CHILD HEALTH AND ECONOMIC DEVELOPMENT IN LAO PDR -AN EMPIRICAL STUDY ON FERTILITY, CHILD MORTALITY, CHILD NUTRITION STATUS AND SOCIAL CAPITAL

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by

Alay PHONVISAY

PhD Dissertation

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For My parents

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EXECUTIVE SUMMARY

Health is one of the crucial components for overall well-being of a nation and individuals. Good health for children induces superior educational ability, and for adults stimulates productivity. On the contrary, poor health can have negative impact on child development and individual productivity, which leads to poor human capital and exacerbates poverty. Adults, who experience health shock during childhood, are said to have relatively lower income than those who do not. This occurs because health problems depress the ability to learn and damage the physical development of children.

Turning to the future prospects of Lao PDR, children are going to become the backbone, the productive labor force and leaders of the country. However, their future depends on our actions today. In other words, we have to provide prerequisites for children to develop their capacity and realize their potential in the future. Indeed, one of the prerequisites for child development is child health. The many factors that negatively affect the cycle of producing and maintaining the health of children include poverty, maternal health, parents' education, and health environment (including the presence of medical doctors, nurses and health volunteers).

Despite having achieved remarkable economic performance in recent decades, low performance in the health sector and mass poverty are still a considerable challenge facing the country. Poverty in Lao PDR has substantially declined, but there is evidence of increasing disparities between the poor and non-poor. Food poverty has direct impact on child health, because children without sufficient food intake are vulnerable to many diseases and are at greater risk of being stunted and underweight. In addition, (maternal) health is still in a deprived condition for most women in Lao PDR, particularly those living in rural and remote areas. The maternal mortality rate is among the highest in Southeast Asia, and the fertility rate ranks second in the region.

Moreover, two indicators of child health (child malnutrition, child mortality rate) rank among the highest in the region and the world.

Therefore, in order to improve child health in Lao PDR, a comprehensive study on child health, poverty, maternal health, and their interrelationship is urgently needed. Additionally, the differences between urban and rural areas will be examined to give a better understanding how these issues interact among the various regions. To the best of our knowledge, no comprehensive academic research on child health in Lao PDR has been conducted.

In view of filling this study gap, the dissertation intends to evaluate the status of child health and issues related to child health for Lao PDR using a comprehensive approach. More specifically, the study covers the whole process of producing healthy children by analyzing problems related to child health before birth (prenatal health) and after birth (postnatal health), and child survival and nutrition status for healthy development. In addition, the study evaluates the impact of social capital on child health and thereby addressing a very important issue for rural communities. This specific analysis is based on field survey data collected by the author in northern Lao PDR in 2009 and early 2010. These two features contribute uniqueness and originality to this research.

First, in addressing prenatal health issues (before birth) the analysis focuses on maternal health. Specifically, it evaluates determinants of fertility (a proxy of maternal health) of Lao women aged between 15 and 49 years, focusing mainly on the impacts of child mortality; parents' educational levels; knowledge of contraceptive methods; household wealth; job specification; and regional differences. The empirical investigation is mainly based on the data from the Lao Reproductive Health Survey 2005 (LRHS-2005). It has been found that women's education contributes a great deal to fertility reduction in all areas. Such contributions occur through many channels, such as increasing mother's wages and associated opportunity costs, and effective use of

health information. The upward pressure of child mortality on fertility also reflects the rationale of mothers for securing future family labor force and for their own security in retirement age, especially for women in rural areas where a social security system is practically absent.

Second, in dealing with postnatal health issues (after birth) the investigation focuses on factors affecting under-five child mortality (a proxy for postnatal child health), such as birth order; parents' education; knowledge on health care; number of medical workers (doctors and nurses) and the like. This empirical analysis is also based on data extracted from LRHS-2005. It has been proved that birth order and mother age at birth are crucial to child survival. These two elements can be easily improved through family planning programs. Moreover, education is fundamental in reducing child mortality, particularly maternal education at the basic level including primary and lower secondary education. In regard to the health environmental factor, it is evident that the number of medical workers contributes significantly to improving the child survival rate, especially in rural areas. Other factors influencing child health include family wealth and access to safe drinking water sources.

Finally, in addressing issues related to child survival and nutrition status for healthy development the study focuses on factors affecting short-term and long-term child health status while considering regional differences. Specifically, it assesses possible impacts on child nutrition status of such determinants as mother's age; parents' education; poverty indicator; presence of health workers (doctors, nurses, health volunteers); access to clean drinking water and latrines; and the like. The analysis also uses two proxies for child nutrition status, namely being stunted and underweight. The former is a measure for long-term child health status and the latter is an indicator for short-term child health status. The empirical investigation uses data from the Lao Expenditure and Consumption Survey 3 (LECS3) which was conducted from March 2002 to February 2003. It has been found that income generation activities

and poverty reduction efforts have significant impacts on short-term child health. The role of health workers is also proved to be crucial for child health improvement, especially long-term child health. Moreover, the role of maternal education in health care betterment is evident in Lao PDR, particularly children's nutrition status.

Notwithstanding good findings on child nutrition status, the empirical analysis faces a limitation due to lack of mother's biological data which is closely related to child nutrition status. In order to enhance our understanding on child nutrition status in Lao DPR and to bolster the significance of the dissertation, a field survey was conducted in three villages in Oudomxay province (Homxay village, Mainatao village, Nasavang village) to collect primary data for the analysis on the effect of social capital on child nutritional status. In particular, data on mother's biological endowment (height) and social capital (kinship network in the village) are often not available in national-level surveys. Evidence has been found that kinship network, which is considered fundamental to social capital, is one of the mechanisms of people in rural areas for buffering economic and health shock. In other words, kinship network appears to exert a significant impact on improving child health status, especially long-term child health.

In summary, the findings of this research imply that maternal education, especially basic education, is the most important socio-economic determinant for maternal health and for child health at all development phases covered under the study. Education helps mothers effectively utilize health information (e.g. use of contraceptives) which is by all means vital for future family planning. At the same time, education plays a significant role in reducing child mortality via effective use of health information for preventing diseases and raising self awareness of the diseases. This results in lower demand for children. Mother's education also helps improve child nutrition status by making use of important/relevant health information provided through various health programs.

Another important socio-economic determinant is the ability of a household to generate income. This determinant has long been a focal point for the government poverty reduction programs. Poverty, especially food poverty, directly affects children's short-term health status which makes children vulnerable to diseases and hence to mortality. If children suffer from malnutrition for a long period, it will unavoidably affect child long-term health. In addition to poverty reduction, improving the quality and quantity of health workers (medical doctors, nurses, and health volunteers) is crucial for reducing child mortality and improving child health in the long term. Not only do health workers directly affect fertility by providing health information to mothers, but they also reduce fertility by means of lowering child mortality rates. In another dimension, social capital, particularly kinship network, is proved to be an important factor for maintaining child health in rural and remote areas where access to outside help is limited. Overall, understanding these issues and their complex interrelation are crucial for health improvement of mothers and children, particularly in rural areas where access to public infrastructures is difficult, if not absent.

In order to make use of the findings from this research, four important policy implications that can be drawn are as follows: expanding health education and adult literacy programs; improving the quality and increasing the quantity of health workers; expanding poverty reduction activities related to child health; and recognizing the role of social capital in development.

- Expanding health education and adult literacy program

More efforts should be made to continue promoting health information by focusing on women. Even though many health promotion campaigns exist at the village level, in most cases households send only one representative, who is usually male regardless of the topic. In order to fully utilize health promotion programs related to child health, mothers should be encouraged to participate.

To increase the quality of health promotion programs, improving maternal education is necessary. Improving and expanding adult literacy programs focusing on women, at least in primary education, would be able to improve maternal and child health.

- Improving the quality and increasing the quantity of health workers

Improving the quality and increasing the number of trained health workers is important for improving child health. At the moment, the number and quality of health workers is considerably low to be able to meet the need. As the evidence shows that relying on health volunteers is not sufficient to improve child health, upgrading health workers from low-level to mid-level and training health volunteers to become low-level health workers (especially in rural areas) would be the best option for the current situation. For long-term objectives and sustainability, however, increasing the number of high level health workers in rural areas is indispensable for better child health.

- Expanding poverty reduction activities related to child health

The recent "Lunch Program" for primary school students aims to overcome the food poverty problem of children. It is important to maintain and expand this kind of program nation-wide, while giving priority to rural remote areas, because this policy would help improve long-run child health. In the short-run, income generation policies, such as job creation programs, are also needed.

- Recognizing the role of social capital in development

Any policy implementation related to child health should account for the impact of the social capital factor. Promoting health campaigns through kinship networks can expand the impact of the campaigns.

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ACRONYMS AND ABBREVIATIONS

2SLS	Two Stage Least Square
ADB	Asian Development Bank
AFTA	AEAN Free Trade Agreement
ASEAN	Association of Southeast Asia Nations
CBHI	Community-based Health Insurance
CEB	Child Ever Born
CEB	Number of child ever born to mother
DHS	Demographic Health Survey
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HEF	Health Equity Fun
IFMT	Institut Francophone pour la Medecine Tropicale
IMR	Infant Mortality Rate
IV	Instrument Variable
LECS3	Lao Expenditure and Consumption Surveys 3
LECS4	Lao Expenditure and Consumption Surveys 4
LRHS	Lao Reproductive Health Survey
MDGs	Millennium Development Goals
MICS3	Multiple Indicator Cluster Surveys 3
MOH	Ministry of Health
NEM	New Economic Mechanism
NGPES	National Growth and Poverty Eradication Strategy
NIPH	National Institute of Public Health
NSC	National Statistic Center
NSEDP	National Socio-Economic Development Plans
OLS	Ordinary Least Square
PCA	Principal Component Analysis
SSO	Social Security Organization
UN	The United Nations
UNFPA	United Nations Population Fund (formerly United Nations Fund for Population Activities)
WHO	World Health Organization

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Health is one of the crucial components for overall well-being of individuals and the nation. Poor health can have a negative impact on children's education and individual productivity which further leads to poor human capital and exacerbates poverty. There is some evidence that adults who experience health shock during childhood have relatively lower income than those who do not (Savedoff and Schultz, 2000). This happens because health problems can depress learning ability and damage physical development in children. Therefore, improving children's health is a key to realizing better human capital for sustainable development of the country. There are many factors that affect the cycle of producing and maintaining good health in children, such as poverty, education, maternal health and health environment. For example, hunger has a direct impact on a child's growth, as well as during the fetal period through the mother's health condition (Stein et al., 1975).

Maintaining adequate child health in the contemporary environment is also a global issue. In addressing the need for improving child health and its impact on human resource and national development, it has been recognized as one of the Millennium Development Goals (MDGs) agreed upon by the United Nations and the member countries. The MDGs relating to child health include 'eradicating extreme poverty and hunger (aiming at improving child nutrition status)', 'reducing child mortality', and 'improving maternal health'.

In Lao PDR, despite having achieved remarkable economic growth with an average growth rate of about 6% over the past three decades (World Bank, 2010b), low performance in the health sector and mass poverty are still a considerable challenge facing the country. In order to overcome these problems, in addition to the commitment

to achieve MDGs in 2015, in October 2003 the Lao government adopted the National Growth and Poverty Eradication Strategy (NGPES).The NGPES treats health care as one of the top priority sectors and focuses on health care related issues in the poorest 72 districts. Regarding health sector development, the Primary Health Care (PHC) policy, among other things, has been set as a tool to realize the development goals of the government. Furthermore, in the PHC policy, maternal and child health continue to be one of the top priority areas (NGPES, 2003).

