LUND UNIVERSITY
School of Economics and Management

Master in Economic Development and Growth

The Impact of early childhood conditions on future labor outcomes: Does the early-life health and nutritional status affect future earnings into young adulthood? A case study of the Cebu Metropolitan Area, Philippines

Elisavet Avgeropoulou
elisavet.avgeropoulou.508@student.lu.se

Abstract: The purpose of this study is to contribute to the expanding literature that associates early childhood conditions to future outcomes. Using the Cebu Longitudinal Health and Nutrition Survey, we will try to provide further empirical evidence to the question whether early-life health and nutritional status has impact on earnings into young adulthood for the case of the metropolitan area of Cebu in Philippines. Acknowledging that the relationship is likely to be driven by unobserved characteristics at household and community level (Hoddinott et al., 2011), we employ the IV approach. The CLHNS provides us with two major exogenous sources of variation in child health and nutrition; residence at the time of birth and price of corn. While the OLS estimation indicates a strong and positive impact of the early childhood health and nutritional status on future earnings, IV estimation contradicts this result. We argue that the drawbacks of the employed instruments along with factors such as the timing of child's growth may drive the IV estimations. Thus, OLS estimations are taken into serious consideration in determining the possible policy implications.

Key words: early childhood, nutrition, health, Philippines, future earnings, IV approach, height-for-age Z-scores

EKHM52
Master thesis, second year (15 credits ECTS)
June 2014
Supervisor: Luciana Quaranta
Examiner: Martin Dribe

Acknowledgements

I would like to give special thanks to my Supervisor, Luciana Quaranta. Her instructions and her guidance on the early life topic contributed notably in conducting this study. I would like also to thank Anna Segura and Nada Bedir for their helpful comments and the fun moments that we share together.

I am particularly indebted to Ximena Jativa for her honest and valuable feedback, her support when I needed it the most, and the incredibly nice moments that we spend together, her friendship, her love and those long coffee breaks. I am also indebted to Orestis Vlachos for his support and his patience during these two years.

I was also to thank my family, my mother, my father and my two little sisters that no matter the distance were always on my side. I want to thank them for their support and the encouragement during these two years.

Finally, I want to thank Jessica Baier, Armando Buelvas, Martina Garcia, Andres Arau, Charlotte Timmermans, Nadia Cavanzo, Laura Kirshner, Mario Gyori, Maria Miguel, Melvin Breton and all the MEDEG students for making these two years that special to me.

Contents

List of Tables

List of Figures

1. Introduction

"THE HIGHEST RATE OF RETURN IN EARLY CHILDHOOD DEVELOPMENT COMES FROM INVESTING AS EARLY AS POSSIBLE, FROM BIRTH THROUGH AGE FIVE, IN DISADVANTAGED FAMILIES. STARTING AT AGE THREE OR FOUR IS TOO LITTLE TOO LATE, AS IT FAILS TO RECOGNIZE THAT SKILLS BEGET SKILLS IN A COMPLEMENTARY AND DYNAMIC WAY. EFFORTS SHOULD FOCUS ON THE FIRST YEARS FOR THE GREATEST EFFICIENCY AND EFFECTIVENESS. THE BEST INVESTMENT IS IN QUALITY EARLY CHILDHOOD DEVELOPMENT FROM BIRTH TO FIVE FOR DISADVANTAGED CHILDREN AND THEIR FAMILIES."

JAMES HECKMAN

DECEMBER 7, 2012

The increasing awareness that early childhood conditions are crucial for the individual's trajectories into adulthood, has given rise to a blossoming literature which associates early life conditions to future outcomes. Ameliorations in early environment, during fetal stage and infancy, have been related to increased height (Bozzoli et al, 2009), better educational attainment (Maccini and Yang, 2009, Mallucio et al. 2009), lower probability of heart disease development (McEniry and Palloni, 2010), higher socioeconomic status (Case et al., 2002). An extended part of the existing literature has notably contributed to our understanding of the importance of early conditions for the individual's lifetime earnings (Smith, 2009), especially for the case of the emerging economies (Hoddinott et al, 2008).

An individual's developmental pathway is often regarded as a cumulative function of early life exposures, during the critical period, beginning in the fetal stage and lasting through the early childhood years (Shonkoff and Phillips, 2000). The critical period is fundamental for individual's health status; any essential functional or structural change occurring during this early stage is considered to be partly irreversible by later experiences (Ben–Shlomo and Kuh, 2002). Hence, early exposures to disease and malnutrition can determine individual's trajectories into young adulthood. Several economists have concluded that adverse conditions experienced by individuals in utero and during infancy have crucial impact on later life outcomes (Almond and Mazumder, 2011; Rocha and Soares, 2011). However, medical experiments have indicated that early stunting can be reversible by catch–up growth (Osborne and Mendel, 1914). Still, recent econometric research has documented that reversibility can be succeeded through early health interventions that can benefit individuals in the long-run (Hoddinott et al., 2008).

Anthropometric indicators provide the major source of evidence of early adverse conditions. Height is often considered as the most representative indicator for cumulative child health and nutritional status, from conception through the early childhood years and hence has been extensively employed by the academic community (Currie and Vogl, 2008). The widespread adoption of the early-life measures has led to a growing literature that seeks to reveal the mechanisms responsible for the long-term effects. Educational attainment (Currie 2009; Cutler and Lleras - Muney, 2007) and health status (Case et al., 2004) are regarded as the most prevalent mechanisms that link early health to future earnings. Better understanding of the potential developmental trajectories contributes to the identification of the causal association between early-life exposures and income during young adulthood. The use of micro-data along with exogenous sources of variation in early-life conditions helps us disentangle the causal links (Bengtsson and Lindstrom, 2000). However, few studies have evaluated the impact of early-life health status on labor outcomes, especially earnings, adopting exogenous sources of variation.
Since, a vast majority of the studies focus on the developed countries, the literature gap between prosperous and developing countries is constantly enlarging. The unavailability of longitudinal surveys that cover long time-periods along with the lack of emphasis on early childhood health and nutritional status, until rather recently, has contributed notably to this gap. However, the consequences of early adverse conditions are more relevant in the context of the emerging economies. Poverty-related shocks are more common in developing countries compared to the more advanced ones (Dupas, 2011). Less developed countries lack in mechanisms that can mitigate these shocks (Currie and Vogl, 2008). For instance, in developed economies, the socioeconomic status allows the household to compensate the child for health shocks, alleviating at the same time the negative long–term effects. Unfortunately, for households in the developing world, this is not the case. In addition, nutrition and disease level is more of a constraint for low-income countries compared to advanced economies (Bozzoli et al., 2009). Thus there is an imperative need for further research that evaluates the impact of early-life adverse conditions in the long-run.

The present case study seeks to reveal the causal link between early-life health and nutritional status and earnings during young adulthood. Acknowledging the existing gap in the economic literature, this paper focuses on an emerging economy, the Philippines. More precisely, the focus is on the Cebu Metropolitan area. The Philippines has provided the academic community with the Cebu Longitudinal Health and Nutritional Survey. This longitudinal, individual–level data set offers the necessary sources of exogenous variation in early childhood conditions so as to determine the causal pathway between early health and future salary. The major assumption is that early health status is endogenous in the wage equation (Hoddinott et al., 2011; Behrman and Hoddinott, 2005), since unobserved characteristics at household and community level can affect simultaneously individual's future earnings and early health status. To the best of my knowledge, this is the only study that aims to determine this causal relationship by exploiting an exogenous source of variation for the case of the Philippines.

The choice of the specific country has been spurred by the existing literature that exploits the Cebu Longitudinal Health and Nutritional survey in order to evaluate the early childhood conditions (Yoon et al., 1996; Molina et al., 1994). Notably, Cebu is a metropolitan area where catch–up growth (Adair, 1998) can be possible through parent's compensatory behavior (Liu et al., 2009). Hence, the combinations of previous results with the present empirical estimations will yield important and consistent conclusions. In addition, further empirical evidence is of imperative need for policy makers in the Philippines. The combination of an idiosyncratic labor market and a fickle economic situation indicates that the adoption of new policies is of utmost importance.

The Philippines is a country with a long history of volatile economic growth rates (*see Appendix I Figure 1*) combined with high poverty and inequality. Particularly, it was only after 2010 that the Philippines started to experience relative stable annual growth rates. The GINI coefficient remains at 0.45 approximately[1] during the last thirty years, between 1985 and 2013 and in 2009 41.53% of the population still lived in absolute poverty, according to the Poverty Headcount Ratio[23]. One of the implications of high poverty incidence is the adverse conditions during early childhood. According to UNICEF[4], the stunting[5] before the age of two amongst Filipino children is rather severe, impairing their cognitive and physical development for life. The following statistical figures are indicative of the present situation; 3.6 million of children aged between 0

[1] The GINI is the inequality index. GINI has a minimum of zero (no inequality) and a maximum of one (maximum inequality)
[2] The PHR is calculated as the percentage of the population that lives with less than 2$ per day (PPP)
[3] The estimations are based on World Development Indicators (WDI) 2013.
[4] http://www.unicef.org/philippines/health_nutrition.html#.U4eu_fl_urQ
[5] Stunting is defined as Height-for-Age <-2SD from the mean (WHO Standards, 2006)

and 59 months are considered underweight, 55.7 percent of children between 6 and 11 months are anemic and 20 percent of children aged between 6 and 11 years also suffer from deficiency of iodine. Nevertheless, the last years there is a steady reduction in the percentage of malnourished children, but still the figures remain at pretty high levels. Unfortunately, the high deficiencies in nutrients intake is not the sole problem; the lack of access in health infrastructure, poor health conditions during pregnancy and breastfeeding, exacerbate the adverse conditions as well. Eventually, more unhealthy children are less likely to have better labor prospects, especially, in the Filipino labor market. The Filipino labor market is characterized by great inequalities in terms of wage and employment differentials between rural and urban areas and between educated and non–educated part of the population. According to ILO, in 2004, the daily wage in Cagayan Valley was 141 pesos approximately compared to the leading regions, such as Calabarzon with 219 pesos per day. In addition, the wage differentials lead to an increased migration from poor rural areas to the rich urban areas and subsequently, the unemployment rates in urban areas is increasing (Canlas, 2008). The inequality is extremely high between individuals with primary education and those with tertiary education; the returns to education are 2.24 and 17.62 percent respectively, in 2000. Low wages can lead to high underemployment rates; a person is willing to work more, despite the fact that he/she is a full–time worker. Hence, high underemployment is related to high poverty incidence. Particularly, during 2005–2006, Luzon had high underemployment and high poverty whereas Mindamao had low poverty and low underemployment (Canlas, 2008). Amongst the Filipino provinces, Cebu Metropolitan Area is one of the most populated one. With a total population of 2,377,588 persons according to Census 2000, Cebu is located in the heart of the Philippine Archipelago (*see Appendix I, Figure 2*). It is a province with rather high dependency ratio, 77.77 in 1995 and a population with median age of 20 years old. Cebu offers rather diverse socioeconomic conditions and a ratio between rural and urban regions that is suitable for further discussion.

The present dissertation is organized as follows; Section 2 provides the detailed presentation of the mechanisms that drive the relationship between early-life health and nutritional status and future earnings along with previous empirical evidence, section 3 describes extensively the data set employed, section 4 presents the empirical framework along with the econometric method and the descriptive statistics, section 5 formulates the main hypotheses and expectations, section 6 introduces the empirical results, section 7 offers a detailed description of the limitations that the study has encountered and the final section presents the detailed discussion over empirical results along with the concluding remarks.

2. Theoretical Background

During the last decades, an increasing number of studies have documented that individuals who experience better early-life conditions, are more likely to be healthier and wealthier as adults (Almond and Currie, 2011). Early childhood environment is regarded by the scholars as one of the most multi–dimensional issues in the economic development literature. The timing of child's growth (Glewwe and King, 2001), the possibility of catch–up growth (Adair, 1998), the importance of prenatal conditions (Barker, 1992) and mortality selection (Bozzoli et al., 2009) and the various mechanisms that link early–life to later outcomes (Smith, 2009; Case et al.,2004) formulate the map of the present analysis. As Cunha and Heckman (2007) point out an individual's skill formation is a process that takes place throughout the life–cycle; it starts in utero and continues into adulthood. Hence an individual's future salary can be considered as the outcome of this life–cycle process.

The term of "critical period" was first established by the medical community. Hubel and Wiesel (1964) put the foundations of the definition of the critical period for brain development[6]. Since then, various economists have tried to identify the semester that is critical for child development. Dobbing (1976) points out that child's physical growth is determined by health and nutritional shocks, occurring within the first six months from birth. Glewwe and King (2001) state that nutritional status in the time spam between 18 and 24 months can have crucial impact on a child's developmental trajectory. Kuh and Ben-Shlomo (2002) bring into focus the importance of the fetal stage and the first year. The relevance of the critical period lays down on the fact that the development of the organism's most vital parts occurs during this stage (Scott, 1986) and any structural or functional change has irreversible impact on later outcomes. However, medical research has documented evidence that catch–up growth can be possible during later stages. The two main hypotheses for the child catch–up growth are the following; the first one is the "neuroendocrine hypothesis" which was proposed by Tanner (1963) who claimed that "If a

[6] In their animal experiment, the authors concluded that the eye neurons may not get developed normally if signals do not "pass to the visual cortex of the brain" (McCain et al., 2007) within a certain time framework.

mismatch is recognized, the body is encouraged to continue growing at a faster-than-normal rate."(De Wit et al, 2013) and second the "growth plate hypothesis" which was proposed by Osborne and Mendel (1914) who concluded that malnourished rats exhibited late growth rates that were higher than the normal. The econometric evidence though is more limited. Adair (1998) employs the Cebu Longitudinal Health and Nutrition Survey and her conclusions indicate that 32.5.% of children who were stunted at the age of two, show a moderate improvement in terms of height–for–age Z-scores at the age of 12. On the other hand, Mcgregor et al. (2007) support that, despite the existing evidence, stunted children are rather unlikely to catch–up in later stages. On the whole, there is little or no consensus amongst the academic community with respect to the timing of child's growth and the possibility of catch–up growth.

The growing evidence brings into focus all the mechanisms responsible for the association between early-life health status and an individual's future earnings. The developmental trajectories from early childhood into young adulthood are strongly affected by conditions in utero that are closely interrelated with the concepts of "selection" and "scarring". Individuals, who survive early-life adverse conditions, are likely to be healthier, i.e selection effect, but exposure to higher childhood mortality rates may augment the adulthood death rates, i.e scarring effect (Preston et al., 1998)

"Is it likely that individual's future trajectories can be affected by the nine months in utero?" The theory that associates prenatal conditions to later life outcomes is known as "fetal origin" hypothesis. One of the greatest proponents of this hypothesis is David J. Barker. In his seminal work in 1992, he supports that poor nutrition in utero can impair the fetus's metabolic characteristics in such a way that the individual is more vulnerable to future diseases. More concretely, his conclusions indicated that malnourished children in utero have higher probabilities to become overweight and to suffer from cardiovascular problems into adulthood. Various economists got influenced by Barker's hypothesis; Benarjee et al. (2010) find that more favorable prenatal conditions lead to better stature during adulthood. Almond's (2006) results indicate that the mother's exposure to the 1918 Influenza Pandemic during pregnancy leads to a higher probability that her offspring will be disabled.

It is not up until late 1950s–early 1960s that the medical community perceives that “the placenta is not some sort of impervious barrier”[7]. The thalidomide episode establishes the significance of prenatal period; Von Lenz and Knapp (1962) refer that thalidomide, which is a medicine for morning sickness, is associated with rather serious defects at birth such as missing parts of the body. In the years to follow, there are various studies that focus on the importance of period in utero. Jones and Smith (1973) define the “fetal alcohol syndrome”; it is about the common pattern in facial expressions and behaviors amongst children whose mothers suffer from alcoholism. Many scientists describe the pattern of latent effects that prenatal conditions may have; amongst them Barker is maybe the most influential one. In order to examine the impact of prenatal conditions, many studies take advantage of natural experiments such as famines. Hoek, Brown and Susser (1998) conclude that schizophrenia incidences are more common amongst those that had been exposed to the Dutch Hunger Winter of 1944, during prenatal period. Clair et al. (2005) reach the same conclusion for the Chinese Famine during 1959–1961. Stein et al. (2006 d; a) also exploit the Dutch famine incidence and their conclusions for the cohort of children that are affected by the “Hunger Winter” indicate the following; first both women and men have undergone important changes on blood pressure and second women experienced variations in fat composition. The scarring effect is evident in all the studies cited above; exposure to adverse conditions, increases morbidity and thus death rates into adulthood.

