending, the results show that an additional kilometer of distance to elementary school decreases the probability of a child going to the next level of education. The relative odds is exp(-0.0544) = 0.95 which is less than 1. This means that the event of moving to the next level of education is less likely to take place. An additional kilometer of distance to junior high school decreases the probability of attaining the next level of education since exp(-0.0064) = 0.99. This means that the event of a child move to the next level of education is 0.99 times less likely to happen if the distance increases by one kilometer.

In order to address the study objective of policy recommendation given the unequal regional socioeconomic characteristic, the next step is to estimate education attainment of children in different regions, given the same explanatory variables. Specifically, equation 3.27 is now updated again into

$$P(\mathrm{Ed}_{1i}=\mathrm{k}|reg = r) = \alpha_0 + \alpha_1 Age_{1i} + \alpha_2 Y_{0i} + \alpha_3 Y_{0i}^2 + \alpha_3 D\ Urban_{1i} + \alpha_4 Health_{1i} + \sum_{p=5}^{9} \alpha_p ParentEd_{0i} + \alpha_{10}\mathrm{Distance}_{1i}$$

In all regions, older children are found to be more likely to have higher education and all were statistically significant. Both contemporaneous and lagged parent income retain their 50-50 chance of getting a child to the next education level. For region 1, healthier children were found to be 1.31 times more likely to achieve higher education by. Children living in urban areas are 1.66 and 1.95 times more likely to attain higher education in regions 1 and 2, respectively.

Parental education has a positive and significant impact in increasing the probability of children moving from one educational level to the next. Notice that in regions 1 & 3, there are no available data on parental education of graduate school level. It shows again the concentration of highly skilled individuals in Indonesia. Distance to schools reduces the probability for children to achieve higher education level but only for elementary and junior high school. The relationship flipped for high school and post-secondary education levels. The finding suggests that elementary school availability is the most crucial for all regions. Additionally, the more developed regions show less sensitivity to distance. It can be further suggested that the multiplier effect of school availability in the less developed region is greater than in the more developed ones.

Table 4.3. Regional Cohort 1 Education Attainment in 2000

Explanatory Variables	Coefficients		
	Region 1	Region 2	Region 3
Age	0.6471**	0.7311**	0.7524**
Cohort 0 Income 1997	2.90e-7**	2.75e-7**	1.99e-7**
Squared of Cohort 0 Income 1997	-9.06e-15	-1.16e-14**	-2.97e-15**
Cohort 0 Income 2000	8.30e-8	4.92e-8**	9.13e-9
Squared of Cohort 0 Income 2000	-2.93e-15	-9.89e-16	-1.91e-15
Health	0.2706**	0.9005	-0.0345
Urban Setting	0.5064**	0.6688**	0.0275
Cohort 0 Junior High School	1.4792 **	0.4899**	0.7260**
Cohort 0 High School	1.1911**	0.8755**	1.1670**
Cohort 0 Associate Degree	1.3878**	0.9383**	1.2097**
Cohort 0 Bachelors	2.9230**	1.2415**	1.8697**
Cohort 0 Grad School	-	5.5700**	-
Elementary School Distance	-0.0616**	-0.0395**	-0.0595**
Junior High School Distance	-0.0033**	-0.0022	-0.0073
High School Distance	0.0360**	0.0279**	0.0012
University Distance	0.0178	0.1928**	0.0135
** Significant at 5% level	R^2= 0.3884	R^2= 0.3489	R^2= 0.3624

4.2.3. Cohort 1 Education Attainment in 2007

Lastly, for children who are consistently tracked from 1997 to 2007, their log of relative odds in attaining higher education when they come from more privileged families remains 1.03. Older individuals have a log of odds ratio of 1.14 indicating that they are 1.14 times more likely to move from one educational level to the next. In 2007, the first attempt of education attainment

is only a function of age, lagged parental income, and whether or not the individual lives in an urban area as reported on the first column of table 4.4.