Poverty in Lao PDR has substantially declined over the past decades, as the poverty incidence fell from 46% to 27.6% during 1992-2008 (Anderson et al., 2006; Gaiha and Annim, 2010). However, there is evidence of increasing disparities between the poor and non-poor. Food poverty has direct impact on health, especially on child health. Children who do not have enough food intakes are vulnerable to many diseases and at greater risk of being stunted and underweight. Regarding child malnutrition, the declining rates of poverty on average make a very small contribution to improving child malnutrition because the poverty gap between the poor and non-poor is widening. Child nutrition status in Lao PDR ranks among the lowest in the world and the second lowest in Southeast Asian countries. For example, from 1993-2006, the percentage of stunted children (children who are shorter than the standard for their age) slightly fallen from 48% to 40.4%, while the percentage of underweight children (children whose weight is lower than the standard for their age) dropped from 44% to 37.1% (NSC, 2008). Overall, focusing on poverty reduction alone appears to be insufficient for reducing child malnutrition. Rather, the issue requires lateral consideration and the interaction between poverty and other potential factors on child health status.

In terms of maternal health, generally the maternal mortality rates, which are defined as the rate of mothers who die while giving birth or 42 days after giving birth, is used as an indicator. For Lao PDR, the maternal mortality rate sharply decreased from 1200 to 580 per 100,000 live births during the period of 1990-2008 (World Bank,

2010a). In spite of government efforts and remarkable improvement, the maternal mortality rate still ranks the highest among Southeast Asian countries (WHO, 2010). Most maternal mortality in Lao PDR occurs during the time of delivery. This implies that high fertility rates are among the major causes of maternal mortality. Concerning the fertility rate, Lao PDR has the second highest rate in the region and high fertility rates are found among the poor and people who live in rural areas (UN, 2010). Therefore, reducing fertility is one channel to improving maternal health, because the proportion of trained birth attendants is still very low and most mothers in rural remote areas give birth without a birth attendant. During our field survey in 2009 and early 2010 we found that only mothers who experienced birth complications went to a health care facility, while women without a bad experience during delivery gave birth at home due to the inability to afford transportation.

With respect to child mortality rates, Lao PDR has still been experiencing high incidences. The country ranks 54th and the second highest in the Southeast Asian region. During 1990-2008, the child mortality rates declined from 163 to 61 per 1000 live births (UNICIEF, 2010). In addition to birth complications, causes of child mortality come from preventable diseases, such as diarrhea, malaria and acute respiratory infection. Malnutrition makes children vulnerable to these diseases. Thus, high rates of fertility and child malnutrition are closely related to high child mortality.

Hence, in order to improve child health in the Lao PDR context, a comprehensive analysis of fertility, child mortality, and child nutrition is urgently needed. Additionally, the differences between urban and rural areas will be examined to give a better understanding how these issues interact among the various regions. To the best of our knowledge, no comprehensive academic research on child health in Lao PDR has been conducted

1.2 OBJECTIVES OF THE STUDY

In view of filling this study gap, this dissertation intends to evaluate the status of child health and issues related to child health for Lao PDR using a comprehensive approach. More specifically, my study covers the whole process of producing healthy children by analyzing problems related to child health before birth (prenatal health), which is demand for children (fertility), and after birth (postnatal health), and child's survival and nutrition status for healthy development.

In more detail, my study explores and evaluates how potential determinants, such as parents' socio-economic status, health environment, the role of Medical Workers (doctor and nurse) and family planning campaigns, and the like, interact with fertility and child mortality in Lao PDR. The study also investigates how these determinants affect fertility and child mortality in different locations, i.e. urban and rural areas, and the three regions (north, center, south), and quantifies such differences. The empirical analyses are based on the Lao Reproductive and Health Survey in 2005.

My study explores how poverty (represented by monthly consumption expenditure per capita) and other determinants, such as parental education and presence of health workers (Medical Workers and Health Volunteers), affect short-term and long-term child health status by considering the differences between urban and rural areas and the differences among the three regions of Lao PDR. The data used for the investigation are mainly extracted from the Lao Expenditure and Consumption Survey 3 (LECS3). In addition, the study evaluates the impact of social capital on child health and thereby addressing a very important issue for rural communities. This specific analysis is based on field survey data collected by the author in northern Lao PDR in 2009 and early 2010. These two features are indeed a uniqueness and original contribution of this research study.

1.3 Uniqueness, Significance and Limitation

My study differentiates itself from previous studies with the following aspects. First, it covers all processes of producing healthy children for better comprehensive child health. Fertility, child mortality and child nutrition are closely related. Before children are born, it is important to consider which factors alter the level of demand for children. After children are born, it is important to consider what factors improve their survival and maintain their health status in order to grow up as healthy population. Second, the dissertation also examines evidence of the impact of social capital on child health. This factor is considered especially important for people who live in rural remote areas.

The analyses in this dissertation face two limitations relating to data availability: (1) the effect of poverty on fertility and child mortality cannot be directly investigated, because the Lao Reproduction Health Survey 2005 does not provide income or expenditure on consumption data; and, (2) the household wealth level in the section of fertility and child mortality is not available. Hence, an Asset Index has been constructed for use in those empirical analyses. Also, most of the samples in the analysis in this dissertation are in rural areas. Thus, the situation of fertility, child mortality and nutrition status might be worse than the actual situation and the results might be somewhat upward-biased.

1.4 Organizational Structure

In terms of organization, the dissertation is structured as follow: Chapter 1 introduces issues of child health, such as determinants of sustainable development, and performance of child health indicators, and presents the study objectives, significance and structure of the dissertation.

Chapter 2 provides information on economic development with an emphasis on current poverty situation, child malnutrition status, fertility, maternal and child

mortality trend, and the health system in Lao PDR.

Chapter 3 presents recent trends of studies on fertility in developing countries, reviews the current fertility and education situation in Lao PDR, and then discusses the findings on factors inducing fertility in urban and rural areas and the differences among three regions.

Chapter 4 discusses the current situation of child mortality, briefly describes current situation of access to health care and services in Lao PDR. Then it presents the analysis of determinants of child mortality and discusses the findings.

Chapter 5 reviews relevant research studies on child nutrition status, illustrates the current situation of malnutrition and poverty in Lao PDR, and elaborates the findings of the analysis on impact of poverty on child nutrition statistics.

Chapter 6 illustrates trends and impacts of social capital on development, presents the data and describes the background and characteristics of the location of the field survey, i.e. the current economic situation, health environment and social capital in three sample villages. It also discusses impacts of social capital on child health in those three villages.

Chapter 7 summarizes the main findings on significant impact of determinants of fertility, child mortality and nutrition status in Chapter 3, Chapter 4, Chapter 5 and Chapter 6. Conclusions, major policy implications and prospects for further study also are presented in this chapter. A bibliography is provided at the end of the dissertation.

CHAPTER TWO
ECONOMIC DEVELOPMENT AND HEALTH SECTOR IN LAO PDR

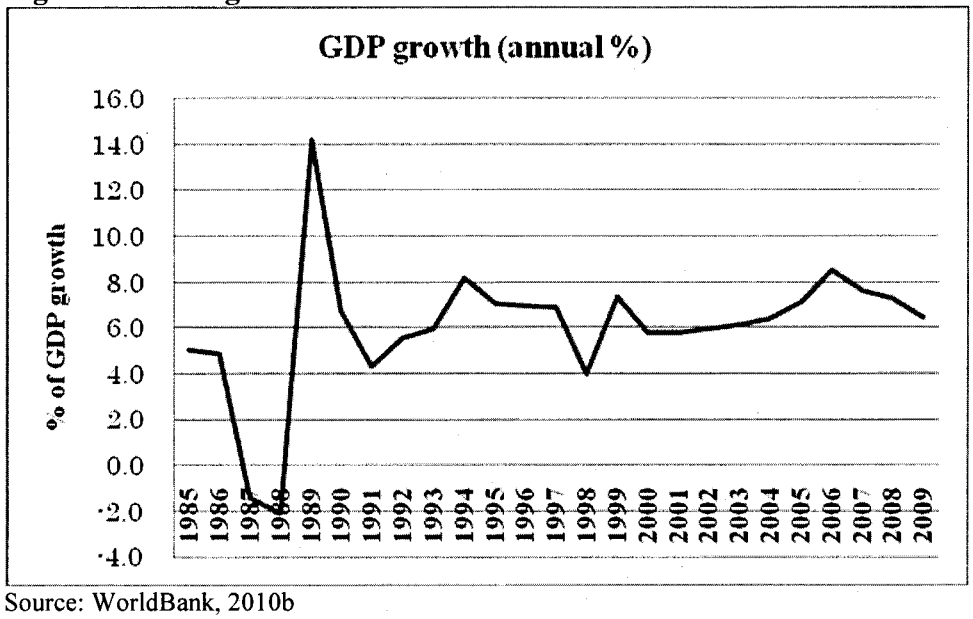
2.1 RECENT ECONOMIC DEVELOPMENT

Since the introduction of the New Economic Mechanism (NEM) in 1986, Lao PDR has been in transition from a centrally planned economy to a market oriented one. Development policies in many sectors have been reformed toward the policies of market economy. The reforms included price decontrol, liberalization of trade and payment systems, introduction of a two-tier banking system, freeing of all but agriculture-related interest rates, initiation of civil service reforms, introduction of a legal framework to support a market economy, and an extensive privatization program. The progress of the reform was reflected in steady growth of Gross Domestic Product (GDP) over the past three decades. According to Figure 2.1, even though Lao PDR experienced negative GDP growth during the first two years of the NEM adoption (1987-88), the annual GDP growth rate of 1989 sharply increased to 14% which resulted in an average annual growth of 4.1% for the period of 1985-89. However, in 1991 the economy shrank drastically to about 4%, partly, due to the collapse of the planned economic system in Eastern Europe.

In the subsequent period, the Lao economy made a relatively quick recovery and continued to grow at an average rate of 6.1% during 1990-1994. The country was hit hard again by the Asian Financial Crisis and the growth rate dropped to just 4% in 1998. In 1997 Lao PDR joined the Association of Southeast Asian Nations (ASEAN) and the ASEAN Free Trade Area (AFTA), a regional trade block. On average the GDP growth during 1995-1999 was 6.4%. In the period of 2000-2004, the economy expanded fairly well at a period average rate of 6.0% per annum for 2000-04 owing to a boom in natural resource sectors (mining and hydro electric power).

In the recent period of 2005-2009, Lao PDR continued to enjoy high economic growth with an average rate of 7.3% as a result of continuously booming in the natural resource sectors. The contribution of the natural resource sectors to GDP growth is about 40%. In 2010, the natural resource sectors alone cover 53% of the growth rate and it is projected to dominate in the total growth rate in Lao PDR by about 43.5% in 2015.

Figure 2.1 GDP growth rate in Lao PDR



Source: WorldBank, 2010b

2.2. POVERTY REDUCTION AND CHILD MALNUTRITION

In order to achieve sustainable development, poverty eradication is the main focus of the government policies. In October 2003, the government adopted the National Growth and Poverty Eradication Strategy (NGPES) as a tool to enhance growth, development and poverty reduction, where health and education which are directly related to long term human capital development are among of the top priority sectors.

Along with impressive performance in economic growth, poverty also remarkably drecreased during the past decade. Poverty incident dropped from 46.0% in 1992/93 to 39.1% in 1997/98 and it steadily declined to 33.5% in 2002/03 and reached

27.6% in 2007/08 (LECS; Anderson et al., 2006; Gaiha and Annim, 2010). However, the reduction of poverty still varies among provinces and regions. Comparing the change of poverty incident between 1997/98 and 2002/03, two provinces in nothern region, three in the central region and one in the southern region experienced an increase in poverty (LECS3). Regarding poverty headcount ratio in 2002/2003, the northern and central regions are home for 72% of the poor, whereas Savannakhet province (in the central region) alone acounted for 18% of the poor in the country (Table 2.1). Moreover, the gap of share in real per capita consumption is also widening. The gap between the poorest 20% and the richest 20% of total population increases from 29.1% in share in per capita real consumption in 1992/93 to 33.0% in 2002/03 (Anderson et al., 2006).

With regard to variation of poverty reduction and increase in equality, there is concern that the economic achievement might be pro-rich growth because the benefits flow mainly among the rich. The sectors, which have contributed to economic growth in the last two decades, have small impact on job creation in overall labor force structure in Lao PDR. According to the Population Census (2005), 79.6% of population are still in the agricultural sector which contribute to only 0.9% to total GDP growth in 2009 (WorldBank, 2010b). Therefore, despite high economic growth rates, malnutrition, especially for children still remains a problem in Lao PDR.