On the other hand, there are various studies that cannot identify the association between early conditions and outcomes in adulthood. Kannisto et al. (1997) cannot establish a causal effect between early-life adverse conditions and future outcomes for the case of Finnish famine of 1866–68. Along the same lines, Stanner et al. (1997) point out that the effects of prenatal conditions are not evident for the case of Leningrad. These studies establish the possible effect of self–selection. Almond and Currie (2011) point out that childhood mortality rates are rather high in both cases and only the healthier individuals can survive, leading to a possible mortality selection bias. This effect can lead to the domination of selection bias effect over the potential stunting for low-income economies (Bozzoli et al., 2009). Thus, diminished mortality can potentially lessen the “population average outcomes”; employment and earnings level could have

[7] Dr. Philip Landrigan (cited in Roan [2007]) Chair of the Department of Community and Preventive Medicine at Mount Sinai School of Medicine in New York City.

been decreasing less slowly in the absence of infant mortality due to adverse conditions during pregnancy (Currie and Vogl, 2008)

Conditions in utero along with the terms of catch–up growth and critical period open just a small window to the association between early-life health and nutritional conditions to future earnings. The most crucial questions remain unanswered;"in which ways early adverse health conditions can impair individual's pathway through adolescence and into young adulthood? And which are the mechanisms that drive individual's future earnings?" Various economists state that health status and human capital accumulation are the two primary components of individual's developmental trajectories into the labor market. Improved health conditions during early childhood are associated to better academic outcomes (Currie 2009) and higher educational attainment can lead to improved health status in young adulthood and more favorable labor market outcomes (Cutler and Lleras-Muney, 2007).

It goes without saying that better health and nutritional status during early childhood are associated to improved academic performance and better later-life health status. Various studies conducted the last decades have established the causal link between early health and school outcomes. Even though, evidence has been documented both for developing and developed countries, the main focus will be on the emerging economies. Alderman et al. (2001) explore the relationship between child health and school enrollment rates in rural Pakistan, using a unique longitudinal data set. Crucial part of their analysis is the use of grain prices as exogenous source of variation for child early health status. Their main assumption is that higher grain prices have negative impact on child health status. Their results indicate that improved nutritional status and thus better health at early age leads to higher school enrollment rates. Glewwe, Jacoby and King (1999) employ the Cebu Longitudinal Health and Nutrition Survey, so as to study the relationship of child's development, captured by the height–for age at the age of 8 approximately, with the schooling outcomes The method of within–siblings estimator along with the IV instrument approach helps them to establish a causal relationship between malnutrition and worse academic performance; malnourished children appear to have not only delayed enrollment in primary school but also lower scores in achievement tests. Maccini and Yang (2009) perform a rather interesting study, by linking data of rainfall during early years to information later in life, for the case of Indonesia. Their main hypothesis is that higher rainfall levels result to better nutritional status and higher height. The authors conclude that better health status can be associated to an increase in the years of educational attainment for women[8]. Currie et al. (2010) evaluate the early-life conditions for the Canadian province of Manitoba. The authors employ public health insurance records for 50,000 children. The specific data set allows them to use within–siblings estimations in order to account for the unobserved characteristics that many affect both early childhood health and subsequent health status along with education. Their results indicate that that child health has a considerable impact on academic outcomes mainly through its impact on late health; adverse early health conditions lead to worse health status and thus to worse academic outcomes.

The academic community has established the causal relationship between early-life health and educational attainment, albeit, reversal of early adverse conditions can be possible through early interventions which can stimulate child's catch–up growth (Bredy et al., 2003). Randomized control trials[9] offer an abundant source of evidence. Bobonis, Miguel and Sharma (2006) carried out the randomized evaluation of a health Program which takes place in the poor, urban areas of Delphi, India. They find that the provision of deworming and iron supplementation medicine to children aged between 2 and 6 years old has a remarkable impact. Five months of treatment is a sufficient time period in order for the results to be evident; considerable weights gains and one–fifth decrease in the days of absenteeism. Vermeersch and Kremer (2004) conduct the evaluation of a preschool feeding program in Kenya. Their results indicate significant gains in terms of participation rates and higher test scores in schools with relatively experienced teachers. During the last years, various interventions in developing countries focus on children's educational and health stimulation before the age of five, in an attempt to improve children's well–being. Amongst them, "Opportunidades"[10] in Mexico is one of the programs that have been evaluated the most by the research community. Gertler (2004) studies extensively the aspects in which "Opportunidades/Progresa" Program benefits child health and his conclusions can be considered rather promising; children who participate in the program, aged 12 to 48 months at the time of

[8] Currie and Vogl (2008) state that the absence of results for men can be associated to mortality selection bias; boys are more vulnerable to early adverse conditions compared to girls.

[9] Randomized control trials method is a novel method of impact evaluation; the basis of the theoretical background is the random allocation of resources, policies and programs to individual, aiming to determine whether a specific program has the desirable effect. (source: Abdul Latif Jameel: Poverty Action Lab)

[10] The motivation to make special reference to this program arises from the fact that it is one of the anti – poverty programs with the lowest attrition rates (Gertler (2004)). This is a fact that grants validity to the program.

the survey, gain in terms of height and lower probability of anemia occurrence. Gertler and al. (2008) go one step further in analyzing the impact of “Oppotunidades/Progresa” for children aged between 3 and 6 years old. Their results are rather encouraging for children’s physical skills. The authors find that for a variety of motor skills (jumping, walking etc), both girls and boys appear to have an increase of 10 to 15 percent approximately.

So far the discussed literature has provided evidence for the importance of the early childhood health status for child’s adolescence. Yet, early-life health status can have a lasting impact into young adulthood. Studies that employ data sets which offer the possibility to track the same individual in various points in time are a priceless source of information and evidence. Yet, the long longitudinal data-sets are more common in the advanced economies. Smith (2009) describes how education, earnings and family income can evolve in United States; using a unique data set which includes information about children and their parents from childhood through adulthood. The main methodological problem though with the majority of these studies is how causal inference between early health and future earnings can be drawn. Due to the availability of information about the siblings, the author is capable of employing the difference within siblings in order to eliminate the unobserved characteristics that may affect simultaneously early health and outcomes in the future[11]. His findings indicate that poor early child health is not only associated with lower earnings growth rates at the age of 25, but also with lower family income and wealth. In addition to this, the results reflect the negative effect that early poor health may have on subsequent health status and finally on labor supply. Smith is amongst those economists who advocate that health can be treated as human capital and thus it has a clear effect on individuals’ earnings and labor supply On the other hand though, there are those who state that current health status has no impact on future economic status (Chandola et al., 2003) and hence adverse health conditions during early childhood cannot affect earnings through current health status.

Along the same lines as Smith, Case et al. (2004) employ a life–course model in order to determine the relationship between early childhood health and adult outcomes for the case of United Kingdom. The authors exploit the 1958 National Child Development Study which allows

[11] Alderman et al. (2000) and Glewwe et al. (1999) recognize the endogeneity of health status in the equation of child’s human capital accumulation and they employ price shocks and the anthropometric characteristics of the younger siblings as instruments respectively.

them to employ a large set of control variables, increasing the reliability of their causal interpretations. They argue that even by using a detailed data set, they cannot eliminate the possibility that unobserved factors; for instance genetic endowments may drive the relationship between early health and financial resources. In the model employed, the economic circumstances play a rather important role in identifying how poor early childhood health can be transformed into lower social status in adulthood. Their conclusions indicate that there is an association not only between poor health during early childhood and lower probability of employment at the age of 33, but also between poor early health and worse socioeconomic status[12].

In the studies cited above, parents' socioeconomic status plays an important role in the evolution of early child health and nutritional status, during fetal stage and the first years. Currie and Hyson (1999) analyze the variations in birth weight according to socioeconomic status; the conclusion of interest is that children with lower SES are more probable to be born with lower birth weight. Currie, Price and Shields (2004) prove that the percentage of children aged from 0 to 3 that suffers from chronic diseases is larger in low income families compared to high income families. Notably, Currie and Stabile (2003) state that families with higher SES are capable of curing or even preventing chronic health diseases and subsequently the effects of child poor health can be restored in later life. Thus, children from families with low SES are more vulnerable to health shocks incidences.

One rather intriguing part in all the studies that focus on health and nutrition is the way in which the authors proxy for child health and nutritional status. Floud et al. (2011) point out that height can summarize "*individual's capacities and constraints*". More concretely, the authors claim that net nutrition along with the impact of disease exposure can be fully described by height. The deviation from the mean height, when the individual reaches his/her full genetic potential, can determine his/her risk of stunting. Fogel (1994b; 2004) brings into focus the impact of malnutrition on later-life health status through its impact on the development of the organism's vital parts. He provides further support to the use of height at proxy for health and nutritional status, as he states that variations in height are interconnected to body's physical development.

[12] Case et al. (2004) define socioeconomic status in terms of working status, i.e professional or unskilled labor.

Deaton (2007) claims that individual’s genetic potential and net nutrition can determine his/her height.

Since height can be measured rather easily (Steckel, 1995), it has been employed in various studies both in developed and developing economies. Thomas and Strauss (1998) associate height to better physical status and therefore to higher productivity in developing economies. Case and Paxson (2006) point out the correlation of height to higher health status and higher cognition for the case of the United States and United Kingdom. Striking is the fact that in developing countries height premium is mainly associated to physical strength whereas in advanced economies is associate to better cognitive skills. Evidence has been reported that height functions through psychological mechanisms for the advanced countries; it can be associated to self–esteem (Young and French, 1996) or even to discrimination (Magnusson et al., 2006). Subsequently, there are various studies that relate height to the probability of entering in the labor markets and the future earnings, using various hypotheses. Barker et al (2004) associate height with future earnings. They study 4630 men who live in Finland, from birth through the age of 50. More precisely, they employ child’s height as a proxy for child’s development and their results indicate that men, who experience lower growth rates during infancy, have lower earnings as adults. The papers mentioned above focus mainly on developed economies. This arises mainly from the fact that studies that investigate the relationship between child health and labor outcomes need data sets which cover long time periods. Plenty of times, longitudinal surveys fail to track all individuals for a long time-period, especially for the developing countries and consequently data that comes from projects offer the most valid and consistent source of information and evidence. Hoddinott et al (2008) examine the long–term effects of a randomized experiment in Guatemala, INCAP (Institute of Nutrition of Central America and Panama). The project involved the random assignment of high–energy nutritional supplements and placebos between the control and the treatment group. The results indicate that improved nutrition during the first two years leads to an increase of 46% for the adult’s future earnings[13]. Gertler, Heckman et al. (2013) evaluate the psychological stimulation program in Jamaica and their results indicate that early-life stimulation can boost an individual’s future earnings by 42%.

[13] The confidence interval though is rather large, between 11% and 80%, which implies that the estimates may be rather inaccurate.

3. Data Sources

The Cebu Longitudinal Health and Nutrition Survey (CLHNS) is an ongoing study of a cohort of Filipino women which gave birth between 1th May of 1983 and 30th April 1984, in the Metropolitan area of Cebu in Philippines. It is a common endeavor of the University of San Carlos, Philippines in collaboration with the University of North Carolina, United States and the Nutrition centre of the Philippines, Manila. Originally, it is conceptualized as a Demographic Survey which fully investigates the infant and maternal health, nutrition and feeding patterns. These topics are analyzed within a longitudinal context, in which household decisions interact with socioeconomic and environmental factors, allowing at the same time the determination of possible causal relationships. The most recent follow–up surveys, which track index children into adulthood, allows us the identification of the impact of prenatal and early childhood nutrition and health in the long–run.

The sampling design of the survey plays a vital role in the deeper understanding of the methods adopted and the empirical results in the present paper. First, there were randomly selected 33 villages (= barraguays in Filipino language), in the Metropolitan area of Cebu; 17 were urban and 16 were rural[14]. The random sampling can eliminate selection bias arising from the non–random selection of households (Heckman, 1976; 1979). In addition, the study area of Cebu is a rather populated area with diverse socioeconomic conditions between urban and rural regions (Survey Procedures, 1989), characteristics that are illustrative of both Cebu and the Philippines. However, the focus on solely one metropolitan area rather on the whole country combined with the absence of elevation weights from the sample design can raise serious doubts for the external validity of the present study.

The first survey was conducted in late 1982 for an initial sample of 28,000 households and the second one in early 1983 in order to locate all pregnant women. The initial sample included 3,327 women who were on the 6th to 7th month of pregnancy so as all births, including preterm births, could be determined. The following surveys took place instantly after birth and then periodically, at bimonthly interims during the first 2 years, collecting anthropometric, health and nutrition data. There were identified 3080 singleton births and approximately 2,600 households

[14] The distinction between rural and urban areas was not part of the survey procedure; it is based on the classification followed by the Census Bureau, according to density and population size, administrative characteristics. (Survey Procedures, 1989)

were followed and studied during the first two years. From the initial sample of 3,327 women, 2,179 responded both the baseline and the last bimonthly survey. The main reasons for the difference between the initial sample and the total respondents arise mainly from migration[15], and less from reasons related to infant mortality; miscarriage and stillbirth (see *Appendix II**,** Table 10***).** Thus the mortality selection (Bozzoli et al., 2009) is unlikely to affect the main results.

Index children have now been followed into young adulthood; 21 years old approximately. In the follow–up survey of 2005, 2,080 individuals are tracked down and 1, 914 of them complete the interview (see *Appendix II***,** *Table 10*). The sample difference between the baseline and the follow–up survey of 2005 leads to a large attrition rate. This is mainly due to the migration in regions that were located outside of the Metropolitan area of Cebu (Adair et al., 2011). Attrition is regarded as one of the main drawbacks of this survey; as it can severely bias the final results if it is correlated to certain individual's characteristics (Alderman et al., 2001). Migration of the most educated part of the population (Adair et al., 2011) can lead to an underestimation of the individual's earnings; less healthy children are expected to be less educated and subsequently earn a lower salary into young adulthood. In addition, missing values is another problem that this analysis should deal with. One illustrative example of how missing values can arise from the part of the anthropometric measures is the fact that small boxes were employed for the child's height measurement. This type of infant - meters was looking like a coffin and thus parents believed that their children were "measured for a coffin" (Survey procedures, 1989). Subsequently, there were many times that the parents did not allow to the interviewers to finish they survey.

However, the CHLNS is a unique data base. It covers a period of 25 years approximately, it contains detailed information on infant and mother's characteristics and the anthropometric measures taken are considered to be rather reliable[16]. In addition to this, one of the strong points of the CHLNS data base is the inclusion of the commodity-prices survey; it is one of the few studies that can offer an exogenous source of variation for child health in the context of the same survey. The commodity prices are derived from the bimonthly food price surveys which are

[15] According to CLHNS report, the 382 out – migrants were brought back into the study, resulted to an initial total population of 2,561.

[16] The data collection followed the Habitch's procedure. (1974)

included in the CHLNS. The data provides information about the following components; first, prices for a variety of food items (poultry, fish, corn, rice, vegetables, cooking oil meat and salt) and second prices for a wide range of brands of infant food and milk. Data are collected in each village, in two stores inside each village for the years 1983, 1984, 1985, 1986[17].

For the purpose of the present analysis, the surveys that will be employed are the following ones; the baseline survey, when the mother is still pregnant, along with the last bimonthly survey of 1986, when the child is 24 months approximately the follow – up survey of 2005, when the child has already entered in young adulthood and he/she is 21 years old approximately and the commodity price survey. The merging - procedure yields a data base with a total of 1,469 observations; more detailed information about the variables and the exogenous source of child health is provided in the section of *Key Variables: Descriptive statistics*.

[17] Data were collected in the following months into the calendar year; January, March, May, July, September, November

4. Empirical strategy

4.1. Conceptual Framework

Better child nutritional and health status is directly associated with parent's decisions to invest more to their offspring. Becker (1975) considers parents' decisions in the context of maximization theory and thus he states that choices are motivated mainly by the future investments in their children's human capital. However, Behrman and Hoddinott (2005) point out that parents' choices are motivated both by their selfish interest (Becker 1975) as well as their affection towards their offspring. The importance of child health and nutritional status stems from the fact that it is considered as another input in the household utility function (Hoddinott and Kinsey, 2001)[18]. The main assumption is that household welfare is increasing at diminishing rates to the improvements of child health and nutritional status. However, parents' decisions depend first on their preferences regarding the use of economic resources and second on their bargaining power into the household. Hence, the decisions can be constrained by a number of factors. These factors can be associated either to economic aspects, such as available wealth, and current prices that each household faces, or to the production process of health, such as knowledge and time devoted to children. Genetic factors, such as heredity, or community characteristics, such as health infrastructure can have also an impact on parents' decisions and on the disease level. Unfortunately, not all these factors can be observed and measured by the researcher.