The second column of table 4.4 is basically a replication of what was done for the year 2000. It includes all variables that were included previously and was shown to increase the R^2 substantially from 0.1124 to 0.2160. An older child is 1.13 times more likely to be enrolled in higher education, which is slightly smaller than with the 2000 data. Living in urban areas will increase the relative odds of children to be enrolled in higher level education by exp(0.3507) = 1.42. Children with Junior High School and High School educated parents are 1.64 and 2.80 times more likely to be enrolled in higher education, respectively. The relative odds get bigger as parents' education gets higher as well. Similar to what was found in the year 2000, an additional distance to school for elementary and junior high schools significantly reduces the probability of children moving from one level of education to the next.

Replicating the process conducted for year 2000, the next estimation attempt is to address the study objective of policy recommendation given the unequal regional socioeconomic characteristic.

Table 4.4. Cohort 1 Educational Attainment in 2007

Variable	Coefficient	
	(1)	(2)
Age	0.1321**	0.1291***
Cohort 0 Income 1997	3.00e-7**	4.49e-7***
Square of Cohort 0 Income 1997	-5.49e-15**	-3.97e-14**
Cohort 0 Income 2000	1.31e-7**	1.68e-8
Square of Cohort 0 Income 2000	-8.81e-16**	3.74e-16**
Cohort 0 Income 2007	-	3.74e-8**
Square of Cohort 0 Income 2007	-	-6.82e-16
Health	-	-0.2277
Urban	0.6949**	0.3507**
Cohort 0 Junior High School	-	0.4975***
Cohort 0 High School	-	1.0288***
Cohort 0 Associate	-	1.6650***
Cohort 0 Bachelor	-	3.0604***
Cohort 0 Graduate degree	-	4.3047***
Elementary School Distance	-	-0.1191***
Junior High School Distance	-	-0.0368***
High School Distance	-	-0.0058
University Distance	-	0.0195*
Region 1	-	0.1082
Region 3	-	0.1269
	R^2=0.1124	R^2=0.2160

The estimation equation used is presented below and the result is reported in table 4.5

$$P(\mathrm{Ed}_{1i}=\mathrm{k}|reg = r) = \alpha_0 + \alpha_1 Age_{1i} + \alpha_2 Y_{0i} + \alpha_3 Y_{0i}^2 + \alpha_3 D\ Urban_{1i} + \alpha_4 Health_{1i}$$

$$+ \sum_{p=5}^{9} \alpha_p ParentEd_{0i} + \alpha_{10}\mathrm{Distance}_{1i}$$

The result showed that most of the explanatory variables lose their ability to explain change in educational attainment in region 1. In region 2 and 3, older individuals are 1.27 and 1.21 times more likely to attain higher education , respectively. An interesting point to highlight is that further lagged parents' income has a larger coefficient. A ten year lag cohort 0 income increases the relative log of odds ratio by 1.05. This indicates that the event of moving to the next level of education is 1.05 times more likely to happen. The 7 year and contemporaneous both resulted in 50-50 chance of an individual in cohort 1 moving to the next education level. All coefficients were statistically significant. In regions 1, cohort 1 living in urban areas are less likely to move from one level of education to the next. In region 3, cohort 1 living in urban areas