Child malnutrition in Lao PDR is still high and improvement is slow over the past decade. The prevalence of underweight of under-five year-old children slightly decreased by 7% from 44% to 37% during 1993 to 2006 while the incident of stunting of under-five year-old children dropped only 8% points from 48% to 40% in the same period (NSC, 2008). Generally, causes of malnutrition are rooted in poverty which results in low intake of fat and protein; food utilization impeded by diseases; household food insecurity; and lack of care and nutritional knowledge. In order to tackle this problem, in addition to poverty reduction policy, the Ministry of Health (MOH)

developed a so-called National Nutrition Policy in 2008. It consists of 10 policy objectives which include improving nutrient intake; reducing food- and vector-borne diseases; improving household food access and food availability; improving mother and child care and education; improving environmental health; improving nutrition programming, management and monitoring and evaluation; making nutrition central to socioeconomic development; making investment in nutrition a priority; improving the nutrition capacity within all sectors and levels of government; and facilitating action-oriented research and information systems (UN, 2008).

Table 2.1: Provincial poverty rates

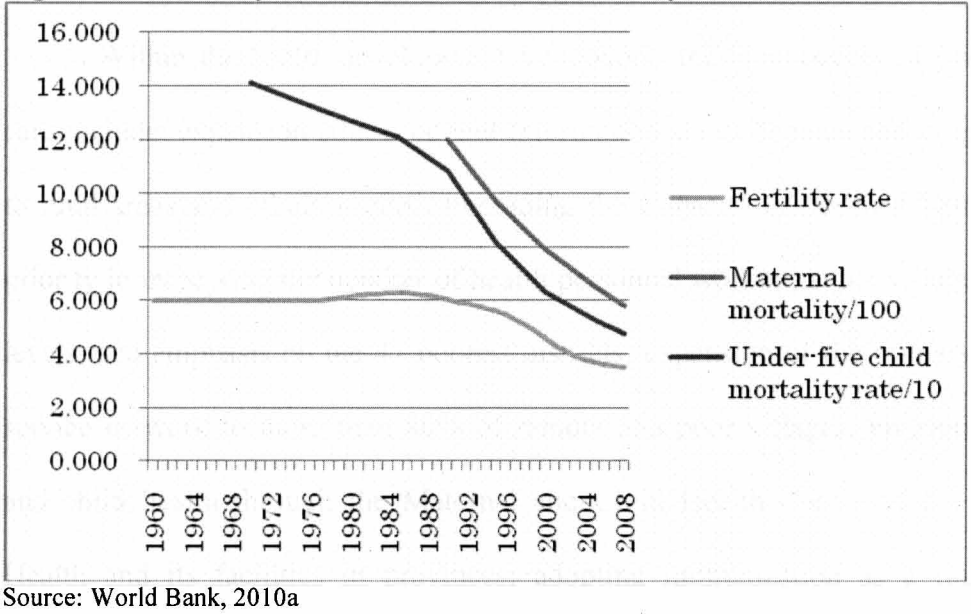
Region and Province	Provincial population estimate (2003)	Population as % of total population	Poverty Headcount Ratio			Poor as % of total poor (in 2002-03)
			1992-93	1997-98	2002-03	
Vientiane Capital	**671,156.8**	**12.4**	**34**	**14**	**17**	**6.2**
Northern region		**31.1**				**34.62**
Phongsaly	162,376.7	3	72	58	51	4.5
Luangnamtha	140,726.4	2.6	41	51	23	1.76
Oudomxay	254,390.1	4.7	46	66	45	6.22
Bokeo	140,726.4	2.6	42	39	21	1.61
Luangprabang	389,704	7.2	59	41	40	8.47
Huaphanh	270,627.8	5	71	71	52	7.65
Xayabury	324,753.3	6	22	18	25	4.41
Central region		**36.4**				**37.22**
Xiengkhuang	221,914.8	4.1	63	43	42	4.98
Vientiane	373,466.3	6.9	31	28	19	4.05
Borikhamxay	216,502.2	4	17	28	29	3.40
Khammuane	324,753.3	6	47	45	34	6.09
Savannakhet	795,645.6	14.7	53	42	43	18.06
Xaysomboun SR	37,887.89	0.7	-	63	31	0.64
Southern region		**20.1**				**18.96**
Saravane	313,928.2	5.8	44	39	54	8.71
Sekong	81,188.33	1.5	67	50	42	1.80
Champasack	584,555.9	10.8	41	37	18	5.94
Attapeu	108,251.1	2	61	48	44	2.51
Total	**5,412,555**		**46**	**39**	**34**	**100**
Rural Poverty			52	43	38	
Urban Poverty			27	22	20	

Source: UN 2008

2.3 FERTILITY, MATERNAL AND CHILD MORTALITY

One of the top poverty eradication priorities in the health sector is reducing maternal and child mortality which are used as one of the proxies of maternal and child health. It has long been recognized that high rates of fertility affect maternal and child health. As can be seen that high fertility rate is one of the leading causes maternal and child mortality (Parnell, 1990). Figure 2.2 shows that the trends of fertility, maternal and child mortality in Lao PDR are moving in the same direction. The average fertility rate was 6 to 6.2 children per woman during 1960-1987 before starting to decline in 1988 (the same period as the beginning of the third stage of demographic transition for Lao PDR), because the Lao government abandoned the pronatalist population policy. Since then, the fertility rates steadily declined to 3.5 children per women in 2008. Along with drops in fertility rates maternal and child mortality rates also sharply decline. Maternal mortality decreased from 1200 to 580 per 100,000 live births during 1990-2008, while infant mortality declined from 141 to 48 per 1000 live births between 1979 and 2009 (World Bank, 2010a).

Figure 2.2: Fertility, maternal and child mortality trends in Lao PDR



Source: World Bank, 2010a

2.4 HEALTH SECTOR IN LAO PDR

2.4.1 GENERAL HEALTH POLICY FRAMEWORK

In line with the goal of the NGPES, which aims to lift Lao PDR from least-developed country status by the year 2020, the Lao government has adopted five-year National Socio-Economic Development Plans (NSEDP), seen as medium-term development plans, as a tool to achieve the country's "Vision 2020". In the latest NSEDP for 2010-2015, health was identified as one of the four priority sectors for development. The main objectives of health sector development policies include reducing urban-rural health differentials; lowering mother and child mortality rates; raising life expectancy and reducing the spread of communicable diseases by increasing prevention; and improving treatment methods in the health sector. The government's basic concepts for health development are: (1) full health care service coverage and health care service quality; (2) development of integrated health care services; (3) demand-based health care services; and (4) self-reliant or financial autonomous health care services. Along with these concepts and objectives, primary health care policy is adopted as a main instrument to increase the population's health standard and the availability of health care (NSEDP, 2010).

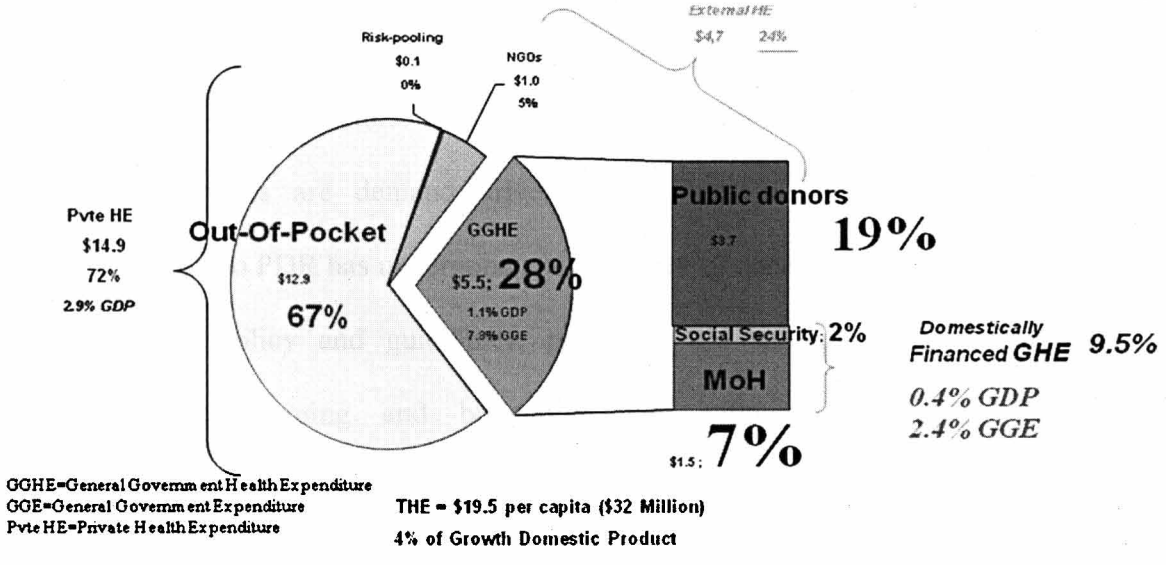
Within the health development framework, the components of primary health care include: expansion education and information about hygiene and proper lifestyles to rural areas and ethnic groups; upgrading the Capacity of Medical workers, with a priority in increasing the number of health personnel working at the village and district levels, and emphasis on the 47 poorest districts; expansion of the primary health care service network to more than 80% of remote and poor villages; promoting maternal and child health through the Maternal and Child Health Centre of the Ministry of Health and its facilities in provinces; adopting immunization as a foundation for primary health care; increasing access to safe drinking water and latrines at schools and in households; controlling communicable diseases such as malaria, dengue, cholera,

tuberculosis and helminthes, through the Global Fund and other financial channels; Controlling HIV/AIDS/STI through surveillance, prevention, care, support and treatment; and developing Village Drug Revolving Funds as a major mechanism to provide at least some curative services for those living in remote areas (ADB, 2007).

2.4.2 PUBLIC HEALTH EXPENDITURE

With only 4% share in GDP Lao PDR has very low total health expenditure compared to other Asian countries, and it is heavily dependent on household payments. Total health expenditure is estimated at USD 19 per capita with 72% paid by personal funds (out-of-pocket money) and 28% paid by general government health expenditures. Of the 28% of government health expenditure portion, 19% come from public donors, while the remaining 7% of total government budget represent only 0.4% of GDP (Figure 2.3). Overall, government health expenditures declined sharply between 1997 and 2005. In 2005, government expenditure on health care was merely 1.9% of the total government expenditure, whereas about 70% (of the expenditure) was spent for salaries (Figure 2.4) (WHO, 2007).

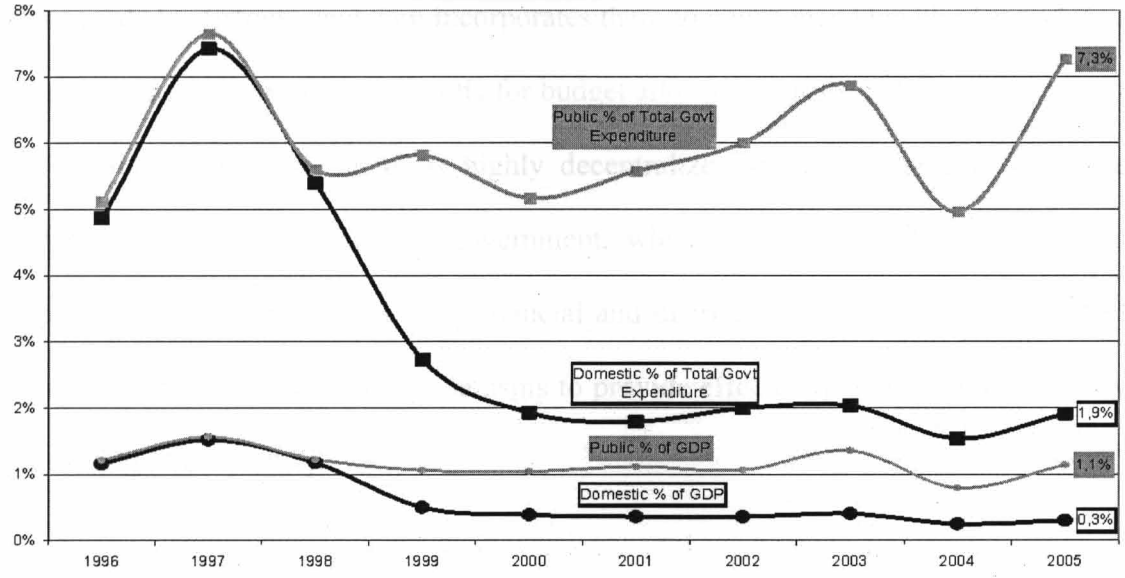
Figure 2.3: Total health expenditures in Lao PDR 2005



Source: Pholsena and Thome, 2009

In terms of sources for general government health expenditure, Lao PDR highly depends on donors' assistance in form of grants and loans. Disease control, investment, training and management/administration are mainly financed by donors as grants and soft loans. In the past five years, the general public health budget was mainly spent on hygiene and prevention (about 45%), curative health services (25%) and administration (recurrent budget) (about 30%) (Pholsena and Thome, 2009).