Each household maximizes its utility which is subject to the constraints mentioned above. Thus, the first order condition for child health is given by the following equation[19].

$$HAZ_{ci} = f_{ci}(C_{ci}, M_{ci}, W_{ci}, A_{ci}, P_{ci}, Z_{ci}, \varepsilon_{ci}) \quad (1)$$

HAZ_{ci} is the proxy for child health and nutritional status, height–for–age Z–scores at the time period c for child i, C_{ci} is a vector that includes child's characteristics such as age and sex, M_{ci} is a vector of the mother and mother's spouse characteristics, such as educational attainment and age, W_{ci} represents the wealth of the household, A_{ci} is the vector that describes characteristics of the household that may affect child health, P_{ci} is the vector of prices that the household faces, Z_{ci} is a vector of community-specific characteristics such as water access, sanitation infrastructure,

[18] This theory is associated to " household demand model" (Becker, 1960)
[19] The notation is from Behrman and Hoddinott (2005)

disease level that may affect child health and ε_{ci} is the disturbance term which includes health shocks that may affect child health and nutritional status.

Future earnings , E_{yi} , for individual, i, during young adulthood, y, can be expressed as a linear combination of child health and nutritional status, HAZ_{ci}, of the vector, X_{ci}, which includes all household, individual and community-based characteristics that affect child health status and subsequently individual's future wage and of υ_{ci}, which is the disturbance term and includes all those characteristics that may affect individual's earnings. The error term cannot be observed by the researcher, for instance, individual's innate ability can be correlated to early-life health and nutritional status through the individual's genetic potential.

$$E_{yi} = g_{yi}\ (HAZ_{ci}, X_{ci}, \upsilon_{yi}) \qquad (2)$$

4.2.Econometric Method

The equation (2) is the equation of interest. In order to provide a better understanding of the estimation methods, equation (2) will be expressed in the following form.

$$E_{yi} = \beta HAZ_{ci} + \gamma X_{ci} + \upsilon_{ci} \ldots\ldots\ldots (3)$$

β is the parameter of interest. So as to get consistent estimates for equation (2), $E(\upsilon_{ci}, HAZ_{ci}) = 0$, the error term should not be correlated to the child health and nutritional status. Provided that CLHNS would contain detailed information about all the inputs at individual, household and community level for both equations, (1) and (2), the omitted variable problem could have been eliminated. Unfortunately, this is not the case and hence the simple OLS estimation can lead to an upward or downward bias in the β estimation[20]. The direction of the bias depends on the type of the correlation between unobserved components, included in the error term and the proxy for child health status. Hoddinott et al. (2011) provide a rather illustrative example. Let's assume that the effect of social networks cannot be observed; Prosperous families tend to belong to social networks of high socioeconomic status and thus invest more to their children's health status. Subsequently, these families are better placed and hence they can provide their children

[20] The formula that indicates the possible bias of β estimator is the following: $E(\beta) = \beta + \gamma \, {}^{Cov(V_i, HAZ_{ci})}\!\big/_{Var(V_i)}$. If we assume that V_i is the vector of unobserved characteristics that are included in the disturbance term, then the bias arises from the correlation of those characteristics with the variable of interest. In the case that the correlation is positive there is an upward bias and in the case that the correlation is negative, there is a downward bias.

with better labor market prospects. This implies that there is a positive correlation between the unobserved component and the main explanatory variable, leading to an upward bias.

The omitted variable bias is not though the sole problem in the estimation of the main equation. Measurement errors[21] may affect the β estimation as well (Alderman et al., 2001). The possibility of measurement error with respect to child's age is rather low, since the child's age is not self – reported by the child's mother, rather it is calculated based on the difference between the birth date and the referred date in which the height was measured by the interviewer. Furthermore, cannot be excluded the possibility that height has been measured with error. According to CLHNS survey procedures (1989), various interviewers were not capable of performing the time–consuming surveys and had to be dismissed from the survey procedure. In addition, there were reported cases in which the interviewer did not have the adequate reading skills. There should be noted though that the number of these cases is not known.

So as to eliminate the two problems mentioned above, the estimation strategy to be followed is the IV instrument approach. The intuition behind the use of IV is that it divides child health in two parts; one that does not and one that does correlate to the disturbance term. Hence, the instruments can detect the variation in child health that does not correlate to the error term.

The main IV assumptions are the following; first the instruments should have a strong impact on the endogenous variable, height–for-age Z–scores and second, the first-stage must be the only reason for the relationship between the outcome variable and the instruments. The first assumption can be tested and the results are presented in the *Empirical Results* section, but the second assumption, known as the "exclusion restriction", is only an indentifying assumption and it cannot be tested[22]. Let's assume that Z_{ci} is the vector which includes the possible instruments, the model that IV approach fits is given by the following formulas

$$HAZ_{ci} = \delta X_{ci} + \pi Z_{ci} + \xi_{ci} \qquad (4)$$

[21]The measurement error bias if given by the following formula:

$$\beta_{OLS} = \left({Var(X)} \middle/ {Var(X) + Var(v)} \right) \beta$$

So, the estimated β converges to a fraction that is smaller than the true value of β, leading always to a downward bias.

[22] Here it should be noted that the exclusion assumption is equivalent to randomization; the variation in Z–scores is regarded as random. (source: Micro-econometrics course, Lund University, December 2013, Prof. Peter Lundborg)

$$E_{yi} = \rho\widehat{HAZ_{ci}} + \kappa X_{ci} + \omega_{ci} \ldots\ldots\ldots.. (5)$$

Equation (4) is the first-state equation and equation (5) is the reduced form equation. Based on equation (4), the height–for-age Z–scores fitted values are estimated and then they are employed in equation (5). The reduced form equation estimates the direct impact of the instruments on the outcome variable. The most common IV estimator is the Two Stage Least Square (2SLS) that was first developed by Theil (1953) and it represents the procedure that is illustrated by equations (4) and (5), i.e least squared regression performed twice. Attention though should be drawn to the second most used IV estimator, Limited Information Maximum Likelihood (LIML) which was first developed by Anderson and Rubin (1949). LIML estimator is regarded less precise than 2SLS estimators but less biased as well (Angrist and Pichke, 2008). Acknowledging the fact that it is rather intriguing to find good sources of exogenous variation for child health and nutritional status, i.e instruments, we cannot exclude the possibility of the instruments employed in the present study are weakly correlated to the endogenous variable leading to the violation of the first IV assumption. Various economists have brought into focus the issues related to the use of weak instruments (Stock et al., 2002, Staiger and Stock, 1997); weak instruments may lead to a bias towards OLS estimator and second the hypothesis testing, which is based on the standard errors, can re rather misleading. Stock et al. (2002) state that that the threshold for the F–statistic is 10; below 10 the instruments are regarded as weak. In addition, we will verify the extent to which the weak instrument may affect the IV results by using Stock and Yogo's (2005) critical values. The authors created the critical values for "2SLS relative bias" which indicates whether the instruments are weak based on the bias of 2SLS estimator compared to the bias of OLS estimator. In the case of weak correlation, we will follow Angrist and Pischke (2008). The authors point out that if 2SLS estimator yields results similar to those of LIML estimator, then the results are rather reliable and we avoid the problems mentioned above.

As it was mentioned in the *Data Sources* section, CHLNS is a rather rich longitudinal survey that allows us to use various sources of exogenous variation. However, the primary exogenous instruments employed in the present study will be two; the price of corn and the dummies for the municipality in which the child was born. The choice is motivated by the previous literature; Glewwe and King (2001) employ the CHLNS and thus their study is considered of high relevance for the present dissertation. They focus on the estimation of the impact of timing of early malnutrition on cognitive development. The specific paper contributes significantly to the literature as the authors use a variety of possible instruments for child health and nutritional status; corn price, rainfall, infant formula price, cerelac milk price. Their conclusions indicate that during the time period between 18 and 24 months, the price of corn can explain the variation in the child's nutritional intakes. Alderman et al. (2001) provide further evidence that the level of prices can determine the health status of children in the long-run. Both studies associate the higher commodity prices with worse early-life health and nutritional status. In the present study, the price of corn from 18 to 24 months is preferred as instrument for child health; corn is a rather important part of both agriculture production and daily diet in Philippines. Particularly, consumption in rural areas is heavily dependent on corn; it is quite striking that according to FAO (Nutrition Country Profile, 2001), during 1989-1991 the 75.4% of the daily calories intake was carbohydrates. Furthermore, the time period from 18 through 24 months is preferred for mainly two reasons; first the percentage of children that is breastfed[23] is rather low, ranging between 33% and 13% approximately (see *Appendix III*, *Table 11*) and second children after the first semester, should get introduced to solid food gradually along with breastfeeding. According to WHO report about child feeding (2009); between 12 and 24 months, the greater part of energy intake comes from sources other than breastfed milk. Therefore, corn can be regarded of utmost significance for child's nutritional status.

However, the price of corn is not free of criticism. Aldrerman et al. (2000) question the validity of price as instrument; in the hypothetical case that the level of prices does not only affect the variable of interest, i.e height–for–age Z–scores, but also the unobserved characteristics which can bear on child's developmental process, e.g parental time use, then the identification of prices as instrument is doubted. More precisely, there would be a violation of the most important assumption of IV instrument, the exclusion restriction; the instrument can affect the dependent variable only through its impact on the variable of interest. Special attention should be drawn to the fact that the validity of the price as instrument is violated when there is a serial correlation between current and future level of prices.

According to, Glewwe, Jacoby and King (1999) the magnitude of the price shocks have to be sufficiently large in order to affect child development. Hence, potential small variability in the

[23] Proxy for breastfeeding is the question in the survey "Did you breastfeed the child yesterday?"

price of corn can lead to low statistical significance and thus the issue of weak instruments can arise. Subsequently, we wish to consider a second source of exogenous variation for child health; the municipality of residence at the time of birth. Thomas and Strauss (1992) conclude that commodity prices along with infrastructure at community level have a strong and positive impact on child's nutrition and health status. Thus, the municipality dummies are employed on the grounds that each municipality provides different access to services and infrastructure, i.e electricity, water access, disease level, hospital infrastructure that may affect child's growth. In addition, it is rather likely that the municipality in which the individuals reside is correlated to the socioeconomic status of the household. However, the main assumption is that once socioeconomic status is controlled for, it is rather unlikely for the dummies to violate the exclusion restriction and thus they can be considered exogenous. To the best of my knowledge, there does not exist another study that employs the location where the child was born as IV instrument.

As it was mentioned above, the components of vector X_{ci} are restricted down mainly to the household and parent's characteristics at the time of child's birth. The reason for this choice arises from the fact that the present study wish to estimate the total impact that child health and nutritional status may have on future earnings. Thus, there are eliminated from the equation of interest, those factors that possibly are affected by child health status, i.e educational attainment, health status in young adulthood, etc., and may have a direct impact on wages (Cutler and Lleras-Muney, 2007). The following example will illustrate better this point; provided that human capital accumulation was an output in the equation (2), it would be likely that the effect of child health on salaries would work through its effect on education. Furthermore, so as for the exclusion restriction to hold, we wish to include in equation (2) all the factors that can be affected by the instruments and thus can affect the outcome variable.

4.3. Key Variables: Descriptive statistics

4.3.1. Outcome variable: Worker's Profile

The outcome variable, daily earnings[24], was drawn from the follow–up survey of 2005. The survey provides information for each individual's employment history. The sample contains 1,469 individuals for whom we disposed complete information. The Table 1 provides the summary statistics for the full sample. The main focus is on the data from individual's last work, thus the sample is restricted to those that are currently working. Mroz (1988) illustrates the possible problem of measurement error in the reported wages; so as to reduce the measurement error that is related to the recall bias, we wish to employ the data on earnings for those that are currently working. Since this is a cohort study, the age ranges from 20 to 22 years old and subsequently the first job is equivalent to the current job for a vast majority of the sample under examination. Given the young age of the sample, special attention should be drawn to the bias that arises for that part of the population that is both working and studying. Individuals that are currently studying are more likely to have lower wages compared to those that are not, given the same level of educational attainment. This leads to a possible underestimation for this part of the population, according to Gertler, Heckman et al., 2013[25]. For the purpose of this study and since the students consist a small part of the whole sample, 9.5%, the sample is restricted to those that are currently working, but are not currently studying, resulting to a sample of 1.160 individuals. Amongst the students, 18% work part-time and the 5% work full-time. Hence by excluding only the students, we partially control for the bias that arises from the part-time workers (Gertler, Heckman et al., 2013). In addition, selection bias may arise from those individuals that choose to participate in the labor force and thus are currently working (Heckman, 1976; 1979). The direction of the bias depends on the various factors that affect the decision of participating into the labor market, such as socioeconomic status of the household, marital status, health status, decision to study. For instance, if the decision to enter in the labor is associated with higher height–for–Age Z–scores, then there will be an overestimation in the estimated effect of child health status on future earnings; healthier individuals are more likely to earn higher salaries.

[24] Due to the unavailability of information about the days worked per week, it is not possible to estimate the weekly or even monthly income.

[25] The authors in order to reduce the bias restrict the sample to full – time workers only.

The wages are expressed in terms of daily earnings, are deflated using CPI at 1994 constant prices and are transformed in logarithms. The sample is divided almost equally between men and women, 53.7 % and 46.3 % respectively. The vast majority was born in 1983 and this implies that the mean individual is 21 years old by the time of the survey. This indicates that the sample is rather representative of Cebu metropolitan area, since the mean age is around 20 years old. Given the young age, the most individuals have never been married, 72%. A rather significant fact is that only the 67.9 % is currently working resulting in a rather reduced sample. A rather small minority is currently attending school; this minority is divided equally between those that are currently working and between those that are not currently working, 4.3% and 5% approximately[26]. In addition, the majority is employed as full–time worker[27], 65.55%. The percentage though of full-time workers is higher in rural areas, 73.4% compared to the urban ones; 62.5%. Last but not least, the reported health condition of the sample is rather good; 79.92% report that is in a rather good health status. The mean individual has rather high educational level, 10.18 years, he/she works 45.61 hours per week and he/she earns 99 pesos approximately per day[28]. The fact that the individual works 45.61 mean hours per week indicates that there is a part of the population that works overtime. This is consistent with the fact that many individuals are underemployed and thus they work more hours so as to cover basic need. This can lead to an overestimation of the daily earnings in the absence of discrimination towards the individuals that work overtime.

[26] The variable " school attend" was constructed based on the available information on Table 12 (see *Appendix III*)
[27] The distinction between full – time and part – time worker is based on the hours worked; the threshold chosen was 45 hours per week. This decision based on the distribution of hours worked (see *Appendix III*, Figure 3)
[28] The standard deviation for the hours per week and the daily wage is rather large though, indicating that the sample is not tightly distributed around the mean value.

Table 1.Summary statistics: Worker's Profile

Variable	Total Number	Percentage (%)
sex		
Male	789	53.7
Female	680	46.3
Year of Birth		
1983	1033	70.3
1984	436	29.7
Never Married	1058	72
Currently Working	997	67.9
Full Time Worker	963	65.55
Urban status of residence	657	62.5
Rural status of residence	306	73.4
Part-Time Worker	506	34.45
School Attend	139	9.5
Currently Working	64	4.3
Currently not working	75	5
Full-time worker	48	5
Part-time worker	91	18
Poor Health Condition	94	6.4
Good Health Condition	1,174	79.92
Urban Status of Residence	1,052	71.61
Rural Status of Residence	417	28.39
Variable	**Mean**	**Standard Deviation**
Daily earnings	98.75	146.18
Education in years	10.18	3.13
Age	20.95	0.008
Hours worked per week	45.61	20.31
Total Sample	1469	

Source: Author's calculation based on CLHNS

4.3.2. Explanatory Variables

4.3.2.1. Main Explanatory Variable: Height– for–Age Z-scores

Anthropometric characteristics, such as weight and height have long been considered as valid proxies for the health shocks that an individual has been exposed to throughout his/her life (Mcdowell, 1902; Gowin, 1915). Height can fully summarize the net nutrition along with the disease level (Floud et al., 2011; Fogel, 1994b, 2004) and the genetic potential (Deaton, 2007). The easy measurement makes height rather appealing into the academic community as a summary proxy for health and nutrition from foetal stage up to the age of three (Currie and Vogl, 2008)[29]. However, the use of height as proxy for child health is not free of criticism. According to Currie and Vogl (2008), it is almost impossible to identify which aspects of child's growth affect the most in the long–run, i.e nutrition, or disease level. For comparability reasons, in the present analysis the height is the ideal proxy for early-life health and nutritional status.

For reasons of comparability and assessment, the height is transformed to height–for-age, Z–scores. According to Yang and Chen (2012), the assessment of child's growth is based on the choice of valid cut–off points, sex-specific patterns and classification of various health conditions, all of them can be summed up by the Z–scores. WHO Multicentre Growth Reference Study (MGRS 2006) suggests the theoretical background for the construction of Z – scores[30]. Height–for–age Z-scores at 24 months is regarded as the most adequate indicator for child health and nutritional status during the first 2 years. Glewwe and King (2001) state that the first two years are extremely crucial for child's growth on the grounds that nutritional studies indicate that stunting can occur during the first 24 months. The main reason to follow the WHO methodology arises from the extraordinary advantages that this methodology has. For the construction of growth standards, there were included children from various countries, such as Norway and Brazil, resulting in the creation of an "internationally applicable standard" (MGRS 2006). Hence, WHO growth standards can apply to both developed and developing countries. Rosenberg (2002) adds further support to WHO growth standards; the author points out that there is notable genomic similarity amongst several ethnic groups. In addition to this, WHO growth charts were

[29] Other common indicators are; Weight–for-length, BMI, weight–for–age.