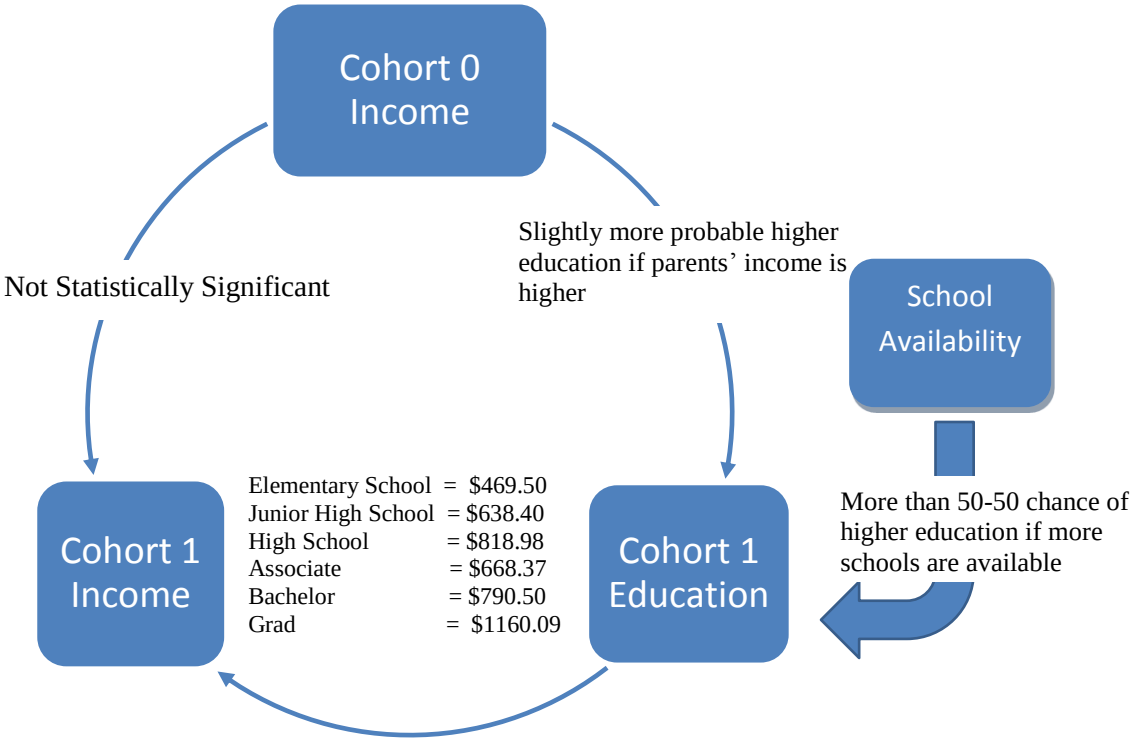
are 2.19 times more likely to move to a higher education level . In region 2, all but cohort 0 education of bachelors degree did not result in a coefficient that are statistically significant at any conventional level. In region 3, each level of cohort 0 education resulted in positive and significant. Further, the higher the cohort 0 education is, the larger the coefficient is. In regions 2 and 3, coefficients of distance to elementary and junior high schools came out negative which means that further schools reduces the probability of the event of an individual in cohort 1moving to the next level of education.

Table 4.5. Regional Children's Educational Attainment in 2007

Variable	Coefficient		
	Region 1	Region 2	Region 3
Age	-0.4076**	0.2366**	0.1925**
Cohort 0 Income 1997	7.39e-8	7.73e-8	8.84e-7**
Square of Cohort 0 Income 1997	-3.41e-14	2.20e-14	-8.75e-14**
Cohort 0 Income 2000	2.19e-7**	6.88e-8	4.17e-8
Square of Cohort 0 Income 2000	-9.83e-16	-4.14e-16	-6.51e-15
Cohort 0 Income 2007	-9.33e-8	8.64e-8**	4.64e-7**
Square of Cohort 0 Income 2007	7.18e-15	-7.77e-16	-5.86e-15**
Health	0.0031	0.0646	-0.1340
Urban	-1.1673**	0.2771	0.7820**
Cohort 0 Junior High School	0.4067	-0.1075	1.1922**
Cohort 0 High School	1.6543	0.0002	2.2452**
Cohort 0 Associate	-2.6780	0.4880	2.6195**
Cohort 0 Bachelor	N/A	3.2016**	6.1438**
Cohort 0 Graduate degree	N/A	-1.5236**	24.9282**
Elementary School Distance	-0.0284	-0.1176**	-0.1794**
Junior High School Distance	-0.0086	-0.0526**	-0.0480**
High School Distance	0.0084	-0.0086	-0.0116
University Distance	0.0053	0.0141	0.0073
	R^2=0.2072	R^2=0.2820	R^2=0.3602

These results can then be employed to update figure 4.4 to show the strong link between parents' income, child's education, and child's income. This updated estimation showed that the impact of parents' socioeconomic condition is channeled through its relationship with children's education which eventually leads to children's higher future income. However, public spending can significantly alter children's education attainment through improvement of school availability (Figure 4.5).