Figure 2.4: Government health expenditure in Lao PDR 1996-2005



Source: MOH, 2008

2.4.3 PLANNING AND BUDGETARY

Prime Minister Instruction No. 01/PM of March 2000 outlined the principle of decentralization for all sectors. This Instruction aims to increase ownership and to ensure that services are demand driven at the local level. Since then, health management in Lao PDR has undergone a high degree of decentralization. The MOH is responsible for policy and guidelines, provinces are strategic unit, districts are responsible for planning and budgeting, and villages are responsible for implementation (MOH, 2008).

The MOH provides the central level budget for central hospitals, national programs, and their departments, while the Ministry of Planning and Investment (formerly Committee of Investment and Planning) is responsible for drafting the capital budget. At the province level, provincial health officers are responsible for processing the provincial health and budgetary plans. All plans are reviewed by officers designated by the party of the province in order to harmonize the provincial plan with that of the central level before submitting it to the MOH. The provincial health planning and budgetary processing unit starts collecting and revising all the proposed plans made by districts, and then incorporates them to a provincial health plan and then proposes a negotiation with the MOH for budget allocation (ADB, 2007).

Since the health sector is highly decentralized, provinces have to negotiate budgets at several levels in the government, which create major delays in budget implementation. Moreover, at the provincial and district levels, there is a shortage of adequate human resources or mechanisms to provide effective planning and budgetary processing (ADB, 2007).

2.4.4 STRUCTURE AND MANAGEMENT OF HEALTH INSTITUTE[1]

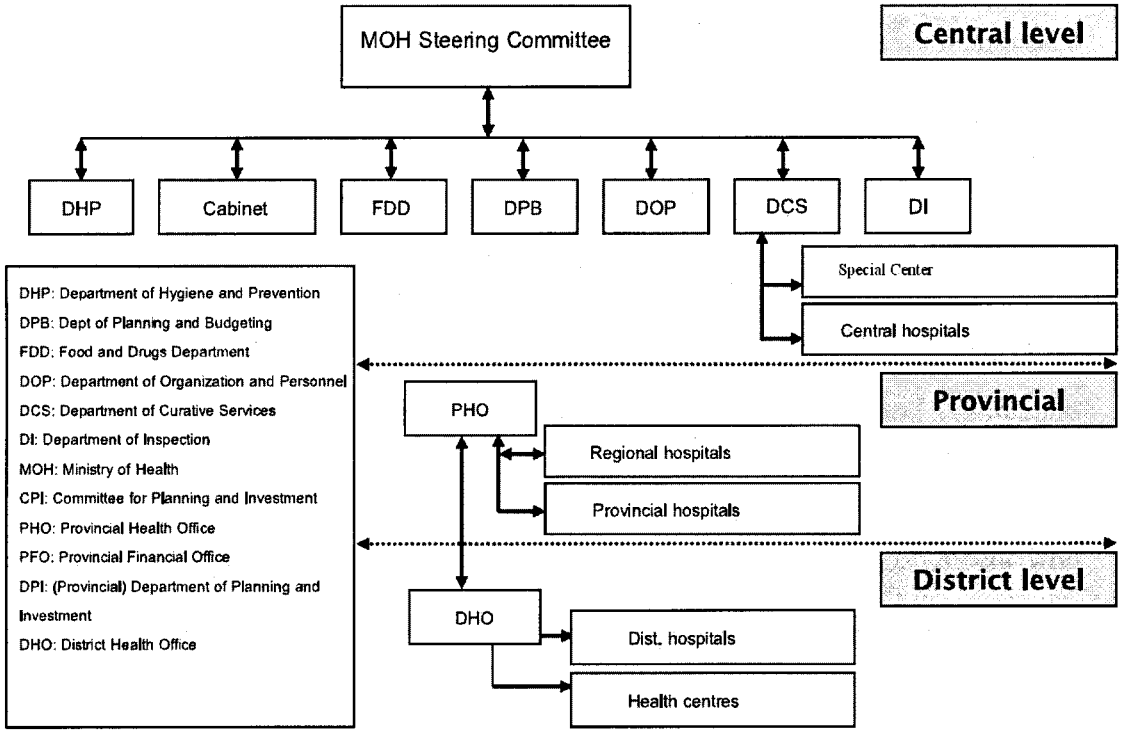
The public health system in Laos is divided according to the fields of (a) Health Care, (b) Prevention, promotion and disease control, and (c) Health management and administration. There are 3 administrative strata in the health system: central level (ministry, college of health technology and reference/specialized centers), provincial level (provincial health offices, provincial and regional hospitals, and auxiliary nursing schools), district level (district health offices, district hospitals and health centers) (Figure 2.5). Nationwide there are 4 central hospitals, 6 special centers, 17 regional and provincial hospitals, 141 district hospitals, 740 health centers, and

[1] This section bases on the final report of LAO: Health sector development reform from ADB (2007)

about 5,000 village drug kits. There are 6,736 hospital beds in the country (MOH, 2008).

Generally, provincial hospitals serve as a second referral level, which covers treatment of more severe and complicated illnesses. They perform major surgery (appendectomies, hysterectomies, laparotomies), as well as general and emergency obstetric care and intensive care of newborns. Pediatrics, some orthopedic services, blood banks and transfusions are available at this level. Moreover, laboratory and diagnostic services at the central level include biochemistry, hematology, urinalysis, parasitology, bacteriology, serology, immunology, and HIV/AIDS/STI testing. ECG and advanced imaging technology (x-ray, ultrasound) are also available.

Figure 2.5: Health organization chart



Source: Pholsena and Thome, 2009

District Hospitals are the first level of the referral system. There are also local training sites for primary health care activities. There exist two types of district hospitals, Type A and Type B. Type A district hospitals provide general and obstetric

surgery, emergency obstetrical care and pediatrics, while Type B district hospitals do not provide general surgery. With regard to quality, there are some district hospitals which have not reached these standard requirements, particularly those situated in remote areas. Most of Type B district hospitals are unable to provide relatively sophisticated clinical functions due to lack of technical skills, personnel, equipment and supplies. Many of the referrals from health centers are therefore transferred to the Type A district hospitals and provincial hospitals. This results in low utilization rates of Type B facilities.

Health centers are health facilities at the sub-district level. One health center covers approximately 8-14 villages. Health centers are also categorized in Type A and Type B. By 2010, all Type A health centers should have a medical doctor in charge, while Type B health centers only have medical assistants in charge. At his level there are also other types of medical staff such as midwives, nurses and primary health care workers. Health centers are expected to provide health education, antenatal care, and safe normal delivery for women without complications, and referral of complicated cases to a district hospital. Health centers provide primary health care services including diagnosis and treatment of simple diseases, disease prevention and health promotion. However, many health centers still lack competent staff and equipment, particularly in rural areas.

At the village level, there are Village Drug Kits and Health Volunteers who have at least 2 weeks training on some basic health care. A Village Drug Kit is a package of 27 items of basic and essential drugs which are provided to the villages guided by Health Volunteers. Health Volunteers are also responsible for disease prevention, health promotion, and treatment of simple common diseases for the population living within their villages.

From 1999 to 2004, the number of health centers increased about 17%. The health network coverage is about 90% of the population with 90 minutes of average

walking distance to a health facility. However, there is a great difference between urban and rural areas; and lowland and highland residences in accessing health facilities. On average, people in urban areas spend only 19 minutes to the nearest health facility compared to 108 minutes for people in rural areas, and residents in lowland areas spend only 48 minutes comparing with 3 hours for highland residents (LECS3). From our field survey, many health centers do not have sufficient Medical Workers or in the worst case there is no worker in that health post at all. This problem occurs partly due to the lack of cooperation between donors and the government, where donors generally prefer to build health facility rather than building human resource. Moreover, the constraint imposed by a quota (personnel) system further limits the number of new Medical Workers. In addition, most of health centers lack means of transportation to transfer patients, who cannot be handled at the health center level, to a higher level health facility.

2.4.5 MEDICAL WORKER FORCES

There are three types of institutions for training Medical Workers (Doctor and Nurse) in Laos. First, the Faculty of Medical and Science of the National University of Laos, the University of Teaching hospital, the National Institute of Public Health (NIPH) and the Institut Francophone pour la Médecine Tropicale (IFMT) provide training for high-level staff. Second, The College of Health Technology in Vientiane provides pre-service training for mid-level Medical Workers, post-basic bachelor degrees for nurses, and English language training for MOH staff. Third, Public Health Schools provide training and education to Mid-level technical nurses, and new primary health care worker cadres. These schools are located in Oudomxay, LuangPrabang, Savannakhet, Champasak and Khamouane provinces (ADB, 2007).

Health professionals are categorized by level and duration of their training. High-level professionals have a University degree, such as medical doctors (7 years of

education), pharmacists (5 years) and dentists (6 years), or have completed a postgraduate academic or professional training. Mid-level professionals have completed 3 years of medical study after graduating from high schools. They include nurses, nurse midwives, assistant pharmacists or laboratory technicians, physical therapists and hygiene inspectors. Medical assistants are also categorized as mid-level professionals. Low-level professionals have completed lower-secondary school, and have studied for 2 years or less in a vocational training program, such as auxiliary nurses, or the new primary health care workers (ADB, 2007).

Over the past 20 years, the number of Medical Workers in Laos has increased slightly. During 1986-2009, Medical Workers increased from 10,679 to 12,422 people (increase by only 16.32% points). This low increase is a consequence of the government quota system. As of 2009, there are 8 professors, 28 associate professors, 754 (6.07%) postgraduates, 2,128 (17.13%) undergraduates, mid-level 4,367 (35.16%) staff, and 5,173 (41.64%) low-level Medical Workers. As for spatial distribution, there are 2,533 workers (20.39%) at the central level, 3,675 (29.58%) workers in provinces, and 6,214 workers (50.02%) in districts and villages (MOH, 2009). The capacity to delivery health services has been much limited and inefficient, because the number and quality of staff have increased at a very low pace, especially the number of low-level Medical Workers in districts and villages.

2.4.6 COST AND PRICING FOR HEALTH CARE[2]

From 1975 to1996, the cost of utilizing healthcare services for Lao citizens in public health facilities was entirely covered by the government. However, because of budgetary constraints, healthcare services during that period were much limited and could not be delivered efficiently. Therefore, through Decree No. 52 in 1996 and

[2] This section mainly bases on Lao People's Democratic Republic: Health financing reform and challenges in expanding the current social protection schemes by Pholsena and Thome (2009)

Decree No. 230 in 1997, the government introduced user fees for specific services and established Revolving Drug Funds. Under this new policy, people using health services in a public health institute were charged for medicines and supplies. The fees for medicines and supplies included a 25% markup on the cost of medicines and supplies in order to cover the associated costs of drugs and medical supplies of the healthcare facility. After the adoption of this policy, medicine fees were regarded as the only income source of public health institutes. Hence, in reality the markup cost for drugs and medical supplies was about 40%, and patients were over-prescribed and given unnecessary drugs. In 2005, under Decree PM381, public health sectors are allowed to charge patients for drugs, medical supplies and all services (Pholsena and Thome, 2009). Patients tend to have more burdens on cost of utilizing healthcare services, especially the poor. According to Schwartz and Viravong (2006), among the households in the poorest quintile 34% sold possessions and 29% borrowed from relatives to pay for healthcare, compared to 5% and 7% in the highest quintile, respectively.