[30] The z – scores were calculated using the command zscore06 in STATA statistical software (Leroy, 2011). The command is based on WHO 2006 references (Igrowup macros) The main discrepancies between WHO 2006 macros and STATA command are the following; first, the storage type (float of double) can lead to infinitesimal differences between zscore06 and Igrowup and second if the child's age is missing the estimated Z–score is missing as well.

developed in order to describe how a child should grow rather than how a child grows in a particular country and in a specific moment in time.

For the purpose of the Z–scores construction, the following variables are employed; the index child's height, measured in centimeters along with index child's age, measured in months and the child's sex. In simplified terms, Z–score exhibits the deviation, positive or negative, of the measured value of height ($\boldsymbol{h_{ci}}$) from the population mean($\mathbf{h_m}$), standardized by the population standard deviation ($\boldsymbol{\sigma}$)

$$\mathbf{HAZ} = \frac{\mathbf{h}_{ic} - \mathbf{h}_m}{\boldsymbol{\sigma}}$$

A Z–score of zero implies that the child has a normal growth in terms of height–for-age whereas a Z-score higher than zero or lower than zero implies that the child is more of less developed respectively.According to WHO 2006 growth standards, a child is regarded as malnourished when SD<-2 and severe malnourished when SD<-3. The interpretation in centimeters is rather distinct for boys and girls; for girls, -2SD and -3SD corresponds to 80cm and 77cm respectively and for boys, 82cm and 79cm respectively.

The Table 2 illustrates the anthropometric characteristics of the sample at the first measurement, when the child is less than a month[31] old and in the last measurement, when the child is 24 months old. Since WHO Z-scores module takes into account the child's sex, it is more intuitive to present child's height and weight according to sex. From the summary statistics, we can draw the following conclusions; the mean child, either boy or girl, was born with normal weight, 3000 grams or 3 kilos approximately, the weight at 24 months is rather closed to the threshold of malnourishment, 9.9 kilos and 9 kilos for boys and girls respectively. With respect to height, the height at first measurement is normal, 50 cm approximately both for males and females, but in the last measurement is close to the threshold of malnourishment, 79.76 cm and 78.29 cm for boys and girls respectively. The definition of "normal" weight and height of each age is given by the WHO growth standards[32]. The figures mentioned provide us with a first indication that a

[31] According the Survey Procedures (1989) the measurement took place approximately in the 3rd day of the child.
[32] Here are the links of the tables that were employed for the comparison mentioned above for girls and boys respectively. http://www.who.int/childgrowth/standards/cht_lfa_boys_z_0_2.pdf?ua=1
http://www.who.int/childgrowth/standards/cht_lfa_girls_z_0_2.pdf?ua=1

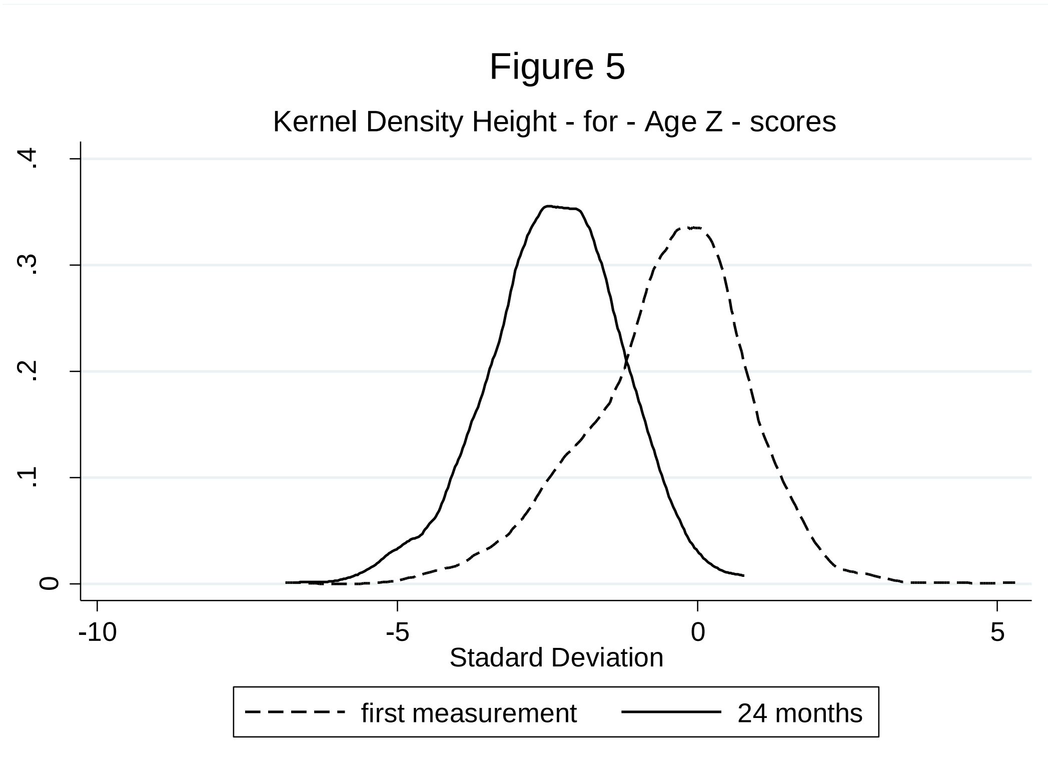
significant part of the population fell behind in terms of physical growth during the first two years of life and not in the utero. In the first measurement, the mean weight and height of the population illustrates a normal physical growth, according to WHO standards, whereas the last measurement demonstrates the mean stunting in the sample under examination, in terms of mean weight and height. The discrepancies between the two sexes are not that large though. (See *Appendix III*, *Figure 4*)

Table 2.Summary Statistics: Child's Anthropometric characteristics

Variable	**Mean**	**Standard Deviation**
Height 24 months		
Male	79.76	3.42
Female	78.29	3.48
Total	79.09	3.53
Weight first weighting		
Male	3076.96	494.81
Female	3038.86	440.54
Total	3059.17	470.45
height first measurement		
Male	49.47	2.11
Female	49.07	2.14
Total	49.29	2.13
weight 24 months		
Male	10069.03	1137.36
Female	9443.83	1080.8
Total	9782.29	1154.24

Source: Author's Calculation based on CLHNS

The Figure 5 shows the kernel densities[33] of Z–scores in the first and last measurement. The Z–scores distribution verifies the conclusions that were drawn from the table 2. When the children are less than one month old, the distribution is more centered to zero, whereas when the children are 24 months the distribution moves to the left. The movement of the distribution towards the left implies that a larger part of the population is regarded as malnourished. This implies that a large majority is likely to experience worse future outcomes (Case and Paxson, 2008; Case et al. 2002, Case and Paxson 2006).



Source: Author's Calculation based on CLHNS

[33] The kernel density was calculated with STATA default, epanechnikov kernel density. The choice was motivated by Cameron and Trivedi (2009) who stated that epanechnikon kernel density does not give equal weight to every data point; instead it weights more the data points that are close to the point of evaluation.

4.3.2.2. Control Variables

The relationship between early-life health status and future earnings is being driven by various determinants. For the purpose of the present analysis the list of explanatory variables includes mainly parent's and household's characteristics at the time of child's birth that may affect child health and nutrition.

Parent's socioeconomic status is one of the most significant control variables and thus we wish to analyze further the way in which the variable was constructed. The wide use of the term "socioeconomic status" in the social sciences and epidemiology reflects the increasing recognition of its importance to the individual's health. The way in which socioeconomic status can be measured has drawn a great deal of attention and hence there is a notable variety in the different proxies that are employed by the researchers. Currie and Hyson (1999) employ father's occupation as proxy for socioeconomic status. Currie and Moretti (2003) document the strong association between mother's education, as proxy of SES, and child health. Case et al. (2002) point out that family income is closely correlated to child health, but Douflo (2000) provides evidence to the fact that the relationship between family income and child health is stronger for the case of developing countries.

Due to the availability of data on economic resources, the proxy for parent's SES employed is the estimated value of assets that the household owns at the time of the child's birth[34]. A variety of the assets were included in the survey and thus our choice was restricted down on the following ones; estimated value of electrical appliances, estimated value of houses owned and estimated value of landholdings. In order to provide supportive evidence to this choice, the variation in the mean of the estimated value of those assets according to certain quality characteristics of the household[35] along with the t–statistic of the differences is referred in *Appendix III, Table 13* [36] The results indicate that the households that have characteristics of lower quality, i.e kerosene as lightning type, no toilet facility in the house or the house is constructed by light material, have significant lower mean estimated value of assets owned. On

[34] The estimated values were deflated using the CPI from Philippines National Statistics Office (NSO) at constant prices of 1994. The baseline survey was conducted in 1983 – 1984 and thus the CPI of those was employed. Hence, the estimated value is expressed in thousands of pesos of 1994.

[35] These characteristics include: type of electricity (electric or kerosene), type of material for the construction of the house (light or strong), access to water (whether the individual has to walk to the water source), type of toilet facility (whether the toilet is inside the house, whether the house does not have any type of toilet facility,)

[36] The calculations were performed in the baseline survey

the other hand, households with higher–quality characteristics have significantly higher mean estimated value[37]. This implies that the employed proxy for SES is consistent with what we expected to find; households of higher SES status, enjoy a higher quality of living standards.

It is common sense that parent's educational attainment has considerable impact on child health (Case and Paxson, 2006) and thus it is included in the main model. More concretely, it is expected that higher parental educational level leads to better child health. In addition, parent's age and the total number of persons that reside in the household, are amongst the primary control variables. Horton (1988) points out that parent's age may have a significant impact on the quality of child. According to Smith et al. (2005) and Prahman et al. (2003), health inequality is present between urban and rural areas and thus the place of residence, defined as urban or rural is included in the list of control variables as one possible determinant of child health status[38]. In addition, according to Glewwe and King (2001), mother's arm circumference during the last trimester of her pregnancy is a consistent proxy for mother's health during pregnancy. The child's characteristics included in the main model are sex and year of birth. Altonji and Blank (1999) document the discrimination between males and females with the same capabilities.

The descriptive statistics for parent's and household's characteristics according to residence status, urban or rural, are included in the Table 3. There are crucial discrepancies between rural and urban areas[39]; A mother has a mean of 7.62 years of education in urban areas whereas only 5.46 years in rural areas. Mother's spouse education exhibits similar variation across urban and rural areas, 8 and 5.29 years respectively. Mother's and mother's spouse ages do not display great differences between urban–rural regions; mother's mean age is 26 approximately and mother's spouse mean age is 28 approximately at the time of child's birth. Household's socioeconomic status shows rather great variation in the mean across urban–rural and this difference is of increasing importance for the poorest part of the population; 1st and 2nd quintile.

[37] The t – statistic is higher than the threshold of 1.994 for a 95 percent critical interval.
[38] In the final sample the urban/rural status at baseline survey coincides with the status at follow–up survey of 2005.
[39] The importance of those discrepancies becomes even more evident from the t–statistic and the p–values of the difference in the mean between urban and rural. Certain differences are rather small in magnitude between urban and rural regions but with a rather low p–value, indicative of the statistical significance of those discrepancies (*Appendix III*, table 14)

Table 3.Summary Statistics: Household, mother and mother's spouse.

Variable	Mean	Standard deviation	lower bound	upper bound
Mother's characteristics				
Mother's Education				
Urban	7.62	3.57	7.4	7.83
Rural	5.46	3.04	5.17	5.75
Total	7	3.56	6.83	7.18
Mother's Age				
Urban	26.05	5.69	25.7	26.39
Rural	26.97	6.33	26.37	27.58
Total	26.31	5.89	26.01	26.61
Arm Circumference				
Urban	24.7	2.37	24.55	24.84
Rural	24.14	1.91	23.95	24.32
Total	24.54	2.26	24.42	24.65
Mother’s partner characteristics				
Partner's Education				
Urban	8	3.68	7.78	8.22
Rural	5.29	3.21	4.99	5.6
Total	7.23	3.75	7.05	7.41
Partner's Age				
Urban	28.63	6.58	28.23	29.03
Rural	29.49	6.74	28.84	30.14
Total	28.88	6.63	28.54	29.21
Socioeconomic Status				
Estimated value of assets				
Urban	37405.16	121655.69	29918.23	44892.09
Rural	13326.73	29780.91	10427.43	16226.03
Total	30530.45	104607.05	25117.46	35943.43
Estimated value assets 1st quintile				
Urban	591.28	440.29	528.88	653.69
Rural	889.4	481.23	776.14	1002.66
Total	670.63	469.55	615.8	725.46
Estimated value assets 2nd quintile				
Urban	3055.45	798.8	2927.02	3183.87
Rural	2610.22	779.66	2467.07	2753.38
Total	2862.24	819.45	2766.61	2957.86
Estimated value assets 3rd quintile				
Urban	6771.1	1531.65	6540.44	7001.75
Rural	6803.07	1351.62	6519.34	7086.81
Total	6781.96	1470.4	6601.73	6962.2

Estimated value assets 4th quintile				
Urban	16591.43	4478.87	15946.48	17236.37
Rural	15473.32	4630.73	14420.4	16526.23
Total	16271.36	4542.25	15721.14	16821.58
Estimated value assets 5th quintile				
Urban	151464.64	228220.04	121097.34	181831.93
Rural	76489.53	60754.09	58245.71	94733.34
Total	139159.56	211828.97	113600.22	164718.9
Household characteristics				
Number of persons				
Urban	5.51	2.68	5.35	5.68
Rural	5.55	2.54	5.3	5.79
Total	5.52	2.64	5.39	5.66
Total Sample (n=1,469)				

Source: Author's Calculation based on CLHNS

4.3.3. Instrumental Variables

As it was pointed out in the *Conceptual Framework* section, the relationship between child health status and future earnings is mostly likely to be driven by unobserved characteristics or by the measurement error in the main explanatory variable, height–for–age Z-scores. Thus, the principal part of the econometric analysis is the IV instrument approach and subsequently the description of the instrumental variables that are employed in the present analysis is crucial.

The chosen instruments are the following ones; prices of corn and the dummies for the municipalities that the child was born. Given importance of those variables, special attention should be drawn to the construction of corn price as instrument. Following the study that was conducted by Glewwe and King (2001), we employed the mean price during the semester between 24 and 18 months. Depending on the date of survey, we estimated for every case the mean price of those months. For instance, if a child was 24 months old on April 1985, then we chose the mean of the prices between March 1985 and September 1984. The prices were deflated by the yearly CPI at constant prices of 1994 and they were transformed into logarithms. *Figure 6 and Figure 7*[40] (see *Appendix III*) exhibit the monthly variation of prices according to the year and the variation between villages respectively. As Glewwe, Jacoby and King (1999) point out, the instrument of prices has to comply with the following assumption; the price-level should

[40] The figure 7 shows the variation in the mean price of corn which is the final instrument.

have a certain variation across households. If we exceed this assumption further, there should be notable price variation across the various communities and across the time periods; both figures illustrate this variation.

The Table 4 provides further information about the instruments employed. It indicates the variation of the sample across the various municipalities and the mean of the corn price, 1201.78 pesos at constant prices of 1994.The vast majority of households reside in the first municipality (42%), the rest of the households almost equally amongst municipalities 2,3,4,7,8. The 5th along with the 6th municipality include only the 3.5% of the sample. As the main assumption behind the dummies for the municipalities is the differences regarding the infrastructure, table 15 (see *Appendix III*) presents certain infrastructure characteristics that were included in the CLHNS. The main conclusion is that the 1st municipality is the most populated region but at the same time, it is closest to a maternity clinic and the public hospital compared to the rest of municipalities.