Figure 4.6. Public Spending Role on Education



4.3. Indonesian Health Estimation

4.3.1. Cohort 1 Health Quality in 1997

The last variable to estimate is individual's health quality. As a reminder to the reader, health estimation will be conducted for individuals who are categorized as children in 1997 in order to investigate how their health evolves over time and eventually alters their income as grownups in 2007. The first intuition when estimating health quality of children is to employ an ordered logit model, just the way education level is conducted. The idea was because it is also an ordered categorical variable and naturally estimated using an ordered logit model. However, the estimation did not provide a satisfactory result. The goodness of fit was very low and most of the explanatory variables were statistically insignificant which is probably caused by the numerous levels of health quality status.

Following Flegal et.al (2010), Kenchaiah et.al (2002), and Krzanowski (1980) we subsequently tried to estimate health quality using a regular OLS model, hence treating health quality as a continuous variable instead of an ordered categorical. This approach resulted in acceptable partial effect coefficients, but the model fit was still low. Even changing the functional form to include the log transformation of the variable did not help the estimation. The model fit was slightly improved when the observations were categorized into two groups, high health and low health. Afterwards, estimations were conducted separately for each category. Setting the cutoff point at level 5, those with reported health level below 5 are categorized as low health and above 5 are categorized as high health. However, many of the selected explanatory variables were not statistically significant.

In order to maintain efficiency, it is better not to separate the data. Hence, the last attempt was to treat the health estimation as a standard logit with dependent variable high health. Again, high health variable represents the health quality status of higher than 5 in the Likert scale. The inclusion of a new variable of the availability of health facilities increased R^2 from 0.1623 to 0.1627. Particularly, health facilities involved in this estimation are those practicing modern/western style health care. The inclusion of health facilities did not have a substantial impact on the estimation and partial effect of health facilities on increasing health was also not statistically significant. The estimation equation is therefore presented below and the result is reported in the first column of table 4.6.

Using the same interpretation of the coefficient of a logistic model, results show that higher family income results in 1.02 higher relative odds of the event to take place. It means that an increase of 100,000 Rupiah in parents' income will make a child 1.02 times more likely to be in high quality health. Those with high school education are 2.37 times more likely to report a high health quality. Compared to region 2, children in region 1 are 3.1 times more likely to have high quality health. Region 3 children are 38% as likely to have high quality health, since exp(-

0.9563) = 0.38. The coefficient on smoking habit means that higher cigarette consumption is associated with a 1.03 times higher probability of attaining high quality health. The partial effect of smoking habit on an individual child's health might potentially be confounded by other explanatory variables. For example, children from wealthier family might have a better access to health care and that way having better health despite developing a smoking habit relatively early.

The better the water quality in a particular home is, the higher the probability for children to be in a high quality health category. A medium water quality is associated with nine times higher probability of a child attaining high quality health. High water quality is associated with a coefficient of 1.2123 which is to be added to the coefficient of medium level water quality, 2.1975. This means that if a home have a good mater quality, then the event of a child to be in a high quality health status is 27.63 times more likely to happen. Only good sanitation resulted in a statistically significant coefficient and it will increase the probability of attaining high health quality by 2.27 times.

$$P(HH_{1i} = 1) = \alpha_0 + \alpha_1 Y_{0i} + \alpha_2 Age_{1i} + \alpha_3 Smoke_{1i} + \alpha_4 DUrban_{1i} + \sum_{s=5}^{6} \alpha_s \, Sanitation_{1i} + \sum_{e=7}^{8} \alpha_e \, Education_{1i} + \alpha_9 Distance_{1i}$$