In order to overcome potential problems that may occur in the health sector, the government is starting to implement social protection mechanisms, including establishment of the Social Security Organization, the Civil Servants' Scheme, Community-based Health Insurance, and Health Equity Funds. Especially, the Health Equity Funds target the poorest households and communities to provide free healthcare. Even though the Health Equity Funds are currently under pilot-testing, still there are various challenges, such as the question on how to identify the real poor households in the village, etc.

The Social Security Organization (SSO): this social security scheme covers salaried employees. The employers shall contribute 5% and employees shall contribute 4.5% of their monthly salary but no more than the maximum amount of 1,500,000 kip (USD 1=8500kip). The members of SSO can utilize ambulance service and admission

to hospital without limitation of services (except for injury from accident and cosmetic purpose). The members have to pay an additional amount of 65,000kip each time they use the service.

Civil Servants' Scheme: it covers civil servants and their spouse and children. Monthly they have to pay 4% of their salary and the government additionally contributes 4%. The service ranges are similar to the SSO.

Community-based Health Insurance (CBHI): The CBHI is designed for self employed workers. It is now in the phase of pilot testing. The management policy includes: affordability for majority people; coverage for all family members; same benefits as SSO with referral system to hospital; payment made by capitation; daily response operation by management committee; and dependency of overall policy on MOH Health Insurance Committee.

Health Equity Funds (HEF): the HEF is designed to help the poor gain access to health care services. The target members of the HEF are those who cannot afford the cost of other social security schemes. The main purposes of HEF are: to protect the poor from new health care service charge system; to reduce expenses for health care of the poor; to help the poor gain access to health care services; and to encourage the poor to use public health services. The members of HEF must be identified as the poor in their district which is difficult to identify and maybe biased. Currently, the HEF is still in its pilot testing phase.

CHAPTER THREE
DETERMINANT OF FERTILITY: ROLE OF MATERNAL EDUCATION

3.1 INTRODUCTION

Fertility has first begun to decline in developed countries and now it is also declining in developing countries (Schultz, 1980). Fertility has been studied since the 19th century in order to find patterns of reproduction, because declining rates in fertility have positively affected development, such as human capital and child's health, especially in developing countries. Because mother and child's health tend to be improved while child's schooling tends to be increased in a family with fewer members (Schultz, 2008).

In the case of Lao PDR, the health sector continues to be one of the top priorities in the National Growth and Poverty Eradication Strategy. Over the past decade, health indicators of maternal and children's health have been continuously improved. However, the maternal mortality rate of 410 per 100,000 births and the under-five child mortality rate of 61 per 1000 live births are considerably high when comparing with other countries in the region (UNCIEF, 2010). The evidence in the literature has shown that high fertility is a leading cause of maternal and child mortality (Parnell, 1990).

Although the fertility rate in Lao PDR has declined to the same degree as other developing countries, its rank (2nd in ASEAN and 63rd in the world) is still considered among the groups of higher rates (UN, 2010). On the other hand, for a small population like Lao a moderate fertility rate would contribute to the expansion of labor forces, market and overall economic growth, if to certain extent the quality of human resource and human capital can satisfy the requirements in modern society. However, the most serious counterargument against high fertility is the persistent mass poverty and the

lack of adequate health services for mothers and children, especially those living in rural areas. According the Lao Reproduction and Health Survey 2005 (LRHS-2005), about 90% of women in rural areas and 50% of women in urban areas deliver at home, which implies a considerable risk factor for maternal and child mortality in the country.

Notwithstanding its importance, research studies on fertility for Lao PDR are still sparse. However, knowledge on fertility and its determinants is indispensable for enhancing maternal and child health. In particular, the impact of mother's education and child mortality on fertility could be one channel to improving education and health. In order to fill this study gap, this chapter analyzes the determinants of fertility focusing mainly on the impacts of child mortality, parents' educational levels, knowledge of contraceptive methods, household wealth, job specification and regional differences on fertility of Lao women aged between 15 to 49 years old. The investigation is mainly based on the data from LRHS-2005.

3.2 LITERATURE REVIEW

3.2.1 TREND OF FERTILITY IN THE WORLD

According to Schultz (2002), the demographic transition is divided into 3 stages. In the first stage, there are high birth rates and death rates which highly fluctuate with shocks such as disease outbreaks and crop failures. In this period, there is not much difference between birth rates and death rates. For fertility, there is no family planning for controlling fertility, thus the birth rate is determined by the ability of women's child bearing. In the second stage, the transition occurs when there is a sharp decline in mortality, and an increase in population with improvement of life expectancy. Life expectancy increases from 30-35 years to 70-75 years when the transition occurred in the current high income countries, while rising from 25-30 years to 45-73 years in low income countries. For the third stage, there is a steady and large

decline in fertility rates as a result of population stability. In this stage, generally the fertility rate reduces about more than half from the previous stage.

According to history, demographic transition first occurred in developed countries in 1750, and then in low-income countries during the 1920s when mortality rates sharply declined (Schultz, 2009). Fertility started to decline during the end of the 19th century in high-income countries and during the 1970s in low-income countries (Schultz, 2002). From the early 1950s and 2009, the world total fertility rate has declined from about 5.0 to 2.5 births per woman while the total fertility rate in Asia has also dropped from 5.7 to 2.3 births per woman (UN, 2010).

There are many frameworks that attempt to explain the cause of decline in fertility. One hypothesis assumes that demand for children depends on the value and cost of children (Bulatao, 1984). Becker and Lewis (1974) propose the concept of interaction between children quality and quantity by assuming that demand for children quality is higher than children quantity when a family's income increases. Moreover, Caldwell (1976) argues that the demographic transition occurs because of the direction of wealth flow between parents and children have changed. He asserts that in a primitive society, wealth flows from children to parents whereas in modern or industrial based societies wealth flows go from parents to children. In addition, the economies based on agriculture have higher fertility since young children have to engage in household and agricultural works (Harris, 1989). Therefore, the fertility rate decreases when economies move towards industrialization. In the second hypothesis, parents adjust fertility rates according to the level of the infant mortality rate occurring in their society (Matthiessen and Mccann, 1978; Sanderson and Dubrow, 2000). Over the past decade, the fertility rate has substantially declined in many countries as a result of a reduction in child mortality worldwide. The last explanation of decline in fertility is that it is a result of the increasing empowerment of women. The rate of women's participation outside the family in the wage labor force has increased in many countries

(Schultz, 1990), which results in lower fertility because women have less time for child bearing.

3.2.2 DETERMINANTS OF FERTILITY

From the large and growing literature on fertility, mother education has played an important role for the decline in reproductive rates (Benefo and Schultz, 1996; Bongaarts et al., 1984; Osili and Long, 2007). This happens through the concept of opportunity cost. Mincer (1963) asserts that an increase in women's wages creates greater opportunity cost to women which discourages them from having children. Women with a higher education level has a greater opportunity cost on child bearing (Schultz, 1974). In addition, educated women tend to be more open minded to modern social norms and family planning. Education also gives women more power to bargain the number of births within the family (Dreze and Murthi, 2000). Using cross-sectional data, Benefo and Schultz (1996) find that a mother's educational level above primary school has a significant impact on lowering fertility in Cote d'Ivoire and Ghana. This reverse relationship can also be found in Vietnam (Nguyen-Dinh, 1997), in Indonesia (Breierova and Duflo, 2004), in Philippine (Bautista, 2007) and in Columbia (Gamboa and Ramirez, 2008). Generally, the difference in fertility rates among women who have least education and those having the highest education level are about 0.5 children (Cochrane, 1983).

Child mortality has a positive relation with fertility. It induces mother to have more children to replace dead children. In addition, in some regions, where the mortality rate is stable or has slowly declined for a long period, parents tend to have fewer children because they adjust their demand for children according to level of child mortality they will face (Schultz, 1980; Benefo and Schultz, 1996). Moreover, the mother who has experienced child mortality has higher fertility because she has a shorter birth interval comparing with mothers who have not experienced child

mortality (Randall and Legrand, 2000).

On the other hand, the relationship between fertility and household income is still controversial depending on countries and region. According to household income hypothesis, increased income induces increased fertility because having children is viewed as a household consumption (Blake, 1968). For instance, a family's permanent income has a positive effect on fertility in Cote d'Ivoire while it affects fertility negatively in Ghana (Benefo and Schultz, 1996) and Jamaica (Handa, 2000). Children might be valued as normal good or inferior goods for the family. Wealthier families tend to want more children if children are viewed as a normal good for the family. However, if parents consider having children as a quantity-quality tradeoff, higher income families tend to have fewer children because they tend to invest in children's quality rather than increasing the number of children (Becker and Lewis, 1974). Nguyen-Dinh (1997) finds that men's educational level, as a proxy of household income in Vietnam, has negative impact on fertility. This same impact is also found in the Philippines (Bautista, 2007).

Women's age and age at marriage have a positive relation with fertility. Mothers who marry at a younger age tend to have more children than women who marry at an older age since younger married women have earlier to exposure and a longer period for child bearing (Mohammad, 1985). In terms of urbanization, there is a belief that urbanization has contributed to reducing fertility because child labor is less likely to be required for household production in urban areas. Moreover, women in urban areas have better accessibility to the use and information of modern contraceptive methods compared to women in rural areas. Contraceptives are considered an important factor influencing the decline of fertility (Balatao, 1984). However, the usage of modern contraceptives still varies among countries and regions.

According to the literature, there are endogeneity problems concerning unobserved variables that correlate with parental education such as parents' ability and

family background (educational level of parents' family and family's wealth). There is a concern that girls might have less opportunity to study than boys because of family background (Breierova and Duflo, 2004, Schultz, 2009). Wolfe and Behrman (1987) argue that there is no effect of mother's education on fertility and child health after controlling for mother's family background. In addition, a possible endogeneity problem concerning child mortality and fertility is addressed in the study of fertility and child mortality in Cote d'Ivoire and Ghana. Instrumental Variables (IV) is used to overcome this problem (Benefo and Schultz, 1996). High rate of child mortality can increase fertility because of died-child replacement mechanism of parents. On the other hand, high fertility might induce high child mortality because having more children means having higher risk of child mortality.

3.3 FERTILITY AND THE EDUCATIONAL SITUATION IN LAO PDR

3.3.1 FERTILITY SITUATION

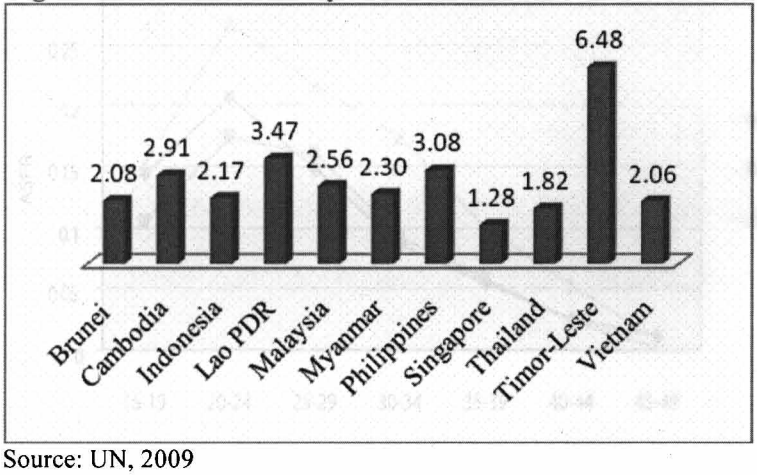
Before 1988, the Lao government had a pronatalist population policy and any distribution of any contraceptive was illegal because the Lao government believed that Lao PDR still had a low population per area. However, after facing massive poverty problems and high fertility being identified as one of the major causes of poverty and poor health, especially for women and children, the Lao government approved birth spacing by legalization of the sale and distribution of contraceptives as an instrument for improving maternal and child health. In the 1990, Ministry of health started to provide birth spacing services but the service was still limited and in 1995, the Lao government officially adopted birth spacing policy and later on changed the name to "family planning" policy.