Table 4.Summary Statistics: Instrumental Variables

Variable	**Number**	**Percentage (%)**	**Sample Size**
municipality 1	617	42	
municipality 2	167	11.4	
municipality 3	181	12.3	
municipality 4	187	12.7	
municipality 5	34	2.3	
municipality 6	18	1.2	
municipality 7	155	10.6	
municipality 8	110	7.49	1469
	Mean	**standard deviation**	
Price of Corn	1201.788	105.0353	1120

Source: Author’s Calculation based on CLHNS

5. Expected Findings

The expectations are formulated based on the theoretical background along with the methodology and the data base description. Early-life health and nutritional status is expected to have a significant, positive impact on the earnings; higher growth during early childhood, higher future income (Barker et al., 2004; Hoddinott et al., 2008). However, this relationship is mainly driven from unobserved characteristics at household and community level (Behrman and Hoddinott, 2005) and the measurement error in the explanatory variable (Alderman et al., 2001). Controlling for these factors the impact of early-life health and nutrition on wages into adulthood is anticipated to remain positive and significant (Smith, 2009; Case et al., 2004). Thanks to the exogenous sources of variation in child health that the CLHNS offers, the IV approach is followed. The prices of corn along with the dummies for the municipalities where the child was born serve as exogenous sources of variation. It is expected that higher corn prices will have a negative impact on child's growth (Glewee and King, 2000). The anticipated effect of the birth location is that the children born in the 1st municipality will enjoy a higher level of infrastructure and subsequently a better early health status. The rest of the municipalities are expected to have a negative impact compared to the first one. The magnitude and the direction of the change of the impact of the main explanatory variable are not certain; the measurement error causes a downward bias, but the omitted variable bias can be either upward or downwards. Nevertheless, the possibility of catch–up growth (Adair, 1999) should be taken into account as the 32.5% of the children in the present data set has undergone accelerated physical growth up to the age of 12 years old. This may imply that the effect of malnutrition and poor health status may no longer be evident in young adulthood.

It is anticipated that the parent's socioeconomic status will have a significant impact on future earnings; children from families with higher SES undergo less health shocks and thus may have higher later-life salaries (Currie and Stabile, 2004). The discrepancies between urban and rural areas are expected to have a strong impact on wages; people in rural areas will enjoy lower salaries compared to individuals in urban areas (Canlas, 2008). The effect of urban and rural areas is anticipated to work though through parent's socioeconomic status. In addition, parent's education is expected to have a positive impact on the future salary through its positive impact on early-life health status.

Attrition and self–selection into the labor market are expected to have a crucial impact the relationship between early health and future earnings. Attrition is rather high and it is positively associated to the migration of more educated persons (Adair et al., 2011) thus it is anticipated an underestimation in the final sample. Self–selection into the labor force is assumed to be correlated positively to better health status and thus an overestimation is anticipated; the healthier part of the population will enter in the labor market. On the other hand though, the current students are those with the highest education level that are in the university or those that are still in school due to absenteeism. Hence, the potential exclusion would lead to an underestimation for the former case and an overestimation for the latter case. In addition, the inclusion of part-time workers is expected to lead to an underestimation; part-time workers are getting paid less compared to full-time workers. Given the high attrition and the fact that the percentage that does not participate into the labor market is high, the results are expected to be driven by the interaction between the high attrition rate and the self–selection into the labor force. Even though, the bias arising for the part–time workers is partially controlled by the exclusion of current students, it is expected to affect the results through the distribution between rural and urban regions.

6. Empirical Results

The starting point of the analysis is the OLS estimation which is presented in Table 5. The results are consistent with the theoretical background (Smith 2009; Case et al., 2004); slower growth during the early childhood leads to lower expected earnings into young adulthood. Table 5 includes four different specifications. The baseline specification includes only mother and mother's spouse characteristics. However, the relationship between child's early health and later wages can be driven by child's characteristics and characteristics of the household. By adding more controls in the main equation, the relationship between children's nutritional and health status and wages is becoming more statistically significant; ranging from a coefficient of 0.0547, statistically significant at 5% in the first specification to a coefficient of 0.0749, statistically significant at 1%, in the last specification. This implies that an increase of 1 standard deviation in child's height–for-age Z–scores leads to an increase of approximately 7 % in daily earnings. The result can be considered economically significant; increase of 7% in the daily salaries is not an infinitesimal change.

Due to the discrepancies between urban and rural areas, the coefficient of residence in specification (2) is 0.195, statistically significant at 1%; the daily earnings in rural regions are 19.5% higher compared to the urban regions. The estimated difference is rather large and thus interactions between socioeconomic status and residence, i.e urban or rural, are added in specification (3). The interactions for the 1st and 2nd quintile of socioeconomic status though are not significant. This is rather puzzling and contradicts the expected findings analyzed in the previous section. In the last specification, it was anticipated that persons in rural areas would have lower salaries (Canlas, 2008) and that the discrepancies between urban and rural regions function through the socioeconomic status of the household. However, this is not the case. Even after controlling for the possible factors that affect daily earnings and early-life health and nutritional status, the estimated result remain unchanged. It can be associated though with the distribution of part-time and full-time works across urban and rural regions. As it was mentioned in the *Outcome variable: Worker's Profile* section, the percentage of full-time workers is higher in the rural areas. This fact can justify this contradictory result. In addition, mother and spouse's educational attainment is statistically significant in every specification; mother's education is positive and significant at 5% and mother's spouse education is also positive and statistically significant at 1%. More precisely, increase of 1 year of educational attainment for mother and mother's spouse will lead to 1.8% and 3.1% increase in child's earning, respectively. This is in accordance with previous findings (Case and Paxson, 2006). Higher educational level is associated to higher household socioeconomic status that can cushion early-life health shocks (Currie and Hyson, 1999). Last but not least, sex plays a rather significant role in determining wages; the females are discriminated negatively compared to males. This difference is not only statistically significant at 1% but also economically significant; since the wages for females are approximately 14% lower compared to male's earnings. This is consistent with the current literature on the discrimination between males and females in the labor market (Altonji and Blank, 1999).

Table 5.OLS Estimation

	(1)	(2)	(3)	(4)
VARIABLES	Log(salary)	Log(salary)	Log(salary)	Log(salary)
Height – for age Z - scores	**0.0547****	**0.0741*****	**0.0725*****	**0.0749*****
	(0.0212)	(0.0211)	(0.0211)	(0.0212)
Mother and Spouse's Characteristics				
Mother's Education	**0.0153****	**0.0183****	**0.0183****	**0.0186****
	(0.00739)	(0.00747)	(0.00751)	(0.00748)
Mother's Age	-0.00531	-0.00714	-0.00683	-0.00697
	(0.00551)	(0.00602)	(0.00604)	(0.00597)
Mother's Spouse Education	**0.0246*****	**0.0315*****	**0.0328*****	**0.0312*****
	(0.00740)	(0.00825)	(0.00828)	(0.00819)
Mother's Spouse Age	0.00155	0.00311	0.00311	0.00334
	(0.00483)	(0.00535)	(0.00534)	(0.00526)
Log(Mother's Arm Circumference)	-0.340	-0.246	-0.238	-0.237
	(0.238)	(0.242)	(0.242)	(0.249)
Characteristics of the household				
residence (1=urban|2=rural)		**0.195*****	**0.169*****	**0.171*****
		(0.0539)	(0.0577)	(0.0572)
Log(value of assets)		-0.00937	-0.00295	-0.00245
		(0.0130)	(0.0192)	(0.0196)
Number of persons residing in the HH		**0.0134***	0.0129	0.0123
		(0.00789)	(0.00801)	(0.00804)
Log(value of assets 1st quintile)*residence			0.00747	0.00160
			(0.0645)	(0.0650)
Log(value of assets 2nd quintile)*residence			0.0666	0.0551
			(0.0448)	(0.0447)
Child's characteristics				
sex (1=male|2=female)				**-0.147*****

				(0.0485)
Year of birth				0.00320
				(0.0552)
Constant	5.393***	4.831***	4.745***	-1.384
	(0.770)	(0.797)	(0.804)	(109.6)
Observations	786	713	713	713
R-squared	0.060	0.087	0.091	0.103

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's Calculation based on CLHNS

The Table 6 [41] presents the IV estimation results using the 2SLS which stands for Two–Stage Least Squares and LIML which stands for Limited–Information Maximum Likelihood estimator; both for the first and the second stage. To begin with, the first stage results are according to the initial assumptions. The price of corn is negative and significant at 10%; increase of one peso can lead to a decrease of 0.7 Standard deviations in child's growth. This is consistent with Glewwe and King's (2001) results in terms of impact direction. However, the statistical significance is rather low in the IV context but the economic significance of the results is rather high. The direction of the impact of the dummies for the municipalities is the expected one. Taking as reference category the first municipality, the rest have a negative impact on child health. This is in accordance with the notion that the municipality with the best infrastructure has a strong positive impact on the child's growth. In addition, the results are statistically and economically significant for the majority of the municipalities; coefficients are ranging from 0.24 to 0.77 with a p-value of less than 0.10[42].

Special attention should be drawn to the validity of the IV instruments. To begin with, we first perform an over–identification test, known as Sargan Test. Since, we employ various instruments for only one endogenous variable, it would be rather important to figure out whether all the instruments used are valid for child health status. The null hypothesis is that all the instruments are valid, failure to accept the null hypothesis implies that are least some of the instruments are not valid. The results indicate that the p–value is rather high, 0.145. This implies that we cannot reject the null hypothesis of the validity of the over–identifying restrictions and thus the

[41] The difference in the sample between to the first and second stage is due to the missing values that variable of the daily earnings has.
[42] The 6th municipality in excluded by STATA due to the fact that includes an infinitesimal part of the population

instruments employed are valid. Furthermore a joint significance test (F–test) should be performed, so as to check whether the IV instruments employed comply with the first assumption of IV instrument approach which was mentioned in *Econometric Method* section. The F–test is 6 approximately which is considered rather low according to the existing literature, leading to a possible bias due to the use of weak instruments (Stock et al., 2002). Stock and Yogo's (2005) critical values for "2SLS relative bias" indicates the following; relative bias of 30% is 5.15 and 20% is 7.25. This implies that if we are willing to tolerate a relative bias between 30% and 20%[43], the instruments are not weak. Since, the use of weak instruments may have crucial implications (Stock et al., 2002; Staiger and Stock, 1997), the LIML estimator is presented as well (Angrist and Pischke, 2008). The results indicate that the 2SLS and LIML estimator yield almost identical results in terms of coefficients, standard errors and sign. Hence, we can safely conclude that the use of weak instruments do not bias severely our results.

The IV results indicate that in the long–run, initial child's low growth does not affect the future daily earnings. The coefficient has the expected direction; increase of one standard deviation can lead to an increase of 6 % approximately in daily earnings. Mother and mother's spouse educational attainment has a positive and significant effect of 2% approximately on wages. This is consistent with the OLS estimations. The discrepancies between rural and urban regions remain evident in the IV estimation and the interactions between the socioeconomic status, i.e. 1st and 2nd quintile of estimated value of assets, and the residence, i.e rural or urban, remain still insignificant.

[43] For instance, If the β OLS is 50% higher than the β 2SLS, then the relative bias is 30% of 50%.

Table 6. IV Estimation

	First Stage	IV - 2SLS Estimator	IV - LIML Estimator
	(1)	(2)	(3)
VARIABLES	Height – For – Age Z - scores	Log(salary)	Log(salary)
Instruments			
log (price of corn)	**-0.704***		
	(0.414)		
municipality1	Ref. category		
municipality2	**-0.569*****		
	(0.134)		
municipality3	**-0.241*****		
	(0.142)		
municipality4	**-0.704*****		
	(0.192)		
Municipality5	**-0.772****		
	(0.319)		
municipality7	-0.054		
	(0.273)		
municipality8	**-0.300***		
	(0.159)		
Household Characteristics			
log (value of assets 1st quintile)*residence	-0.0179	-0.0283	-0.0284
	(0.117)	(0.0765)	(0.0765)
log (value of assets 2nd quintile)*residence	-0.0161	0.0100	0.00988
	(0.0909)	(0.0608)	(0.0609)
residence (1=urban|2=rural)	0.379*	**0.257*****	**0.258*****
	(0.193)	(0.0717)	(0.0718)
log (value of assets)	0.0721**	-0.0136	-0.0135
	(0.0354)	(0.0241)	(0.0243)
number of persons in the HH	-0.0533***	0.0113	0.0111
	(0.0153)	(0.0113)	(0.0116)
Mother's and Spouse Characteristics			
Mother's education	0.0496***	**0.0208***	**0.0209***
	(0.0142)	(0.0108)	(0.0112)
Mother's age	-0.0109	**-0.0137***	**-0.0137***
	(0.0107)	(0.00712)	(0.00714)
Mother’s spouse education	0.0315**	**0.0224****	**0.0225****
	(0.0133)	(0.00948)	(0.00961)
Mother’s spouse Age	0.00628	0.00839	0.00840
	(0.00946)	(0.00623)	(0.00624)
log (mother's arm circumference)	2.473***	-0.292	-0.286
	(0.423)	(0.385)	(0.409)
Child's Characteristics			
sex(1=male|2=female)	0.107	**-0.137*****	**-0.137*****
	(0.0780)	(0.0526)	(0.0528)

year of birth	0.151	0.0761	0.0762
	(0.121)	(0.0787)	(0.0788)
Height - for Age Z - scores		**0.0682**	**0.0660**
		(0.0970)	(0.110)
Constant	-10.28***	4.224*	4.194*
	(3.975)	(2.210)	(2.310)
Observations	707	635	635
R-squared	0.231	0.094	0.094
Sargan p – value		**0.145**	**0.145**
Sargan score		9.54858	9.54858
IV F-stat		**6.097**	**6.097**
2SLS Relative bias	20%	**30%**	
	7.25	**5.15**	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author’s Calculation based on CLHNS

7. Limitations

The constraints of the present study have tremendous implications, not only for the rationalization of the results but also for further research suggestions. The limitations that have been indentified throughout the study are discussed in detail below.

7.1.Attrition

As it was mentioned in *Data Sources* section, attrition is considered crucial part in the interpretation of the empirical results. More concretely, non–random attrition rates can lead to low estimation precision (Watson and Wooden). In the CLHNS, attrition is closely related to the decision of the individual to migrate to regions located outside of the metropolitan area of Cebu (Adair et al., 2011) and negatively to the possibility that an individual will respond both to the baseline and the follow-up survey of 2005. The Table 7 presents the probability that an individual will be both in the baseline and in the follow-up survey off 2005. A dummy variable, D was constructed, which takes the value of one if the individual is both in the baseline survey and in the follow-up survey of 2005 and the value of zero if the individual is only in the baseline data base. There is estimated an IVPROBIT equation for the probability that an individual exists in both data sets. The choice of IVPROBIT instead of PROBIT regression arises from the fact that height–for-age Z–scores is endogenous in this regression, since there exist unobserved characteristics that may affect both the initial child health status and the fact that the individuals responds in both surveys. The table 7 presents both the first and the second stage of IVPROBIT. Higher height–for–age Z–score at the age of 24 months is related negatively to the probability that an individual will respond the follow–up survey of 2005[44], but it is not statistically significant. However, socioeconomic status is positively associated to the probability that an individual is in the last survey. This leads to the conclusion that people with higher socioeconomic status are less likely to migrate and hence more likely to participate in both surveys. Since, the decision to migrate is an investment decision and thus a large initial capital is needed; the households which do not own the necessary economic resources cannot migrate. In addition, the number of people living in the household along with mother's spouse educational attainment has a negative impact on the probability of the individual responding the last survey. The latter result is consistent with Adair's et al. (2011) estimations that the decision to migrate is positively associated to the educational level. Furthermore, an increased number of people

[44] In IVPROBIT equations, there can interpreted only the direction of the impact but not the magnitude.

residing in the same household is related to a lower socioeconomic status and thus to a higher probability of migration. Based on the IVPROBIT results, attrition is not random and hence, it is rather likely that the empirical results are driven by attrition rates. Since parent's education have a strong positive effect on children's health status and on future salaries, the OLS and the IV estimation underestimate the impact of early health on future daily earnings.