Table 4.6. Cohort 1 Health Quality

Variables	Coefficients (1)	(2)	(3)
Age	-0.0492	-0.0396	-0.1456
Cohort 0 Income 1997	1.59e-7**	-	4.18e-7
Cohort 0 Income 2000	-	3.36e-8**	1.73e-8
Junior High School	-0.2529	0.0103	0.6531
High School	0.8611**	1.4993**	0.5926
Associate&Bachelor Education	-	-	0.0763
Urban Area	0.4140	-0.3363	-1.0367
Region 1	1.131**	-0.5364	0.6559
Region 3	-0.9563**	0.8000	-2.4243**
Cigarette consumption	0.0288**	-0.0756**	0.0807**
Age smoking	-0.0208	0.0451**	0.0743
Medium water quality	2.1975**	-	-13.5590**
High water quality	1.2123**	-0.7029**	-14.0126**
Medium sanitation	-0.1158	-	-0.8086
High sanitation	0.8198**	1.2790**	-0.7827
Distance to hospital	-0.0044	0.0016	0.0052
** significant at 5%	$R^2 = 0.1627$	$R^2 = 0.1585$	$R^2 = 0.2126$

Column (1) reports health quality estimation for cohort 1 in 1997
Column (2) reports health quality estimation for cohort 1 in 2000
Column (3) reports health quality estimation for cohort 1 in 2007

4.3.2. Cohort 1 Health Quality in 2000

In the year 2000, the same estimation equation was run and the result is reported in the second column of table 4.6. An increase in parental income leads to exp(3.36e-8) = 1, which again means there is a 50-50 chance of getting a high health. Educational attainment improves health quality only beyond junior high school level. Children with high school education are 4.48 times more likely to be in the high quality health. Smoking habit variables showed the expected coefficients. The more cigarettes consumed, the lower the probability of having high health quality since exp(-0.0756) = 0.93. However, children who started smoking at an older age are 1.05 times more likely to have high quality health. Inclusion of hospital availability only slightly improved the model fit from 0.1584 in the original model to 0.1585 although the individual variable coefficient is not statistically significant.