The population of Lao PDR has reached 5.6 million, and has a natural growth rate of 2.5 percent. Lao PDR has a young population structure with about half of the total population under the age of 20. The average household size is 5.9 persons and

about 10% of household heads are women (NSC, 2005a). The Total Fertility Rate (TFR) has been steadily declining during the past decade. During 1990-1995, TFR dropped from 6.4 to 5, and it is continuing to fall to 4.8 and 4.5 in 2000 and in 2005, respectively (LRHS-2005). Comparing with other Southeast Asia countries (Figure 3.1), Lao PDR ranks 2nd highest fertility rate per women after Timor-Leste (UN, 2010).

Even though fertility in Lao PDR has substantially declined over the past decade, there are differences in fertility rates among urban and rural areas, geographical regions, and mothers' educational levels. In Figure 3.2, the highest fertility rate is found among uneducated women (5.43 children/mother), rural areas without roads (4.74) and in Southern region (4.84). The lowest fertility is 2.02 for mothers with upper secondary education, and 2.04 for mothers in Vientiane Capital (LRHS-2005).

Figure 3.1: Total fertility rates in selected countries in Southeast Asia, 2008

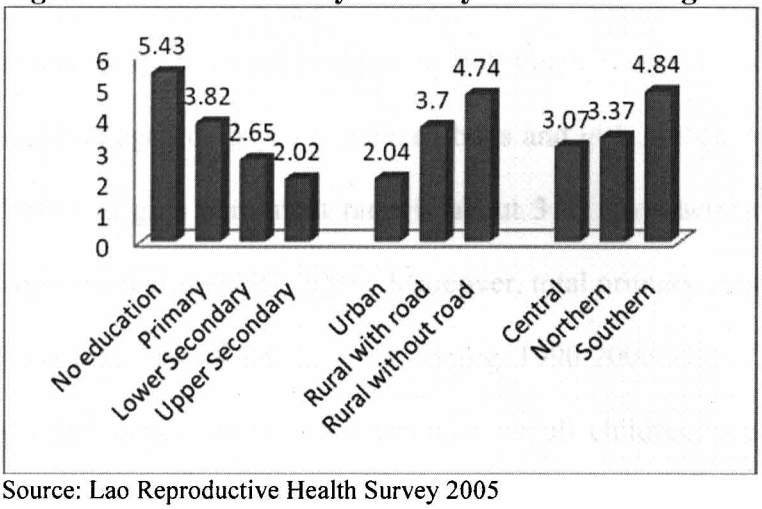


Source: UN, 2009

In terms of Age specific fertility rates (ASFR), comparing among three regions, women in Southern region have higher ASFR and start child bearing slightly earlier than Northern and Central regions. The peak child bearing age for all regions is between 20-24 years old and it decreases significantly after the age of 30. The median length of birth interval is 34 months. Interestingly, the early child bearing age among married women in Lao PDR is relatively high. About 10 percent of women have given

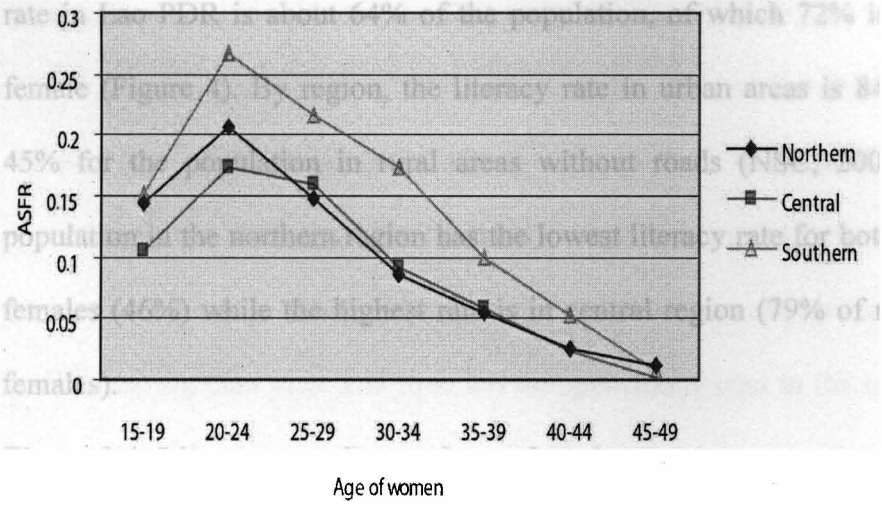
birth before the age of 15 years old, while 37% had not given birth before age 18. At the age of 25, four fifths of married women have already had their first birth (NSC, 2005b).

Figure 3.2: Total Fertility Rates by women's background and characteristics



Source: Lao Reproductive Health Survey 2005

Figure 3.3: Age specific fertility rates (ASFR) by region



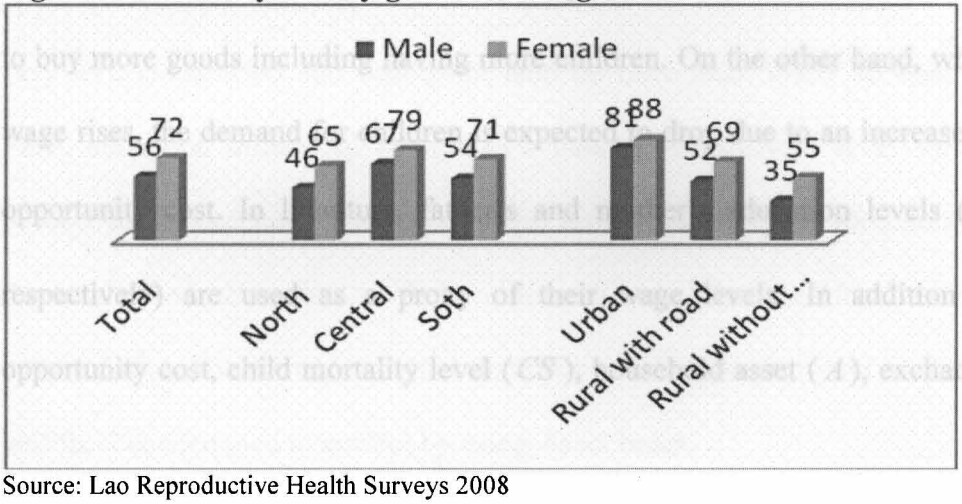
Source: Lao Reproductive Health Survey 2005

3.3.2 EDUCATION SITUATION

The education system in Lao PDR consists of preschool (age 3 to 5), five years of primary education, three years of lower secondary school education, three years of upper secondary school education, one to three years of vocational/technical education, and four to six years of university education, depending on majors.

Comparing between 2002 and 2008, the number of primary schools and lower secondary schools in villages raise about 10% which are 89% and 18% respectively (NSC, 2008). Since 1990, education has been dramatically improved. Net primary enrollment has also substantially increased for both males and females from 1990 to 2008. It has risen from 57% to 84% for females and 67% to 87.5% for males, respectively. Generally, there is not much difference of net enrollment rates for children aged 6-15 years between boys and girls. In the north, the difference between boys and girls enrolment rates is about 3 to 5% where it is about 4% in central and southern region (NSC, 2008). Moreover, total primary completion rate has significantly increased from 46% to 75% during 1990-2006 (UN, 2008). However, access to primary education is not guaranteed for all children, especially for girls in minority ethnic groups, delayed enrollment and grade repetition rates remain very high. In terms of literacy rate, there is still a lot of difference between gender and region. The literacy rate in Lao PDR is about 64% of the population, of which 72% is male and 56% is female (Figure 4). By region, the literacy rate in urban areas is 84%, while the only 45% for the population in rural areas without roads (NSC, 2008). Moreover, the population in the northern region has the lowest literacy rate for both males (65%) and females (46%) while the highest rate is in central region (79% of males and 67% for females).

Figure 3.4: Literacy rate by gender and region



Source: Lao Reproductive Health Surveys 2008

3.4 THEORETICAL FRAMEWORK, EMPIRICAL MODEL AND DATA DESCRIPTION

3.4.1 THEORETICAL FRAMEWORK

Fertility is determined in a dynamic environment of human lifecycle. Parents look beyond their current condition in deciding the number children they would like to have. They consider both the cost of having children, which would incur at present and in future, and the merit they will receive in future. In other words, the rationale for determining fertility relates to the assessment of future benefit in the current condition. For example, farmers in developing countries would consider having more children a source of labor for agricultural production in future. Also, in the absence of an appropriate social security system, children are considered life security for their future, especially after retirement. Hence, demand for children varies greatly among urban and rural households. Specifically, the fertility rate in rural areas is usually higher than that of urban families. In addition, the fertility rate depends on family characteristics, such as education level, wealth and the like, and preferences.

According to Schultz (1973, 1981) and Benefo and Schultz (1996), demand for children (F) depends on both father's and mother's wage through the concept of opportunity cost. Generally, the husband's wage is assumed to be family income and the mother's wage is assumed be the price variable, because women spend more time on childrearing than male and time has an opportunity cost in the market place. When income rises, the demand for children is expected to increase, since family can afford to buy more goods including having more children. On the other hand, when mother's wage rises, the demand for children is expected to drop due to an increase in mother's opportunity cost. In literature, father's and mother's education levels (E_f and E_m , respectively) are used as a proxy of their wage levels. In addition to parents' opportunity cost, child mortality level (CS), household asset (A), exchange prices of

commodity at local market (P), and access to public services (G) also affect the fertility level. The demand for children used in this chapter can be written as:

$$F = f(E_f, E_m, CS, A, P, G)$$

3.4.2 EMPIRICAL MODEL

From the theoretical framework above, we have the reduced form of fertility function as follows:

$$CEB = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_9 x_{10} + \beta_9 x_{11} + \beta_9 x_{12} \quad (1)$$

where CEB is the number of children born which is used as a proxy of fertility or demand for children (F); x_1 and x_2 are women's age at married and women's age; x_3 and x_4 are men's and women's educational level; x_5 experiencing of child mortality; x_6 is contraceptive knowledge; x_7 is the number of Medical Workers in the district; x_8 and x_9 are dummies of men's and women's jobs; x_{10} is the dummy of rural area; and ; x_{11} is the dummy of region.

With respect to the endogeneity problem of parents' unobserved variables such as family background and ability, the problem concerning education of parents' family is considered very minor or even non-existent in the Lao PDR context. After the war, very well constructed and well-to-do families have most likely escaped the country. Thus, education influenced by mother's parents' educational level would not exist because most households have a very short history, especially in rural areas. In addition, the level of education in Lao PDR is deemed very low. Therefore, the difference in terms of education is very marginal. In terms of family background respect to family's wealth, it is attempted to control by using Asset Index.

Regarding possible endogeneity problem between fertility and child mortality, this analysis applies two procedures to deal with the problem. First child mortality is treated as exogenous and used as normal independent variable without using Instrument Variable (IV) method. The results from this model serve as the main findings in this Chapter. Second, in view of providing persuasive statistical inferences attempts have been made to apply the IV method to the empirical analysis by using access to safety water and type of toilet as instrumental variables, because these two variables closely relate to child mortality, while a relation with fertility is practically absent.

For the analytical method in Equation (1), the OLS and 2SLS method are applied to estimate the explanatory variables on the number of children born to a mother.

3.4.3 DATA DESCRIPTIVE

3.4.3.1 STATISTICAL DATA

Statistical data used for the empirical analysis in this Chapter is obtained from the Lao Reproductive Health Survey 2005, which was conducted from March 2004 to February 2005 by the National Statistics Centre (NSC) with the support of UNFPA. The LRHS-2005 sample was made up of 10218 married women aged between 15-49 years covering all 17 provinces. It provides information on household conditions, reproduction, mortality and socio-economic background.

Upon removing incomplete samples, the econometric analysis is based on 8,689 observations covering roughly 85% of the original number, which is considered a very high ratio by any standard. Therefore, this sample size is deemed sufficient for analyzing the determinants of fertility. The definition of each variable is presented in the next section.