Table 7.IVPROBIT Attrition

	Second stage	First Stage
	(1)	(2)
VARIABLES	D	Height-for-age Z-scores
Main explanatory variable		
height-for-age Z –scores	**-0.224**	
	(0.138)	
Household characteristics		
Log(value of assets 1st quintile)*residence	-0.0278	0.0296
	(0.110)	(0.0894)
Log(value of assets 2nd quintile)*residence	0.0869	0.0381
	(0.0777)	(0.0613)
residence(1=urban|2=rural)	0.127	0.215*
	(0.0889)	(0.124)
Log(value of assets)	0.0653**	0.0978***
	(0.0296)	(0.0231)
number of persons residing in the HH	-0.0404***	-0.0483***
	(0.0130)	(0.00992)
Mother's and Spouse's Characteristics		
Mother's Education	-0.0155	0.0332***
	(0.0128)	(0.00923)
Mother's Age	0.000721	0.00813
	(0.00842)	(0.00684)
Mother's Spouse Education	**-0.0286****	0.0557***
	(0.0145)	(0.00864)
Mother's Spouse Age	-0.00104	-0.0110*
	(0.00749)	(0.00605)
Log(Mother's Arm circumference)	0.206	2.020***
	(0.440)	(0.268)
Child's characteristics		
year of birth	0.0481	0.0411
	(0.0714)	(0.0614)
Sex (1=male|2=female)	-0.0719	0.173***
	(0.0677)	(0.0511)
Instruments		
Log(price of corn)		-0.328
		(0.301)
2 municipality		-0.523***

		(0.0831)
3. municipality		-0.176**
		(0.0839)
4. municipality		-0.540***
		(0.112)
5. municipality		-0.602***
		(0.207)
6 municipality		0
		(0)
7 municipality		0.0454
		(0.162)
8 municipality		-0.283***
		(0.0962)
Constant	-96.21	-89.33
	(141.9)	(122.6)
Observations	1,665	1,665

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's Calculation based on CLHNS

7.2.Self - Selection

7.2.1. Self selection into the labor market

The next issue that poses crucial constraints to the present study is that of self–selection. IV approach can solve the endogeneity and measurement error problems, but it cannot address the issue of self–selection into the labor market. Heckman (1976; 1979) put the foundations for the self–selection models. Mroz (1988) studied extensively the married-women self–selection into the labor force[45]; the author stated that the upwards bias due to the assumptions of exogeneneity is diminishing significantly, once self–selection is controlled for. In the present study, the selection bias arises from those individuals that choose to participate in the labor force and thus they are currently working and it can affect the IV and OLS estimations if it is not random. Table 8 describes the factors that affect the probability that the individuals will participate in the labor market. The IVPROBIT is chosen on the grounds that early-life health status is endogenous in the equation; unobserved factors affect simultaneously early health and the decision to work[46]. The results indicate that people with lower initial health and nutritional status have lower probability of entering into the labor market. This is likely to lead to an overestimation in the

[45] Mroz(1988) studies the self – section the in context of hours worked.
[46] Work now if the variable that takes the value of one if the individual is currently working and zero otherwise.

wage equation, since the people who are self–selected into the labor force, have better early health and thus higher wages. On the other hand though and given the young age of the sample, one of the most anticipated reasons for staying outside of the labor force is the decision to study. Persons who decide to proceed to university studies are anticipated to have a higher early-life health status and their exclusion will lead to an underestimation. However, it can be the case that individuals are still studying due to absenteeism and this is associated negatively with the initial health status. Hence, their exclusion will lead to an overestimation.

The main reason that the self-selection model was excluded from the present analysis is the choice of the selection equation, i.e these factors that affect the probability of participation into the labor force. According to Wooldridge (2010) the variables included in the outcome equation should be a subset of those variables included in the selection equation. This implies that if the extra variables in the outcome equation affect the decision for participation in the labor market, then there is an omitted variable problem. Verbeek (2000) provides further support to Wooldridge. He states that if the extra variables in the outcome equation are not related to the selection process then their inclusion does not pose threat to the exclusion restriction. Along the same lines, Daniel Millimet (2001) points out that the factors that affect the selection equation should not have an impact on the outcome variable. Hence, in the context of the present study, it is impossible to track down those factors that comply with the theory of self–selection models; affect the decision to work but cannot affect the daily earnings.

Table 8.IVPROBIT self-selection into the labor market

	Second Stage	First Stage
	(1)	(2)
VARIABLES	Work now	height-for-age Z -scores
Main explanatory variable		
height-for-age Z –scores	**-0.537*** **	
	(0.154)	
Household characteristics		
Log(value of assets 1st quintile)*residence	0.0306	0.109
	(0.136)	(0.110)
Log(value of assets 2nd quintile)*residence	0.0306	0.0226
	(0.0882)	(0.0719)
residence(1=urban|2=rural)	-0.0944	0.275*
	(0.111)	(0.148)
Log(value of assets)	0.0906**	0.0884***
	(0.0360)	(0.0291)
number of persons residing in the HH	-0.0396**	-0.0538***
	(0.0168)	(0.0128)
Mother's and Spouse's Characteristics		
Mother's Education	-0.00715	0.0335***
	(0.0168)	(0.0115)
Mother's Age	-0.0129	-0.00921
	(0.0107)	(0.00871)
Mother's Spouse Education	0.0146	0.0473***
	(0.0165)	(0.0110)
Mother's Spouse Age	0.00381	0.00565
	(0.00954)	(0.00771)
Log(Mother's Arm circumference)	1.202**	2.360***
	(0.574)	(0.355)
Child's characteristics		
year of birth	0.0651	0.0809
	(0.0881)	(0.0751)
Sex (1=male|2=female)	0.0396	0.159**
	(0.0821)	(0.0639)
Instruments		
Log(price of corn)		-0.0264
		(0.337)
2 municipality		-0.457***
		(0.0998)
3. municipality		-0.181*
		(0.0970)
4. municipality		-0.509***
		(0.134)
5. municipality		-0.492**
		(0.233)
6 municipality		0
		(0)

7 municipality		-0.0402
		(0.182)
8 municipality		-0.272**
		(0.108)
Constant	-134.1	-171.5
	(175.1)	(149.9)
Observations	1,016	1,016

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7.2.2. Self selection into Part – time work

As it was mentioned in *Outcome variable: Worker's Profile* section, the part-time workers were considered in the final sample. However, it should be drawn attention to the fact that self-selection bias is not only associated to the decision to participate in the labor market but also to the decision to work full–time or part–time. Thus the discrepancy between full–time and part–time workers is one more source of bias, as the part–time workers earn lower wages. Blank (1998) stresses out that wage differences arise from the heterogeneity in worker and job level between part–time and full–time workers. Hirtch (2004) provides further evidence; he states that worker's skills and job-specific skills account for large part of the difference across occupations. Since, the part–time workers are more likely to earn a lower salary; their inclusion in the sample can lead to a possible underestimation of the true effect of height–for-Age Z–scores on daily earnings. In order to illustrate better the factors that may affect the decision of the individual to work part-time or full-time, Table 9 presents the probability of working full or part-time[47]. The main explanatory variable does not affect the probability of working full or part- time. However, the urban/rural status of residence has a strong and positive impact on the probability that the individual will work full-time. This is consistent also with the fact that the rural status has a strong and positive impact on individual's daily earnings.

[47] The depend variable full_time takes the value of one is the individual is workinh full – time and zero otherwise.

Table 9.IVPROBIT self-selection into part-time work

	Second Stage	First Stage
	(1)	(2)
VARIABLES	Full-time Worker	height-for-age Z –scores
Main explanatory variable		
height-for-age Z –scores	**-0.339**	
	(0.212)	
Household Characteristics		
Log(value of assets 1st quintile)*residence	0.0310	0.102
	(0.150)	(0.110)
Log(value of assets 2nd quintile)*residence	-0.120	0.0246
	(0.0947)	(0.0719)
residence(1=urban|2=rural)	**0.456*** **	0.289*
	(0.117)	(0.153)
Log(value of assets)	-0.0254	0.0869***
	(0.0424)	(0.0292)
number of persons residing in the HH	0.000193	-0.0540***
	(0.0204)	(0.0129)
Mother's and Spouse's Characteristics		
Mother's Education	-0.00730	0.0340***
	(0.0178)	(0.0116)
Mother's Age	-0.0189*	-0.00844
	(0.0109)	(0.00871)
Mother's Spouse Education	-0.00482	0.0477***
	(0.0192)	(0.0111)
Mother's Spouse Age	-0.00511	0.00552
	(0.00996)	(0.00771)
Log(Mother's Arm circumference)	0.682	2.317***
	(0.679)	(0.355)
Child's characteristics		
year of birth	0.00999	0.0485
	(0.0919)	(0.0762)
Sex (1=male|2=female)	0.0125	0.156**
	(0.0867)	(0.0640)
Instruments		
Log(price of corn)		-0.381
		(0.379)
2 municipality		-0.489***
		(0.0985)
3. municipality		-0.143
		(0.101)
4. municipality		-0.458***
		(0.146)
5. municipality		-0.559**
		(0.242)
6 municipality		0
		(0)

7 municipality		-0.0559
		(0.191)
8 municipality		-0.147
		(0.119)
Constant	-22.01	-104.6
	(183.0)	(152.3)
Observations	1,016	1,016

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7.3.IV Approach

IV approach has drawbacks that are worth to be mentioned. Heckman and Urzua (2009) stress out the non–robustness of IV. According to the authors; first, IV is not robust to the choice of various instruments and second IV with weak instruments can be rather unstable. In the present study, heterogeneity arises from the individuals that chose to study and to work as part–time or full–time employees. Heckman et al. (2006) point out that IV assumptions are valid for homogenous models. However, for the case of heterogeneous models the responses to the instruments are not homogenous for the whole sample. Special attention should be also drawn to the issue of weak instruments. Staiger and Stock (1997) point out that the use of weak instruments can produce biased estimations and distorted confidence intervals, especially if the sample size is small. However, they add that LIML estimator is less biased than 2SLS estimators and thus it can lead to more consistent results[48]. One further constraint that is associated with the use of weak instruments is the Hausman endogeneity test (1978); Hausman test does not have power under weak instruments (Lochner and Moretti, 2014) and thus cannot be performed in the present analysis. In addition, we cannot exclude the possibility that the fact that we employ more than one instrument can lead to a greater bias (Hahn and Hausman, 2003).

As it was mentioned in *Econometric Method* section, the instruments employed are subjected to criticism; serial correlation in prices and correlation of the instruments to other unobserved characteristics pose a threat to the validity of IV approach. Aldrerman et al. (2000) state that a possible solution for the prices as instrument could arise; first, from the identification of strong price-shocks during early childhood, so as not to be correlated with price–level in the following

[48] Their opinion is consistent to that of Angrist and Pirscke (2009)

time periods and second sufficient data for the prices in the following period in order to exclude the possibility of serial correlation

7.4.External validity

The next limitation of the present study is the external validity of the results. It was mentioned in *Data Sources* section, the CLHNS survey focus on one metropolitan area rather than the whole country. Thus, it is rather difficult to draw conclusions for the whole population in Philippines. In addition the reduced sample that arises from the missing values poses one more limitation to the external validity of the present analysis. Attrition along with missing values can lead to a finite–sample bias. Especially, in the context of IV approach with multiple instruments, Bound et al.(1995) claim that “even enormous samples do not eliminate the possibility of quantitatively important finite–sample bias”.

8. Discussion and Concluding Remarks

Using the Cebu Longitudinal Health and Nutrition cohort survey, the present paper examined the impact of early child health and nutritional status, proxied by height–for-age Z–scores, on an individual's daily earnings into young adulthood. In the context of the analysis, two different methods were adopted; the OLS estimation and the IV approach. The OLS estimations are consistent with previous findings on the topic (Barker et al., 2004, Smith 2009, Case et al., 2004); healthier children are becoming wealthier adults. On the other hand, the possibility that this relationship is driven by unobserved characteristics at household and community level cannot be excluded (Hoddinott et al., 2011) and thus the IV estimation is performed. However, the statistical significance of the IV estimation contradicts various researchers who concluded that poor child health and nutritional status has significant impact on future earnings. Nevertheless, the catch–up growth cannot be excluded from the list of the possible justifications for this contradictory result. Adair (1999) employs the CLHNS in order to determine whether the children in Philippines exhibit catch–up growth. The conclusions indicate that by the age of 12, 32.5 % of the children are no longer stunted, in terms of height–for-age Z–scores. If it is likely for a child to exhibit catch–up growth between 2 and 12 years old, then child poor health and nutritional status is unlikely to have strong impact on the daily earnings at the age of 21 approximately. In addition, parents' compensatory behavior is evident in the Philippines (Liu et al., 2009) and especially for lower income household. Hence, if health and nutritional shocks are mitigated by parents' compensatory behavior, the association between early-life adverse conditions and future earnings does not exist.

Furthermore, non-random self-selection along with high attrition rates has deterministic impact on the results. Whereas attrition into the labor market leads to a downward bias through the migration of the most educated parents, self–selection into the labor market results to an upward bias through the self–selection of the healthiest part of the population. The exclusion of students partially controls for the bias that arises from part-time employment but the inclusion of part-time workers leads to an underestimation of the effect of early health on future earnings. In addition, attrition along with missing values lead to a reduced sample that decreases the precision of the estimates (Watson and Wooden).

OLS and IV estimation yield quite contradictory results. Whereas, the omitted variables bias and the measurement error in the explanatory variable (Alderman et al., 2001) justify completely the use of the IV approach, the IV can be inconsistent if the instruments are inconsistent. First, the issue of the timing of child growth arises. As it was mentioned on the *Theoretical Background* section, there is no consensus in the academic community with respect to the right timing of growth (Glewwe and King, 2000; Dobbing, 1976). Thus we cannot exclude the possibility that the instruments do not correspond to the right timing and the IV yields inconsistent results. In addition, the use of corn price as instrument is not free of criticism (Alderman et al., 2001; Jacoby, Glewwe and King, 1999) and thus it is likely that is leads to inconsistent estimations. The fact that multiple instruments rather than one is likely to lead to worse bias (Hahn and Hausman, 2013) makes us even more skeptic towards the IV estimations. Consequently, we strongly believe that OLS estimations should be taken into account in order to draw possible policy implications.

The present analysis fills the literature gap with respect to the relationship between early-life health and future earnings for the case of Philippines. It is an attempt to yield conclusions that can be useful for policy planning. Early childhood conditions play crucial role especially in countries like the Philippines where the health shocks cannot be cushioned by household socioeconomic status or country's social mechanisms. Early childhood health policies, before the age of 5 can be more cost–effective than policies implemented at later stages. Thus, early childhood health and nutrition programs should be preferred. We should also take into account that projects which focus on the youngest part of the population are suitable for countries with long-term high poverty and inequality rates. Children born in a disadvantage environment will turn into poor adults and subsequently they will not be capable of offering to their offspring a better quality of life. This leads to a vicious cycle of intergenerational poverty transmission. Thus, early childhood programs are a radical solution to this crucial problem.

The analysis has brought into focus several issues for further research. Consensus into the academic community about the timing of child's growth along with the determination of which aspects of early-life health matters the most are of crucial importance for further conclusions in the early childhood development. More elaborate data-sets can make plausible the use of measures other than height, which can identify the exact time period and disease level that affect the most child health. Self–selection should be incorporated further in the models that study early adverse conditions and future labor outcomes. Discrepancies between rural and urban areas should be brought into focus along with the interactions between the socioeconomic status and early-life conditions.

Bibliography

Adair, L. S. (1998). Filipino Children Exhibit Catch-Up Growth from Age 2 to 12 Years. *American Society for Nutritional Sciences*.

Adair, L. S., & Borja, J. B. (n.d.). *The Cebu Longitudinal and Nutrition Survey:Contributions and Policy Implications.*

Adair, L. S., Popkin, B. M., Akin, J. S., Guilkey, D. K., Gultiano, S., Borja, J., . . . Hindin, M. J. (2011). Cohort Profile: The Cebu Longitudinal Health and Nutrition Survey. *International Journal of Epidemiology*, 619 - 625.

Alderman, H., Behrman, J. R., Lavy, V., & Menon, R. (Winter, 2001)). Child Health and School Enrollment: A Longitudinal Analysis. *The Journal of Human Resources*, Vol. 36, No. 1, pp. 185-205.

Alderman, H., Berhman, J. R., Kohler, H. P., Maluccio, J. A., & Watkins, S. C. (2001). Attrition in Longitudinal Household Survey Data. *Demographic Research*.

Almond, D. (2006). Is the 1918 Influenza Pandemic over?Long - term effects of in utero influenza exposure in the post - 1940 US population. *Journal of Political Economy*, 672 - 712.

Almond, D., & Currie, J. (2011). Human Capital Development before age of 5. *Handbook of labor economics*, 1315 - 1486.

Almond, D., & Currie, J. (2011). Killing me softly: The fetal origin hypothesis. *Journal of Economic Perspectives*, 153–172.

Almond, D., & Mazumder, B. (2011). Health capital and the prenatal environment: the effect of Ramadan observance during pregnancy. *Am. Econ. J. Appl. Econ.*, 56 - 85.

Altonji, J. G., & Blank, R. (1999). Race and Gender in the Labor Market. In O. Ashenfelter, & D. Card, *Handbook of Labor Economics, Vol 3 C* (pp. 3143-3259). Amsterdam: Elservier.

Anderson, T., & Rubin, H. (1949). Estimation of the parameters of a single equation in a complete system of stochastic equations. *Annals of Mathematical Statistics*, 46 - 63.

Angrist, J. D., & Pischke, J.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion.*

Banerjee, A., Duflo, E., Postel-Vinay, G., & Watts, T. (2010). Long - run health impacts of income shocks: Wine and phylloxera in nineteenth-century France. *Review of Economics and Statistics*, 714 - 728.

Barker, D. J. (1992). Fetal and Infant Origins of Adult Disease. *London: British Medical Journal*.

Barker, D., Eriksson, G. J., Forsen, T., & Osmond, C. (2005). Infant growth and income 50 years later. *Arch Dis Child*, 272–273.