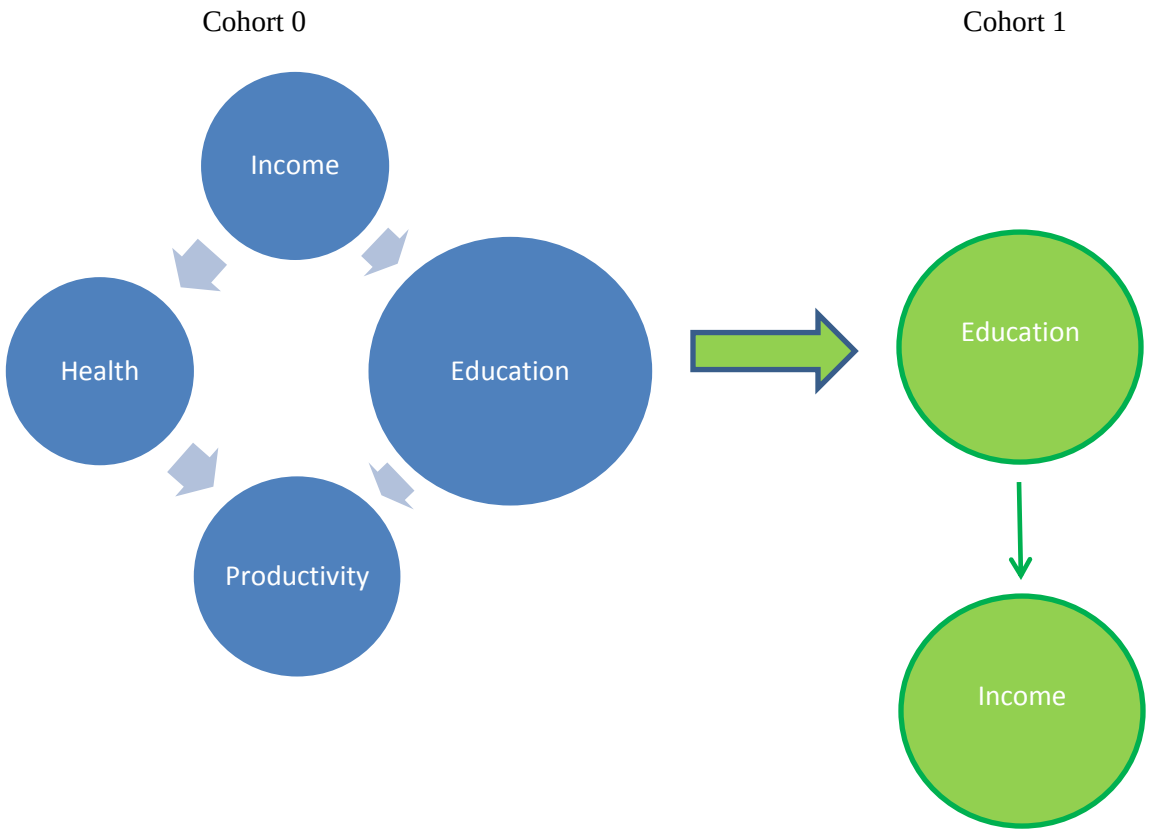
4.3.3. Cohort 1 Health Quality in 2007

Once again, the model is employed to estimate health quality of the consistently tracked individuals 10 years along the way. In the year 2007 different prospective model specification is tried, especially regarding the effect parental income. Intuitively, since some of the individuals included in this estimation are adults then the relevant parental income to be included should be the lagged parents' income. When all parental income variables since 1997, 200, and 2007 the model's R^2 was quite high, at 0.4205. However there are too many observations lost potentially due to the inconsistency of respondents in the survey. Furthermore, almost all of the coefficient values are counterintuitive. When only including parental income in 1997 and 2000, the R^2 values are 0.0867 and 0.1864, respectively. The best-performing model is the one in which the health estimation only includes lagged parental income.

$$P(HH_{1i} = 1) = \alpha_0 + \alpha_1 Y_{0i} + \alpha_2 Age_{1i} + \alpha_3 Income_{0i} + \alpha_4 Smoke_{1i} + \alpha_5 DUrban_{1i} + \sum_{s=6}^{7} \alpha_s \, Sanitation_{1i} + \sum_{e=8}^{9} \alpha_e \, Education_{1i} + \alpha_{10} Distance_{1i}$$

Table 4.6. column 3 reports results to the above equation with model's R^2 being 0.2126. Health estimation in 2007 gives a less conclusive result. For instance, lagged parents' income variables are not statistically significant. The impact of improved sanitation facility is also inconclusive. The signs of water quality is inconsistent with the previous year's report. It suggests that health quality is the harder variable to predict using the available data used in this thesis. Hence, the updated version of figure 4.2 treats the relationship between parents' income and children's health as a weak link, represented by a dotted line (Figure 4.6).

Figure 4.7. Education Role in Breaking The Cycle of Poverty



4.4. Model Interpretation

The initial cohort 0 income estimation treated all explanatory variables as exogenous, since data regarding parents' socioeconomic condition were not available. The estimation result reported that, all else being equal, experience improves one's income, which is consistent with Bedi and Gaston's finding (1999). Additionally, higher education resulted in higher income which is consistent with Benhabib and Spiegel's finding (1994) that a one-percentage-point increase in human capital as measured by years of schooling is associated with 12.8% higher income. It is also consistent with findings by Meng and Wu (1998) that an additional year in years of education is associated with approximately 0.06% higher average household income and was statistically significant. As reported in Table 4.1, every improvement of health quality level increases income by $199.1, $146, $288.84, $321.2, $333.84, $448.79, and $569.63 annually.

This is consistent with findings by Rivera and Currais (1999) and by Kiuila and Mieszkowski (2007). Estimation results showed that individual income is higher in urban areas which is consistent with what was found by Bedi and Gaston (1999), although the coefficients were not statistically significant.

Compared to the result of income estimation model in 2007 regional variables both are statistically insignificant. This suggests that geographical characteristic loses its power to explain individual income vis-à-vis educational attainment and household economy. The impacts of contemporaneous and lagged parental income were not significant either. This suggests that there are no direct correlations between parents' income and children income. However, education and health variables retain their signs and significance. This suggests that both parents' and children's income are explained by education and health.