3.4.3.2 VARIABLE DEFINITION

- CEB is the number of children born alive. This number accounts for all the children who were born alive and later died, children who are living with or living elsewhere of the sample women (range from 1 to 15 children).
- Women's age at married is the age of the sample at the time of getting married. This variable is expected to have a positive correlation with fertility and that the younger the age of the sample at marriage, the higher the rate of fertility will be. It is used as a proxy to control biological endowment.
- Women's age is the current age of women in the sample. The age of women is categorized into 5 age groups (15-24; 25-29; 30-34; 35-39; 40-49) in order to control impact of each age range on fertility level. It is used as a proxy of biological endowment. This variable is expected to have positive effect on fertility because older women tend to have given birth to a higher number of children.
- Men's and Women's educational levels are the highest educational levels of the samples. This variable is used as a proxy of parents' opportunity cost. The educational levels are divided into 5 categories which are: No education, Have some primary educational level; Completed primary school level, Have lower secondary school level, and Have upper secondary school level or higher. The sign of women's educational level is expected to be positive because a higher education means a higher opportunity cost. Moreover, women with higher education are able to utilized contraceptive information and methods more effectively. On the other hand, the sign of men's education is controversial because it is used as proxy of household income. Thus the fertility level depends on the perspective of men on a value of the children.

- Experiencing child mortality is a dummy variable and defined as 1 if a woman has experienced child mortality and 0 otherwise. From the well documented literature, this variable is expected to have positive correlation with fertility because of the replacement effect.
- Contraceptive knowledge is a dummy variable and defined as 1 if a woman has ever heard about any modern contraceptive method and 0 otherwise. This variable is used to capture the impact of contraception on fertility.
- The number of Medical Workers in a district is number of Medical Worker in the district where a woman lives. This variable is used as a proxy of government health public service.
- Dummy of men's and women's jobs are dummy variables of husband and wife and defined as 1 if a man or woman has wage earner job and 0 otherwise.
- The dummy of rural is defined as 1 if a woman lives in a rural area and 0 otherwise.
- Region is a dummy variable used for identify which regional a woman lives. It is classified into 3 regions: Northern region, Central region, and Southern region.
- Asset index is used as a proxy of family nonhuman capital wealth to control family's wealth (which is one of family's backgrounds). It is categorized into 5 quintiles. Because most Demographic Health Surveys (DHS) lack income and consumption data, there is an introduction of Principal Component Analysis (PCA) to construct an index based on the selected variables from DHS data to be used as proxy for household wealth (Filmer and Pritchett, 2001).

However, this method has been criticized for being not appropriate for categorical variables (Booysen, Maltitz, and Rand, 2007). Therefore, by using LRHS-2005, the Asset Index in this Chapter is constructed based on the Polychoric PCA method in Table 1. Polychoric PCA is more appropriate for

categorical data and its coefficients are more accurately estimated (Moser and Felton, 2007).

The asset index used in this analysis is calculated as follows:

$$C_n^i = \sum_{j=1}^{J} w_t^{i,j} a_n^{i,j}$$

Where C_n^i is i type capital index (Asset index) of household n,

$a_n^{i,j}$ is type j of asset a^i from household n which a is measured by a binary, ordinal, or cardinal variable.

w is the weigh assigned to each type of asset (a). w is calculated by means of Polychoric PCA.

The variables are used for construct the asset index in this Chapter includes: having a radio, television and a newspaper subscription, the type of drinking water sources and toilet, the type of source for electricity and cooking heat, and roof, wall, and floor material for houses (see appendix, Table A 3.1).

3.4.3.3 MAJOR CHARACTERISTICS OF THE SAMPLES

The variables for empirical analysis are calculated and compiled from LRHS 2005 data applying the definitions in the previous section. Table 2 presents the means and standard deviations of certain variables.

On average, CEB are 3.5 children per mother. Women with no education have the highest rate of children (3.9 children per mother) while mothers with upper secondary school and higher educational levels have the lowest rate of children (2.2 children per mother). There is not much difference between CEB among regions. The highest CEB is found in the South (3.7 children per mother), while it in is about 3.4 per mother Northern and Central regions.

About 15% of samples have experienced under-five child mortality. 90% of samples have heard of modern contraceptive methods. The average number of Medical Workers is 43 people per district. About 86.2% and 90.6% of men and women, respectively, are self-employed worker. The average age of married is 19.5 years and the average age of women is 32.6 years.

With respect to educational level, women's year of education is 3.4 years, on average. About 32.6% of married women have no education, while 27% could not finish the primary level. Men's educational level is 4.7 years and 20% have no education, while about 24.3% have only some primary educational level, on average.

Table 3.1: Basic characteristics of variables in fertility analysis

Variable	Obs	Mean	Min	Max
CEB (Total number of children ever born alive to a woman)	9395	3.508	1	15
Women's age at first married	9395	19.575	10	44
Women age (Year)	9395	32.692	15	49
Women's education (year)	9395	3.407	0	11
No education	9395	0.326	0	1
Some priamry (1 - 4 years)	9395	0.271	0	1
Complete primry school (5 - 7 years)	9395	0.258	0	1
Complete lower secondary school (8 - 10 years)	9395	0.100	0	1
Complete upper secondary school and higher (11 + years)	9395	0.044	0	1
Men's education	9395	4.706	0	11
No education	9395	0.203	0	1
Some priamry (1 - 4 years)	9395	0.244	0	1
Complete primry school (5 - 7 years)	9395	0.293	0	1
Complete lower secondary school (8 - 10 years)	9395	0.150	0	1
Complete upper secondary school and higher (11 + years)	9395	0.110	0	1
Experiencing under-five mortality	9395	0.148	0	1
Heard of modern contraceptive method	9395	0.910	0	1
Number of health worker in a district	9395	43.076	6	113
Wage-earner jobs (Men)	8865	0.138	0	1
Wage-earner jobs (Women)	9395	0.044	0	1
Rural areas	9395	0.795	0	1
Norther region	9395	0.401	0	1
Central region	9395	0.379	0	1
Souther region	9395	0.220	0	1

Source: Author's calculations, data from LRHS-2005, National statistical Centre, Lao PDR

3.5 EMPIRICAL RESULTS

The empirical analysis consists of six cases. The first three cases show the analysis of fertility in all areas and separately between urban and rural areas. The remaining three cases compare the situation among northern, central, and southern regions. Equation (1) is estimated by using OLS regression and the results are summarized in Table 2 and 3.

On average, education is found to have a strong negative impact on fertility. Less educated women have more children (reference group). Women, who have some primary education, completed primary level, lower secondary, and higher education, are likely to have fewer children by 0.23, 0.41, 0.49 and 0.53 respectively as educational level rises. This finding emphasizes the importance of basic education in Lao PDR. Only some primary educational level has already had some impact on reducing fertility, while it has been found that women would need to finish at least the primary level in Cote d'Ivoire and Ghana (Benefo and Schultz, 1996) and secondary school level in Vietnam and the Philippines (Nguyen-Dinh, 1997; Bautista, 2007) if education is to exert any impact on fertility. Also, the magnitude of the impact of women's secondary education is higher in Lao PDR (coefficient of 0.5) than in Vietnam (0.1) and the Philippines (0.4). The magnitude of the impact of education on fertility appears to be stronger at higher levels of education. This might be attributable to two main reasons.

First, due to the lack of a non-farm labor market, women who have only some primary and completed primary education may face many disadvantages in finding a wage-earning job. About 57% of women with a completed lower secondary level or higher can find a non-farm job, as compared with 22% of women with a completed primary or less do so (LRHS-2005). Second, mothers with higher education would be able to use health information, such as contraceptive methods, to avoid unwanted pregnancy more effectively.

Comparing between urban and rural areas, the result shows that women with some primary education in urban areas have no impact on fertility reduction while all educational levels still have strong negative correlation with fertility. This is attributable to the fact that there are more wage-earning jobs available in urban areas. When comparing among regions, education has a weaker negative effect on fertility in the South. Comparing uneducated women with educated women, the only effect on a decline in fertility is for women who complete primary school. Moreover, among the three regions, mother's education in the central region tends to have higher magnitude of negative impact on fertility. The reason behind this is that the central region has a higher proportion of wage-earner mothers and more wage-earning job availability than other regions.

Overall, family income tends to have a strong positive effect on fertility in Lao PDR. It is shown through the strong positive impact of husband's educational level and men with wage-earning jobs on fertility. Men with some primary education and completed primary education[3] have higher fertility comparing with uneducated men at the country level (by 0.12 and 0.17 respectively), rural areas (0.13 and 0.18 respectively) and the Northern region (0.28 and 0.33 respectively), while men with wage-earning jobs also have statistically positive significant correlation with fertility at the country level, urban areas and Northern region by 0.08, 0.19 and 0.17 respectively. Interestingly, this finding contradicts previous studies on fertility in Vietnam (Nguyen-Dinh, 1997) and Philippine (Bautista, 2007). This may come from the fact that the cultures of people in Philippine and Vietnam are completely different from the culture of Lao people even though Lao PDR and Vietnam are neighbors. The positive relation between family income and fertility lends support to Benefo and Schultz (1996) and Handa (2000). This finding also shows that men in the North want to have more

[3] This finding is consistent with the finding of Onphanhdala (2009, 2010) about the productivity of farmer in Lao PDR. He finds that farmer with some primary and complete primary school educational level has higher agricultural productivity comparing to other educational level.

children when the level of income increased. The assumption behind this is due to most husbands in the samples are farmers (90%) and the result from our field survey showed that farmers tend to buy more land in order to increase production when their income levels increase. Moreover, due to the geography of agricultural land being in upland areas, the amount of labor can significantly influence agricultural productivity compared to other regions, which are mostly lowland areas and have a lower demand for children because machines can be more efficiently utilized.

In general, experiencing child mortality has a strong positive correlation with fertility. This positive impact lends support to previous literature, such as Schultz (1980) and Benefo and Schultz (1996). However, in this case it is difficult to point out the causality between child mortality and fertility due to endogeneity problem. Women with experience of child mortality in urban areas have a smaller coefficient compared to their counterparts in rural areas. In terms of regional difference, the highest negative coefficient of experience of child mortality correlate with fertility is found in the North and in rural areas. The assumption behind this is that child mortality rates in rural areas and northern regions are relatively higher than urban areas and other regions (LRHS-2005).

Knowledge of contraceptives has negative correlation with fertility, but is not statistically significant. Interestingly, when comparing among regions, however, knowledge of contraceptives is statistically significant with a decline in fertility in the South even though the usage rate of contraceptives is lowest (22.8%) compared to the Northern (33.8%) and Central (42.6%) regions (LRHS-2005). Women who have heard about modern contraceptives in the Southern region have fewer children than women who have not heard of any method of modern contraceptives by 0.3 children at the 5% statistical significance. On the other hand, the number of Medical Workers has no impact on fertility in any cases.

Mother's age and her age at first marriage have a strong positive effect on

fertility for all age groups. Compared with women aged 15-24 (reference group), fertility increases significantly in each age group. The cause for such an impact is that CEB is a cumulative measure of fertility, i.e. it is the number of children ever born alive to women at the time of the survey. Thus, women at a higher age would generally have more children than those who are younger.

In terms of family's wealth, Asset Index tends to have a negative correlation with fertility in the Lao PDR. By comparing with the 20% lowest asset-group, households belonging to the 3rd, 4th, 5th asset index quintile group tend to have lower fertility in rural areas, the Northern region, and Central region. This means that a wealthy family tends to have fewer children.

Table 3.2 and Table 3.3 also show results of the estimation using IV method by assuming that accessibility to safe water and usage of toilet as instrument variables to overcome endogeneity problem between fertility and child mortality. After running the Hausman test, the null hypothesis of child mortality being exogenous cannot be rejected [Chi-square (25) =1.23]. The regression results from the Two Stages Least Square (2SLS) are consistent with those of the OLS analysis. Interestingly, the striking difference between the OLS results and 2SLS coefficients lies in the impact of child mortality on fertility. More specifically, from the 2SLS results under-five child mortality does not seem to be associated with fertility in urban areas, while such impact is significant in rural areas and nationwide. This is finding is attributable to the fact that child mortality in rural villages is higher than that of urban areas, which would constitute a rationale for having more children for replacement, particularly for labor-intensive agricultural production. Generally, the effect of women education remains strong except for urban areas. Women's education in urban areas becomes statistically insignificant, while the impact of women education on fertility in rural areas, Northern region and Central regions remain strong. This can imply that women's education has a direct effect on the fertility level. At country level, the positive impact of men's

education on fertility becomes statistically insignificant. On the other hand, the degree of men's educational effect in the Northern region is getting larger. For other variables, such as mother age at birth, mother age, wealth index and regional dummies, the coefficients are only slightly different from those of the OLS results.