Becker, G. (1975). Human Capital and the Personal Distribution of Income: An Analytical Approach. *Human Capital*, 94–117.

Behrman, J. R., & Hoddinott, J. (2005). Programme Evaluation with Unobserved Heterogeneity and Selective Implementation: The Mexican PROGRESA Impact on Child Nutrtion. *oxford bulletin of economic and statistics*, 0305-9049.

Behrman, J. R., & Lavy, V. (1998). Child Health and Schooling Achievement: Association, Causality and Household Allocations. *Philadelphia: University of Pennsylvania*.

Bengtsson, T., & Lindstrom, M. (2000). Childhhod misery and disease in later life: The effects on mortality in old age of hazards experiences in early life, southern Sweden,1760-1894. *Population Studies*, 263-277.

Blank, R. (1998). Labor Market dynamics and Part - time Work. *Research in Labor economics*, 57 - 93.

Bobonis, G., Miguel, E., & Sharma, C. (2006). Iron Deficiency, anemia and school Participation. *Journal of Human Resources*, 672 - 721.

Bound, J., Jaeger, D. A., & Baker, R. M. (1995). Problems with instrumental variable estimation when the correlation between the instrument and the explanatory endogenous variable is weak. *Journal of amrican statistical association*.

Bozzoli, C., Deaton, A. S., & Quintana - Domeque, C. (2009). Child mortality, income and adult height. *Demography*, 647–69.

Brendy, T., Humpartzoomian, R., Cain, D., & Meaney, M. (2003). Partial reversal of the eff ect of maternal care on cognitive function through environmental enrichment. *Neuroscience*, 571 - 6.

Cameron, A., & Trivedi, P. (2005). *Microeconometrics: Methods and Applications.* New York: Cambridge University Press.

Canlas, D. B. (2008). *Philippine labour market outcomes and scenarios: 2000-2015.* Geneva: ILO .

Case, A., & Paxson, C. (2006). Stature and status: Height, Ability and labor market outcomes. *NBER WORKING PAPER SERIES*, Working Paper 12466.

Case, A., & Paxson, C. (2008). Height, health and cognitive function at older ages. *American Economic Review*, 98:2,463 - 467.

Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics*, 365–389.

Case, A., Lunotsky, D., & Paxson, C. (2002). Economic Status and Health in Childhood: the origins of the gredient. *American Economic Review*, 1308-1334.

Chandola, T., Bartley, M., Sacker, A., Jenkinson, C., & Marmot, M. (2003). Health selection in the Whitehall II study, UK. *Social Science and Medicine* , 2059–2072.

Clair, D. S., Xu, M., Wang, P., Yu, Y., Fang, Y., Zhang, F., . . . He, L. (2005). Rates of adult schizophrenia following prenatal exposure to the Chinese famines of 1959-1961. *Journal of the American Medical Association*, 557 - 562.

CLNHS. (1989). *The Cebu Longitudinal Health and Nutrition Survey: Survey Procedures.* Cebu: Office of Population studies, University of San Carlos, Carolina Population Center, the University of North Carolina, Nutrition Center of the Philippines.

Conti, G., & Heckman, J. (2012). The Economics of Child Well-Being. *IZA discussion papers*, No. 6930.

Cunha, F., & Heckman, J. (2007). The technology of skill formation. *NBER Working Papers*, Working Paper 12840.

Currie, A., Shields, M. A., & Price, S. W. (2004). Is the child health/family income gradient universal? evidence from england. *IZA Discussion Papers*, No. 1328.

Currie, J. (2008). Healthy, wealthy and wise: economic status, poor health in childhood and human capital development. *NBER Working Paper No. 13987*.

Currie, J., & Hyson, R. (1999). Is the impact of health shocks cushioned by socioeconomic status: the case of low birth weight. *American Economic Review*, 19 - 22.

Currie, J., & Moretti, E. (2003). Mother's education and the intergenerational transmission of human capital: evidence from college openings. *Quarterly Journal of Economics*, 1495-1532.

Currie, J., & Stabile, M. (2003). Socioeconomic status and health: why is the relationship stronger for older children. *Amrican Review*, 1813-23.

Currie, J., & Vogl, T. (2008). Early-Life Health and Adult Circumstance in Developing Countries. *Annual Review of Economics*, 1 - 36.

Currie, J., Stabile, M., Manivong, P., & Roos, L. L. (2008). Child Health and Young Adult Outcomes. *Journal of Human resources*.

Davidson, R., & McEwen, B. (2012). Social influences on neuroplasticity: stress and interventions to promote well-being. *Nature Neuroscience*.

Deaton, A. (2007). Economics of Health and Mortality Special Feature: Height,health, and development. . *Proceedings of the National Academy of Sciences*.

Dobbing, J. (1976). Vulnerable periods in brain growth and somatic growth. In *The biology of human fetal growth.* London: Taylor and Francis.

Duflo, E. (2000). Child health and household resources in South Africa: evidence from the old age pension program. *American Economic Review*, 393-398.

Dupas, P. (2011). Health Behavior in Developing Countries. *Annual Review of Economics*.

Fernald, L. C., Gertler, P., & Neufeld, L. M. (2008). Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's Oportunidades. *Lancet*, 828–37.

Florencio, C. A. (1988). *Nutrition, Health and Other determinants of academic achievement and school retaled behavior of Grades one to six Pupils.* Quezon City, Philippines: University of Philippines, mimeo.

Floud, R., Fogel, R. W., Harris, B., & Hong, S. C. (2011). *The changing body. Health, nutrition and human development in the Western World since 1700.* New York: cambridge university press.

Fogel, R. (1994b). Economin growth, population theory and physiology: the bearing of long- term processes on the making of economic policy. *The american economic review*, 369-395.

Gertler, P. (2004). Do Conditional Cash Transfers Improve Child Health? Evidence from PROGRESA's Control Randomized Experiment. *American Economic Review*, 336-341.

Gertler, P., Heckman, J., Pinto, R., Zanolini, A., Vermeersch, C., Walker, S., . . . McGregor, S. G. (2013). labor market returns to early childhood simulation: a 20 years follow - up to an experimental intervention in Jamaica. *NBER Working Papers*, Working Paper 19185.

Glewwe, P., & King, M. E. (2001). The impact of Early Childhood Nutritional Status on Cognitive Development: Does the Timing of Malnutrition Matter. *The world bank economic review*, 81 - 113.

Glewwe, P., King, E., & Jacoby, H. (2000). Early Childhood Nutrition and Academic Achievement: A longitudinal analysis. *Journal of Public Economics*, 345 - 368.

Gowin, E. (1915). *The Executive and His Control of Men.* New York: Macmillan.

Habicht, J.-P. (1974). Estandarizacion de Metodos Epidemiologicos Cuantitativos Sobre el Terreno. *Boletin de la Oficina Sanitaria Panamericana*, 375-384.

Hahn, J., & Hausman, J. A. (2003). Weak instruments: Diagnosis and cures in empirical econometrics. *American Economic Review: Papers and Proceedings*, 118–125.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 1251–1271.

Heckman, J. (1976). The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. *Annals of Economic and Social Measurement*, 475–492.

Heckman, J. (1979). Sample selection bias as a specification error. *Econometrica*, 153–161.

Heckman, J. (2012). *Invest in early childhood development:Reduce deficits, strengthen the economy.* The heckmnan Equation project.

Heckman, J. J., & Urzua, S. (2009). Comparing IV with Structural Models:what simply IV can and cannot identify. *IZA Working Papers*, No. 3980.

Heckman, J. J., Urzua, S., & Vytlacil, E. (2006). Understanding Instrumental variables in models with essential heterogeneity. *The review of economics and statistics*, 389–432.

Hirsch, B. T. (2004). Why do part - time workers earn less?The role of worker and job skills. *IZA Working Papers*, Discussion Paper no.1261.

Hoddinott, J., & Kinsey, B. (2001). Child health in the time of drought. *Bulletin*, 409 - 436.

Hoddinott, J., Behrman, J., & Martorell, R. (2005). Labor Force Activities and Income among Young Guatemalan Adults. *Food and Nutrition Bulletin*, 98 - 109.

Hoddinott, J., Maluccio, J., Behrman, J., Flores, R., & Martorell, R. (2008). Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. *Lancet*, 411–16.

Hoek, H. W., Brown, A. S., & Susser, E. (1998). The dutch famine and schizophrenia spectrum disorders. *Social Psychiatry and Psychiatric Epidemiology*, 373 - 379.

Horton, S. (1986). Child nutrition and Family size in Philippines. *Journal of Development economics*, 161 - 176.

Hubel, D., & Wiesel, T. (1965). Binocular Interaction in Striate Cortex of Kittens Reared with Artificial Squint. *Journal of Neurophysiology*, 1041-59.

Jamison, D. T. (1986). Child malnutrition and school performance in China. *Journal of Development economics*, 299 - 310.

Jones, K. L., & Smith, D. W. (1973). recognision of the fetal alcohol sydrome in early infancy. *The Lancet*, 999 - 1001.

JPAL. (n.d.). *http://www.povertyactionlab.org/*. Retrieved May 17, 2014, from http://www.povertyactionlab.org/methodology

Kannisto, V., Christensen, K., & Vaupel, J. W. (1997). No increased mortality in later life for cohorts born during famine. *American Journal of Epidemiology*, 987 - 994.

Lenz, W. V., & Knapp, K. (1962). Die thalidomid-embryopathie. *Deutsche Medizinishe Wochenschrift*, 1232{1242.

Leroy, J. L. (2011). *zscore06: Stata command for the calculation of anthropometric z-scores using the 2006 WHO child growth standards*. Retrieved from http://www.ifpri.org/staffprofile/jef-leroy

Liu, H., Mroz, T., & Adair, L. (2009). Parental compensatory behaviors and early child health outcomes in Cebu, Philippines. *Journal of Development Economics*, 209 - 230.

Lochner, L., & Moretti, E. (2014). Estimating and Testing Models with Many Treatment Levels and Limited Instruments.

Maccini, S., & Yang, D. (2009). Under the weather: health, schooling, and economic consequences of early-life rainfall. *American Economic Review*, 1006–26.

Magnusson, P., Rasmussen, F., & Gyllensten, U. (2006). Height at age 18 years is a strong predictor of attained education later in life: cohort study of over 950,000 Swedish men. *international journal of Epidimielogy*, 658–63.

Maluccio, J., Hoddinott, J., Behrman, J., Martorell, R., Quisumbing, A., & Stein, A. (2006). The Impact of Nutrition During Early Childhood on Education Among Guatemalan Adults. *University of Pennsylvania Population Studies Center Working paper 06 - 04*.

McCain, M., Mustard, F., & Shanker, S. (2007). *Early years study 2: putting science into action.* Canada: Council for Early Child Developmen.

McDowell, W. (1902). On criminal anthropometry and the identification of criminals. *Biometrika*, 177–227.

McEniry, M., & Palloni, A. (2010). Early life exposures and the occurrence and timing of heart disease among the older adult Puerto Rican population. *Demography*, 23–43.

McGregor Grantham, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *Lancet Series*, 369: 60–70.

Miller, J. E., & Korenman, S. (1993). Poverty, Nutritional Status, Growth and Cognitive Development of Children in the United States. *Princeston, NJ: OPR Working Paper*, No. 93 - 5.

Millimet, D. (2001). *STATA*. Retrieved May 17, 2014, from http://www.stata.com/support/faqs/statistics/endogeneity-versus-sample-selection-bias/

Molina, P. D., Sherman, J. A., Strogatz, D. A., & Savitz, D. A. (1994). association between materna education and infant diarreahin different household and community environments of Cebu, Philippines. *Social science Medicine*, 343 - 350.

Mroz, T. A. (1987). The sensitivity of an empirical model of married women's Hours of Work to economic and statistical assumptions. *Econometrica*, 765 - 799.

NSO. (n.d.). *Philippine statistics authority: National statistic office*. Retrieved May 20, 2014, from http://www.census.gov.ph/content/cebu-second-most-populated-province-philippines

(2001). *Nutrition country profiles - -Philippines.* Rome: Food and Agricultures Organization.

Onis, M. d., Onyango, A., Borghi, E., Siyam, A., & Pinol, A. (2006). *WHO child growth standards :length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age : methods and development.* Geneva: World Health Organization.

Osborne, T., & Mendel, L. (1914). The suppression of growth and the capacity to grow. *J Biol Chem*, 96 - 106.

Praghan, M., Sahn, D., & Younger, S. (2003). Decomposing world health inequality. *Health Economics*, 271-93.

Preston, S. H., Hill, M. E., & Drevenstend, G. L. (1998). Childhood conditions that predict survival to advances ages among African - Americans. *Social science medicine*, 1231-1246.

R., F. (2004). *the escape for the hunger and premature death, 1700 - 2100: Europe, America and the third world.* Cambridge: Cambridge University Press.

Roan, S. (n.d.). Living for two. *The Los Angeles Times*, 2007.

Rocha, R., & Soares, R. (2011). *Early life health and educational performance: evidence from rainfall fluctuations in the Brazilian northeast.* Mannheim: ZEW.

Rosenberg, N. A., Pritchard, J. K., Weber, J. L., Cann, H. M., Kidd, K. K., Zhivotovsky, L. A., & Feldman, M. W. (2002). Generic structure of human populations. *Science*.

Scott, J. (1986). Crtical periods in organizational processes. In J. Scott, *Human Growth Volume 1* (pp. 181 - 96). New York: Falkner F and Tanner JM.

Shlomo, Y. B., & Kuh, D. (2002). a life course to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary prespectives. *International journal of epidemiology*, 285 - 293.

Shonkoff, J., & Phillips, D. (2000). *From neurons to Neighborhoods: The Science of Early Childhood Development.* Washington DC: National Academic Press.

Smith, J. (2003). Consequences and predictors of new health events. *NBER Working Paper*, W10063.

Smith, J. P. (2009). The Impact of Childhood Health on Adult Labor market outcomes. *RAND Corporation and IZA*, Discussion Paper No. 4274.

Smith, L., Ruel, M., & Ndiaye, A. (2005). Why is child malnutrition lower in urban than in rural areas? Evidence from 36 developing countries. *World Development*, 1285-305.

Staiger, D., & Stock, J. H. (1997). Instrumental variables regression with weak instrument. *Econometrica*, 557–586.

Stanner, S. A., Blumer, K., Andres, C., Lantseva, O. E., Borodina, V., Poteen, V. V., & Yudkin, J. S. (1997). Does malnutrition in utero determine diabestes and coronary heart disease in adulthood? results from the leningrad seige study, a cross sectional study. *British Medical Journal*, 1342 - 1348.

Steckel, R. (1995). Stature and the Standard of Living. *Journal of Economic Literature*, 1903 - 1940.

Stein, A., Kahn, H. S., Rundle, R., Zybert, P. A., van der Pal-de Bruin, K., & Lumey, L. H. (2006a). Anthropometric measures in middle age after exposure to famine during gestation: Evidence from the dutch famine. *American Journal of Clinical Nutrition*, 869 - 76.

Stein, A., Kahn, H. S., Zybert, P. A., van der Pal-de Bruin, K., & Lumey, L. H. (2006b). Exposure to famine during gestation, size and birth and blood pressure at age 59:Evidence from the dutch famine. *European Journal of Epidemiology*, 759 - 65.

Stock, J. H., & Yogo, M. (2005). *Testing for weak instruments in linear IV regression. In Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg.* New York: Cambridge University Press.

Stock, J. H., Wright, J. H., & Yogo, M. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business and Economic Statistics*, 518–529.

Tanner, J. (1963). Regulation of growth in size from mammals. *Nature*, 845-50.

Theil, H. (1953). *Repeated Least Squares Applied to Complete Equation Systems.* The Hague: Mimeograph from the Central Planning Bureau.

Thomas, D., & Strauss, J. (1992). Prices, infrastracture, household characteristics and child height. *Journal od development economics*, 301 - 331.

Thomas, D., & Strauss, J. (1997). Health and wages: evidence on men and women in urban Brazil. *Journal of Economics*, 159–85.

UNICEF. (n.d.). *http://www.unicef.org*. Retrieved May 16, 2014, from http://www.unicef.org/philippines/health_nutrition.html#.U3c3ZPl_urQ

Verbeek, M. (2000). *A guide to modern Econometrics.* Wiley.

Vermeersch, C., & Kremer, M. (2004). School meals, educational achievement and school competition: Evidence from a randomized evaluation. *World Bank Policy Research*, Working Paper No. 3523.

Walker, S., Wachs, T. D., Gardner, J. M., Lozoff, B., Wasserman, G. A., & Pollit, E. (2007). Child Development: Risk factors for adverse outcomes in developing countries. *The Lancet*, 145 - 157.

Wang, Y., & Chen, H.-J. (2012). Use of Percentiles and Z -Scores in Anthropometry. In *Handbook of Anthropometry: Physical Measures of Human Form in Health and Disease.* V.R. Preedy.