Based on estimation result for children in 1997 the impact of parents' income on children's education is consistent with findings by Crosnoe et.al (2002) who reported that children from underprivileged families are less likely to attend higher education. Economic disadvantage predicts later enrollment in high education with coefficient of -0.33 and was significant at 1% level. This means that children of disadvantaged family are 0.72 times less likely to be enrolled in higher education during young adulthood. On the same note, Blanden et.al (2005) suggested that children from the poorest income groups increased their graduation rate only by 3% between 1981 and the 1990s while those who were born to richer families increased graduation rate by 26% within the same time frame.

Three years later, parental income maintains its positive and significant impact on children's education. The estimation result showed that children's education attainment is not only a function of their parents' contemporaneous income but also their income in the past. In the year 2000 the coefficient estimation of lagged parental income was even higher than the

contemporaneous parents' income, which suggests that the previous socioeconomic condition of a child plays a bigger role in explaining a child's educational attainment.

Even 10 years later, the impact of lagged parents' income is still positive and significant which means that what their parents earned 10 years ago significantly increases the probability of moving from one educational level to the next. The negative sign of "squared parent income" suggest that this effect is increasing at a decreasing rate. Furthermore, the coefficient of parent's income 10 years ago was larger than the coefficient of parent's income 7 years ago. This suggests that children who come from well-established rich families will be more likely to have higher education. This result is supported by the findings of Jolliffe (2002), Blanden et al. (2005), and Lleras-Muney (2005).

Children's education estimations showed that parental education has an important role in explaining children's education both nationally and regionally. Higher parents' education significantly increases the probability of children to achieve higher education level.. The relationship was maintained for estimation in 2007 when done nationally, but only in region 3 when done regionally.

This result is supported by Ganzach (2000) who found that parents' education strongly influences parents' educational expectation and children educational attainment. Similarly, Hahs-Vaughn (2004) suggested that there is a relationship between parents' education and the children's educational attainment. It was found that pre-collegiate traits, such as father's education and mother's education, were a stronger influence for non-first generation students and on educational outcomes. Perhaps more educated parents tend to have a better realization of the expected return to education.

The important part to highlight is the fact that the contribution of school availability outweighs the contribution of parental economic condition. The result suggests that school

availability as a representative of government intervention to human capital accumulation plays a bigger role than the individual effect of parents' income. When considering the fact that parents' education has a substantial impact on children's education, government expenditure potentially perpetuates the increase in education for the next generation. Relating this to the fact that higher income is significantly explained by higher education, government expenditure potentially has a large multiplier effect in increasing income for the next generation.

Health quality is the harder variable to predict using the data available for this thesis. Although it significantly explains income and educational attainment, data used in this thesis do not provide enough information as to what explains health. Using the current data, it cannot be conclusively inferred if there is a solid reason for policy recommendation to provide better health care.

Combining all the estimation models above, it can be deduced that education is the most central issue since it consistently plays a significant role in explaining income for both parents and children. Furthermore, in almost all regions and in each estimation year the availability of school is a significant predictor of education achievement. Hence, public spending in a form of increasing the availability of school is expected to significantly increase education which will eventually lead to higher income.

CHAPTER V

CONCLUSIONS AND POLICY IMPLICATIONS

5.1. Conclusion

Contemporaneously, income is explained by education and health. In the absence of government intervention, individuals born in wealthy families will be more likely to attain higher education and also having a better health quality. At the same time, better health also leads to higher education. Moreover, individuals born into more educated families will be more likely to attain higher education. These findings imply that children from wealthier families will end up earning even more money as grownups. It will be a recurring process which feeds on itself and eventually create a larger and larger gap between those with wealth and those without.

The role of government in providing basic education is extremely important. Making elementary and junior high schools reachable at a convenient distance will increase enrollment in these basic education levels which is a prerequisite to achieve higher educational attainment and ultimately higher income. Higher parents' education helps break the cycle of poverty by allowing children's education to increase so that they earn more than $2 per day per person, significantly higher than $1.25 per day per person, the poverty level currently designated by World Bank.

The need for government investment in public hospitals is not empirically supported to the same extent by data used in the current thesis. Furthermore, good infrastructure and public transportation allow individuals to attain modern health care which are not located at a convenient distance from them.

5.2. Policy Implications

Education remains a central issue in the attempt to increase income. Infusion of human capital is extremely crucial to increase next generation's income and beyond. Assuming no major and abrupt institutional change, this relationship will be a continuous process and make the future generations earn even more money. Public spending in the form of government investment in public schools will allow those who come from less fortunate families to improve their opportunities to catch up to their wealthier counterparts. Though it does not automatically annul the effect of family's wealth in individuals' educational attainment, it diminishes the impact quite significantly. Education should be considered as an integral part of industrialization process. As suggested by Lucas (1988) and Appleton and Balihuta (1996), better human capital helps improve technology through better cognitive and non-cognitive skills. The positive externality resulting from public education justifies the disposition of resources to fund public education.

One of the advantages of public education provision is that it avoids misallocation of government budget. The potential problem with cash subsidies is that sometimes the money is used to buy goods that are not the main target of the program. For example, food stamp recipients sometimes use the money to buy cigarettes and alcoholic beverages instead of food. If the government spends the money directly on providing schools, teachers, and other educational tools then it can potentially reduce the probability of education money to be spent on goods other than education.

Being the first level of education, availability of elementary school is the most sensitive one to distance. An additional kilometer of elementary school reduces enrollment which substantially decreases probability of attaining higher education. This implies that for every region, making elementary education accessible should be first and foremost. Furthermore, innately different regional characteristics cause each region to behave differently vis-à-vis an additional distance to a particular level of education. However, the regional education estimation did not give a uniform result with regards to the sensitivity of each region to school availability. Hence, it cannot be inferred using this thesis that there is a need for a "tailor-made" policy for each region.

5.3. Study Limitations and Further Studies

The discontinuous and uneven interval of the surveys might cause some imperfections in the study's estimation process. Additionally, health quality is not commonly considered as a choice variable, since it is not something one can choose but rather is innate to each individual surveyed for each variable might also contribute to these imperfections. Supplementary data and/or studies will be useful to provide a better understanding about the dynamics of household income.

The fact that health quality is measured by an interviewer's assessment likely causes some subjectivity. To some degree, this might explain why health variable estimation does not give a conclusive result. Data using actual medical records might help improve the estimation of health quality. For example, data regarding blood pressure, daily caloric intake, or body mass indices could be used as a representation of health quality in lieu of a Likert Scale based on an interviewer's assessment.

Since capital accumulation is a continuous process, in the future it is important to evaluate the Indonesian government attitude towards education. Specifically, it would be helpful

to determine what caused the government to invest more in education. Another aspect that is important to study is how Indonesian individuals actually evaluated the education payoffs in order for them to decide to invest in education. It appears there was a market failure in education, in that individuals were apparently not purchasing enough education services without the government subsidies. There were substantial individual as well as societal gains that were not being realized without the subsidies. It is interesting to evaluate how market failure affects individual decision in human capital accumulation.

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VITA

Masniaritta Pohan

Candidate for the Degree of

Doctor of Philosophy

Thesis: HOW EDUCATION BREAKS THE CYCLE OF POVERTY:
AN INTER-REGIONAL STUDY OF INDONESIAN HOUSEHOLDS

Major Field: Agricultural Economics

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in May, 2013.

Completed the requirements for the Magister Sains in Perencanaan dan Kebijakan Publik at Universitas Indonesia, Depok, Indonesia in 2003.

Completed the requirements for the Sarjana Ekonomi in Ilmu Ekonomi dan Studi Pembangunan at Universitas Katolik Parahyangan, Bandung, Indonesia in 2000.

Experience:
Teaching Assistant in Farm & Agribusiness Management, Agricultural Economics, Oklahoma State University, Spring 2013.
Academic Tutoring, Learning and Student Success Opportunity Center, Oklahoma State University, Fall 2012-Spring2013.
University Lecturer, Jurusan Ilmu Ekonomi dan Studi Pembangunan, Universitas Katolik Parahyangan, January – June 2009.
University Lecturer, Jurusan Manajemen, Universitas Kristen Maranatha, August 2000 – December 2008.