Watson, N., & Wooden, M. (n.d.). *Identifying Factors Affecting Longitudinal Survey Response.*

WHO. (2009). *Infant and young child feeding: model chapter for textbooks for medical students and allied health professionals.* Geneva: World Health Organization.

WHO. (n.d.). *Urban health inequity and why it matters: Chapter 3.* Geneva: World Health Organization.

Wit, C. C., Sas, T. C., Wit, J. M., & Cutfield, W. C. (2013). Patterns of Catch-Up Growth. *The journal of Pediatrics*.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data.* Cambridge: MIT press.

Wu, S. (2003). The effects of health events on the economic status of married couples. *Journal of Human Resources*, 209 - 230.

Yoon, P. W., Blank, R. E., Moulton, L. H., & Becker, S. (1996). Effect of Not Breastfeeding on the Risk of Diarrheal and Respiratory Mortality in Children under 2 Years of Age in Metro Cebu, The Philippines. *American Journal of Epidemiology*.

Appendices

Appendix I

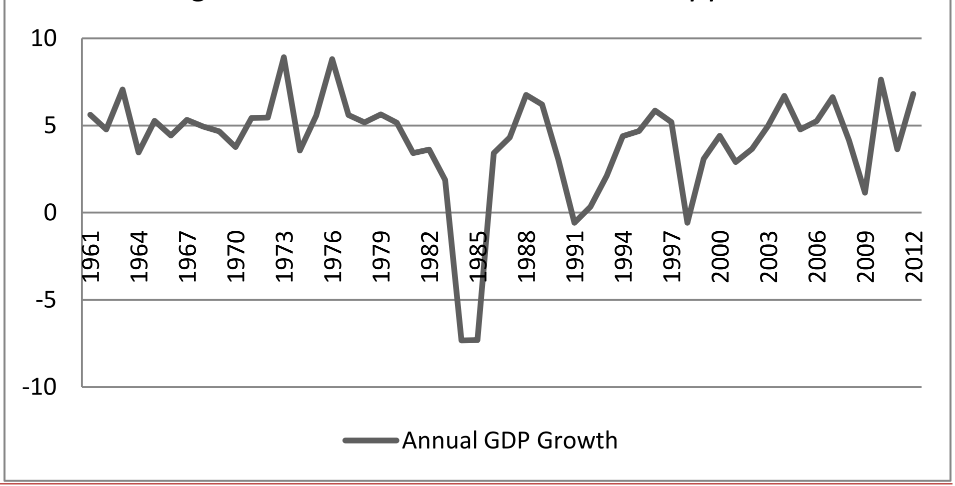


Figure 1. Annual GDP Growth. Philippines

Source: Author's Calculation based on World Indicators 2013

Figure 2. Map of Philippines

Appendix II

Table 10.Survey Status

Baseline Survey Status of Sample Woman	Frequency	Percent
Complete	2,179	65.49
Out - migrant	446	13.41
Temporary Migrant	382	11.48
Refusal	66	1.98
Infant Died	155	4.66
Stillbirth	38	1.14
Miscarriage	13	0.39
Twin Birth	26	0.78
Discovered Late		
Dropped	22	0.66
Missed		
Total	3327	100
2005 follow - up survey Status of Index Child	**Frequency**	**Percent**
Index Child interviewed	1,914	92.02
Index Child dead	8	0.38
Index Child moved out of Cebu Province	97	4.66
Index Child cannot be located in Metro Cebu	4	0.19
Index Child cannot be located outside Metro Cebu	24	1.15
Index Child refused	20	0.96
Index Child seriously/mentally ill	6	0.29
Index Child incarcerated/in institution	7	0.34
Total	2,080	100

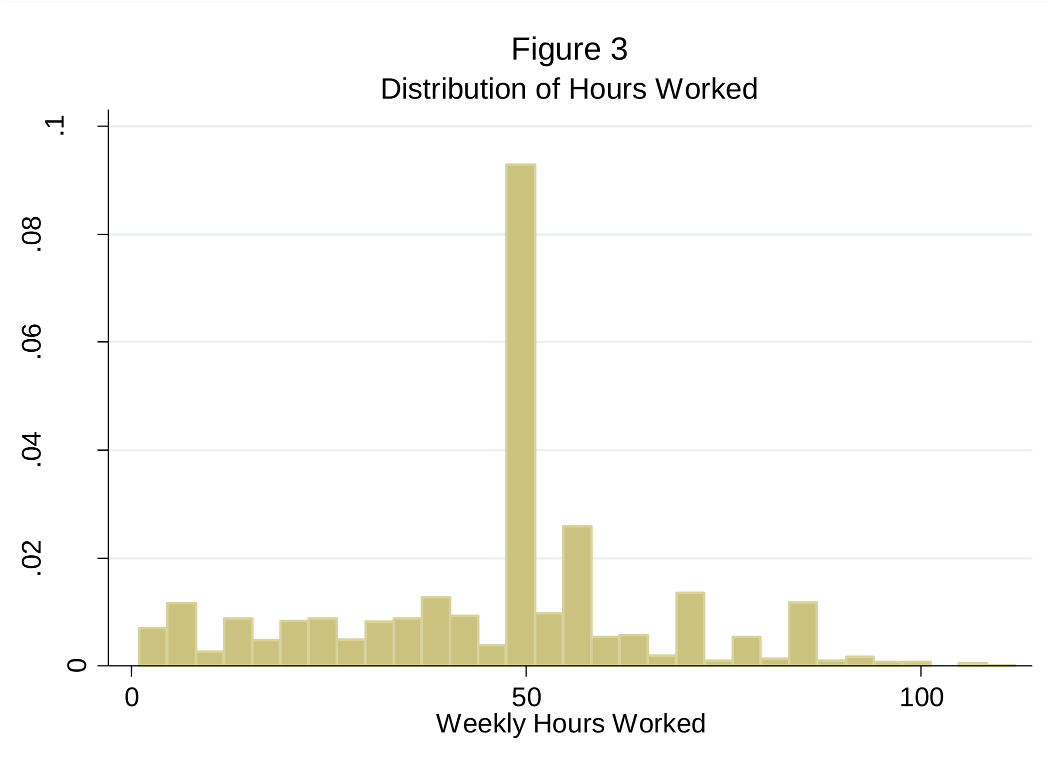
Source: Author's Calculation based on CLHNS

Appendix III

Table 11.Breastfeeding Pattern: 10-24 months

Variable	Age (in months)	Percentage (%)
Breastfeeding	10 months	68.28
	12 months	61.96
	14 months	53.07
	16 months	43.34
	18 months	**33.82**
	20 months	**25.54**
	22 months	**18.63**
	24 months	**13.73**

Source: Author's Calculation based on CLHNS



Source: Author’s Calculation based on CLHNS

.

Table 12.Characteristics of individuals that are still studying

IS INDEX CHILD CURRENTLY IN SCHOOL	Frequency	Percent
No	1,193	81.21
Yes	134	9.12
No, enrolled but dropped out	11	0.75
No, graduated from college	104	7.08
No, but enrolled in first semester	22	1.5
Yes, but not enrolled in first semester	3	0.2
Yes, post graduate	1	0.07
Total	1,469	100

Source: Author’s Calculation based on CLHNS

Figure 4

Kernel Density

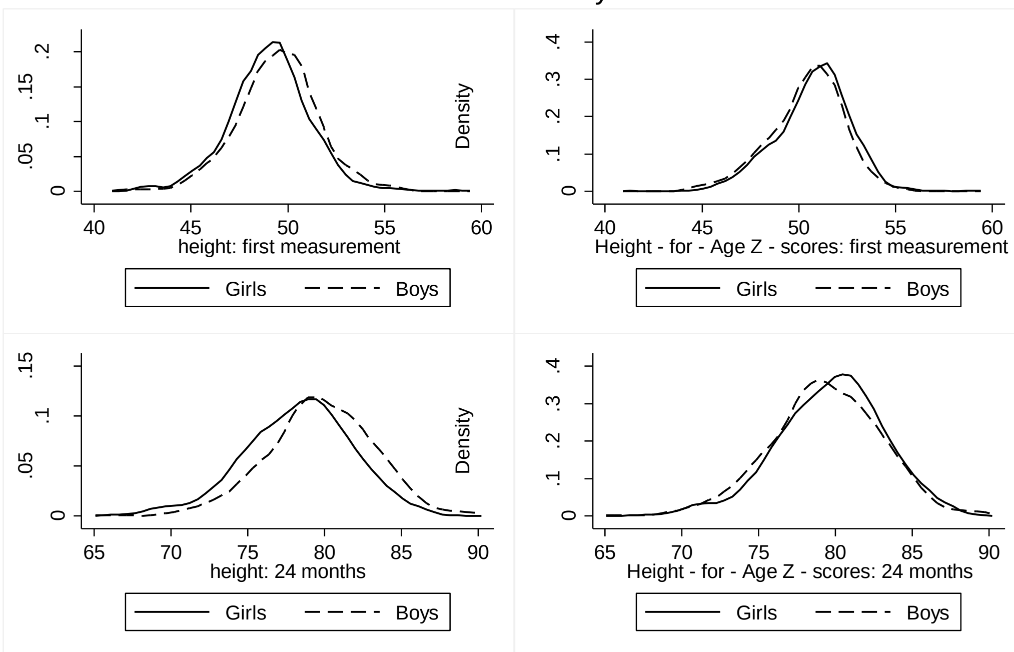


Table 13. Estimated Value - Assets according to household characteristics: Mean Differences and t-Statistics

Variable	Mean Estimated value Appliances	Mean Estimated value Houses	Mean Estimated value Landholdings	Mean Estimated Value Total
Type of Lightning				
electric				
no	515.83	5578.98	5482.9	11543.77
Yes	8427.79	26915.57	26990.91	59360.81
t - statistic of the difference	-16.8043	-11.3229	-4.16	-8.1285
kerosene				
No	8386.57	26828.64	27352.66	59616.44
yes	513.41	5546.82	5001.14	11019.51
t - statistic	16.7151	11.293	4.3241	8.2644
Water access				
No	16170.78	55818.35	63637.79	134045.7
yes	2528.62	9680.15	8575.77	19366.04
t - statistic of the difference	20.5652	17.4707	7.3869	13.6926
Construction Material				
light				
No	7042.44	25029.23	25763.93	55192.72
yes	1024.85	4405.32	3626.08	8970.4
t - statistic of the difference	12.4259	10.8176	4.2442	7.7807
strong				
No	2373.06	8976.04	9108.14	18995.05
yes	13869.37	48802.63	48762.87	109473.26
t - statistic of the difference	-19.0051	-16.6185	-5.8845	-11.9266
Type of Toilet Facility				
Do you have the toilet inside the house?				
No	3532.08	12140.44	13286.08	27075.52
yes	16563.29	55791.3	56573.01	125548.92
t - statistic of the difference	-15.7443	-13.1661	-4.61	-9.3322
Do you have toilet?				
Yes	5844.42	19931.88	20875.34	44496.73
No	866.47	6482.8	4124.1	11438.08
t - statistic of the difference	9.217	6.3176	2.9065	5.0227
Total (Sample size = 3,284)	4453.77	16175.64	16174.98	35181.92

Source: Author's Calculation based on CLHNS

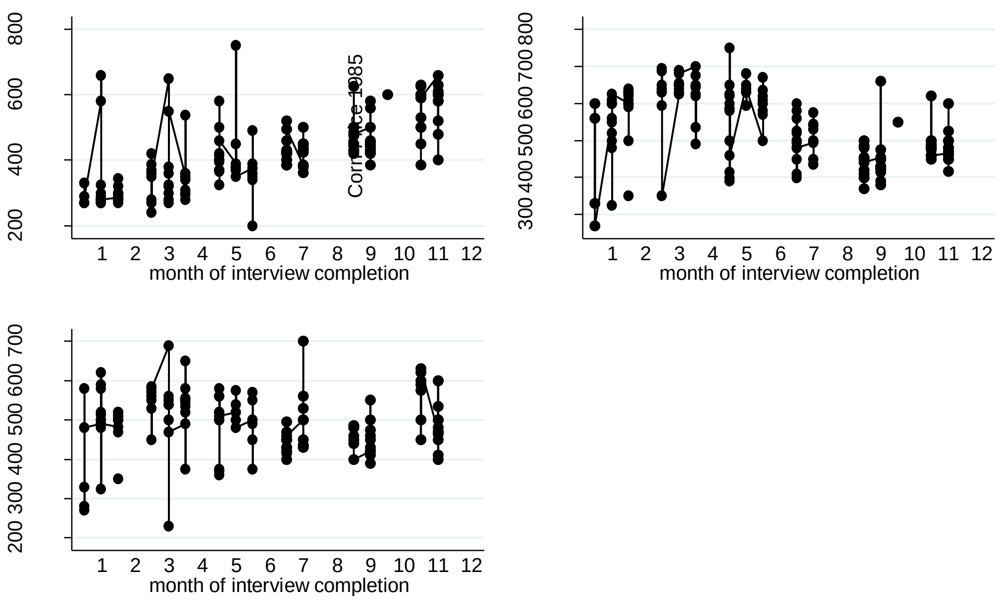
Table 14. Differences between urban and rural area: t-statistics

Variable	t - statistic	p - value
Mother's education	10.867	0
Partner's education	13.155	0
Mother's age	-2.72	0.0066
Mothers arm circumference	4.275	0
Partner's age	-2.245	0.0249
Estimated value of Assets	3.94	0.0001
Number of persons	-0.219	0.8265
Estimated value of assets 1st quintile	**-4.733**	**0**
Estimated value of assets 2nd quintile	**4.544**	**0**
Estimated value of assets 3rd quintile	-0.165	0.8687
Estimated value of assets 4th quintile	1.809	0.0716
Estimated value of assets 5th quintile	2.136	0.0336

Source: Author's Calculation based on CLHNS

Figure 6

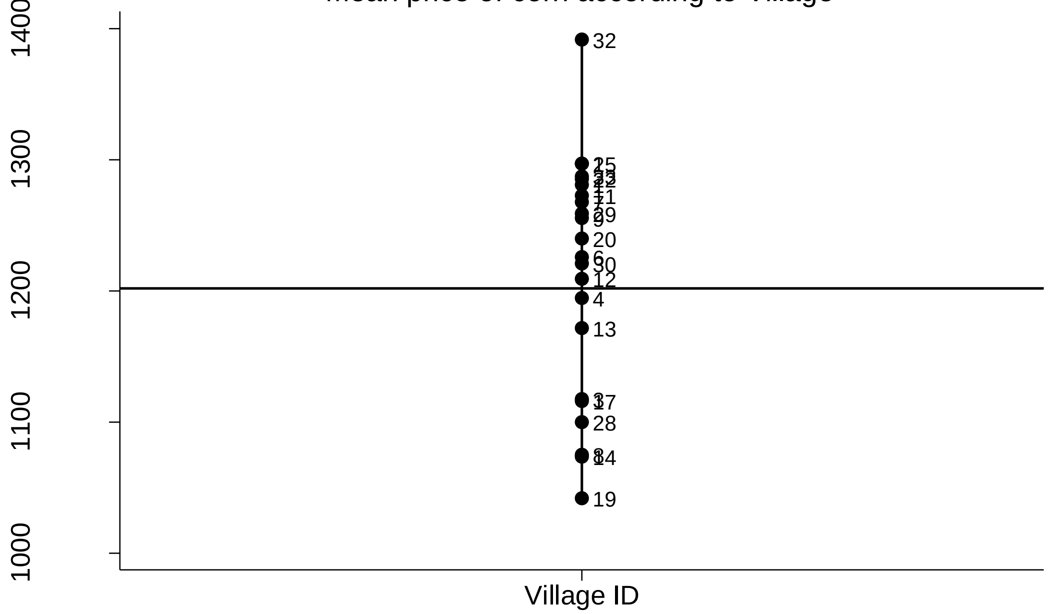
Variation in the Price of Corn according to year and month



Source: Author's Calculation based on CLHNS

Figure 7

Mean price of corn according to Village



Source: Author's calculations based on CLNHS

Table 15. Difference in infrastructure across municipalities

municipality	Mean population	Mean population density	Mean distance for the public hospital (in km)	Mean distance from maternity clinic (in km)
1 (n=9)	7117.78	22747.33	**4.75**	**3.19**
2 (n=4)	3246.5	5514.25	11.83	16.5
3 (n=4)	3157.5	6447.75	5.5	4.06
4 (n=6)	1757.67	3234.67	11.92	5.7
5 (n=1)	1102	3066	5	20
6 (n=1)	647	640	15	7
7 (n=6)	1437.33	512.83	10.92	11.42
8 (n=2)	3482.5	2319.5	5.5	5.5
Total (n=33)	3562.42	8588	8.5	7.23

Source: Author's calculations based on CLNHS