Table 3.2: Fertility at national level, the difference between urban and rural areas

CEB (Total number of children)	Total (b/t)		Urban (b/t)		Rural (b/t)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Women's age at first married (years)	-0.109***	-0.098***	-0.1***	-0.067***	-0.111***	-0.103***
	(-18.37)	(-7.74)	(-8.23)	(-1.8)	(-16.51)	(-8)
Women's age 15 - 24 (Base category)						
25 - 29 years	1.002***	0.96***	0.737***	0.595***	1.038***	1.009***
	(27.44)	(16.61)	(10.85)	(3.27)	(25.09)	(17.22)
30 - 34 years	2.066***	1.947***	1.576***	1.284***	2.153***	2.064***
	(46.43)	(15.31)	(20.52)	(4)	(41.71)	(15.79)
35 - 39 years	2.76***	2.587***	2.16***	1.753***	2.883***	2.751***
	(53.64)	(14.36)	(23.97)	(4.1)	(48.06)	(14.75)
40 - 49 years	3.488***	3.247***	2.978***	2.216***	3.591***	3.415***
	(58.43)	(13.22)	(29.44)	(2.88)	(51.08)	(13.93)
Wife's Education (0 year is Base category)						
Some priamry (1 - 4 years)	-0.234***	-0.245***	-0.1	0.036	-0.243***	-0.256***
	(-4.54)	(-4.52)	(-0.65)	(0.14)	(-4.45)	(-4.44)
Complete primry school (5 - 7 years)	-0.412***	-0.367***	-0.306**	-0.146	-0.415***	-0.383***
	(-8)	(-5.19)	(-2.18)	(-0.57)	(-7.38)	(-5.26)
Complete lower secondary school	-0.491***	-0.412***	-0.363**	-0.109	-0.564***	-0.499***
(8 - 10 years)	(-7.74)	(-4.03)	(-2.51)	(-0.34)	(-7.37)	(-4.24)
Complete upper secondary school	-0.539***	-0.481***	-0.583***	-0.274	-0.373***	-0.34**
and higher (11 + years)	(-6.56)	(-4.58)	(-3.74)	(-0.72)	(-3.04)	(-2.51)
Husband's Education (0 year is Base category)						
Some priamry (1 - 4 years)	0.129**	0.079	0.166	-0.04	0.137**	0.102
	(2.14)	(0.99)	(0.82)	(-0.11)	(2.16)	(1.27)
Complete primry school (5 - 7 years)	0.172***	0.129	0.222	-0.022	0.182***	0.153**
	(2.77)	(1.64)	(1.18)	(-0.06)	(2.77)	(1.96)
Complete lower secondary school	0.053	0.035	0.124	-0.092	0.066	0.057
(8 - 10 years)	(0.78)	(0.47)	(0.67)	(-0.27)	(0.88)	(0.73)
Complete upper secondary school	0.024	-0.01	0.064	-0.269	0.03	0.029
and higher (11 + years)	(0.32)	(-0.11)	(0.34)	(-0.65)	(0.33)	(0.31)
Having child mortality*	1.649***	2.916**	1.395***	6.44	1.677***	2.56**
	(27.85)	(2.34)	(9.68)	(1.28)	(26.08)	(2.19)
Heard contraceptive	-0.112	-0.103	-0.205	-0.633	-0.109	-0.1
	(-1.52)	(-1.36)	(-0.55)	(-0.97)	(-1.45)	(-1.31)
No.health worker	0.001	0.001	0.002	0.002	0.001	0.001
	(1.01)	(1.18)	(0.95)	(0.93)	(0.84)	(0.95)
Wage earner men	0.085*	0.077	0.196***	0.247**	-0.03	-0.047
	(1.68)	(1.4)	(2.86)	(2.02)	(-0.41)	(-0.59)
Wage earner women	-0.17**	-0.152**	-0.244***	-0.228*	-0.077	-0.041
	(-2.5)	(-2.02)	(-2.99)	(1.72)	(-0.65)	(-0.3)
Lowest quintile (Base category)						
Quintile 2	0.013	-0.006	0.007	-0.513	0.015	0.003
	(0.24)	(-0.09)	(0.03)	(-0.74)	(0.26)	(0.05)
Quintile 3	-0.13**	-0.149**	0.408	0.126	-0.162***	-0.175***
	(-2.27)	(-2.36)	(1.49)	(0.26)	(-2.73)	(-2.76)
Quintile 4	-0.295***	-0.27***	-0.045	-0.148	-0.289***	-0.273***
	(-4.92)	(-4)	(-0.18)	(-0.37)	(-4.53)	(-3.97)
Quintile 5	-0.725***	-0.672***	-0.331	-0.279	-0.809***	-0.776***
	(-10.51)	(-7.5)	(-1.3)	(-0.69)	(-10.03)	(-8.23)
Rural	0.157***	0.124**	-	-	-	-
	(3.3)	(2.03)				
Northern (Base category)						
Central region	0.273***	0.33***	0.207***	0.415*	0.288***	0.328***
	(6.98)	(4.88)	(2.87)	(1.74)	(6.31)	(4.78)
Sounthern region	0.362***	0.384***	0.374***	0.347**	0.356***	0.376***
	(8.02)	(7.38)	(4.03)	(2.27)	(7)	(6.39)
Constant	3.522***	3.23***	3.404***	3.109***	3.646***	3.426***
	(21.95)	(9.72)	(6.19)	(3.91)	(18.41)	(9.54)
Observation	8689	8689	1780	1780	6909	6909
R-square	0.491	0.448	0.488	.	0.4852	0.4637

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected t-statistics in parentheses.
3) * significant at 10% level. 4) ** significant at 5% level. 5) *** significant at 1% level.
6) The variable "Having child mortality" is instrumented by access to safe drinking water and access to latrine in 2SLS model

Table 3.3: The difference of fertility among regions

CEB (Total number of children)	Northern region (b/t)		Central region (b/t)		Southern region (b/t)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Women's age at first married (years)	-0.088***	-0.102***	-0.104***	-0.106***	-0.159***	-0.136***
	(-10.04)	(-5.65)	(-9.84)	(-6.88)	(-14.22)	(-6.56)
Women's age 15 - 24 (Base category)						
25 - 29 years	0.972***	1.004***	0.996***	1.005***	1.164***	1.031***
	(16.57)	(14.97)	(16.82)	(14)	(14.87)	(7.71)
30 - 34 years	1.972***	2.121***	1.969***	1.997***	2.5***	2.285***
	(27.18)	(11.77)	(28.57)	(13.13)	(25.41)	(11.54)
35 - 39 years	2.615***	2.819***	2.746***	2.792***	3.139***	2.822***
	(32.32)	(11.79)	(33.39)	(11.59)	(27.08)	(10.27)
40 - 49 years	3.449***	3.739***	3.325***	3.386***	3.925***	3.493***
	(35.64)	(11.12)	(36.51)	(10.86)	(29.38)	(9.69)
Wife's Education (0 year is Base category)						
Some priamry (1 - 4 years)	-0.282***	-0.258***	-0.384***	-0.385***	0.004	-0.009
	(-3.59)	(-2.96)	(-4.17)	(-4.14)	(0.04)	(-0.08)
Complete primry school (5 - 7 year	-0.376***	-0.422***	-0.561***	-0.574***	-0.231**	-0.115
	(-4.65)	(-4.17)	(-6.58)	(-5.35)	(-2.05)	(-0.72)
Complete lower secondary school	-0.499***	-0.593***	-0.65***	-0.666***	-0.242	0.005
(8 - 10 years)	(-4.8)	(-3.99)	(-6.51)	(-5.08)	(-1.64)	(0.02)
Complete upper secondary school	-0.511***	-0.573***	-0.737***	-0.751***	-0.096	0.121
and higher (11 + years)	(-3.44)	(-3.51)	(-6)	(-5.23)	(-0.56)	(0.45)
Husband's Education (0 year is Base category)						
Some priamry (1 - 4 years)	0.282***	0.403**	0.009	0.014	-0.039	0.001
	(3.26)	(2.47)	(0.08)	(0.12)	(-0.31)	(0.01)
Complete primry school (5 - 7 year	0.337***	0.422***	0.038	0.036	-0.015	-0.059
	(3.72)	(3.13)	(0.34)	(0.32)	(-0.11)	(-0.39)
Complete lower secondary school	0.165	0.245***	-0.079	-0.094	-0.081	-0.09
(8 - 10 years)	(1.56)	(1.71)	(-0.69)	(-0.7)	(-0.53)	(-0.54)
Complete upper secondary school	0.183	0.276	-0.071	-0.077	-0.235	-0.219
and higher (11 + years)	(1.39)	(1.59)	(-0.59)	(-0.62)	(-1.39)	(-1.15)
Having child mortality*	1.71***	0.321	1.615***	1.225	1.523***	3.521**
	(20.06)	(0.21)	(14.34)	(0.63)	(12.63)	(2.25)
Heard contraceptive	-0.028	-0.039	-0.203	-0.213	-0.304**	-0.31**
	(-0.26)	(-0.35)	(-1.21)	(-1.24)	(-2.22)	(-2.15)
No.health worker	-0.001	-0.001	0	0	0.003	0.002
	(-0.55)	(-0.45)	(0.28)	(0.13)	(1.13)	(0.79)
Wage earner men	0.174**	0.215**	0.023	0.025	0.078	0.123
	(1.98)	(2.15)	(0.34)	(0.36)	(0.61)	(0.84)
Wage earner women	-0.15	-0.198	-0.185*	-0.189*	-0.165	-0.205
	(-1.29)	(-1.55)	(-1.89)	(-1.87)	(-1.03)	(-1.02)
Lowest quintile (Base category)						
Quintile 2	0.03	0.055	-0.105	-0.09	0.088	0.118
	(0.38)	(0.61)	(-0.98)	(-0.74)	(0.74)	(0.9)
Quintile 3	-0.181**	-0.182**	-0.24**	-0.231**	0.085	0.03
	(-2.19)	(-2.1)	(-2.23)	(-2.1)	(0.68)	(0.21)
Quintile 4	-0.457***	-0.495***	-0.361***	-0.361***	0.034	0.103
	(-5.22)	(-4.84)	(-3.36)	(-3.34)	(0.25)	(0.65)
Quintile 5	-0.674***	-0.746***	-0.772***	-0.786***	-0.72***	-0.679***
	(-6.31)	(-5.41)	(-6.59)	(-5.53)	(-4.25)	(-3.5)
Rural	0.241***	0.308***	0.116	0.124	0.055	0.056
	(3.18)	(2.81)	(1.61)	(1.5)	(0.47)	(0.4)
Constant	3.119***	3.378***	4.145***	4.227***	4.651***	4.076***
	(12.55)	(8.75)	(13.91)	(8.68)	(14.4)	(7.23)
Observation	3484	3484	3304	3304	1901	1901
R-square	0.4842	0.4254	0.4961	0.4926	0.5142	0.4106

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected t-statistics in parentheses.
3) * significant at 10% level. 4) ** significant at 5% level. 5) *** significant at 1% level.
6) The variable "Having child mortality" is instrumented by access to safe drinking water and access to latrine in 2SLS model

3.6 CONCLUSION

Improving maternal and child health is a crucial issue that needs to be addressed if the well-being of the population is to be improved. Healthy mothers deliver healthy children and healthy children have a greater potential to become productive labor force in the future. Thus, both maternal and child health problems have to be solved together.

One factor which is directly related to these issues is fertility. With fewer births, mother's health would not deteriorate and the exposure to various risks would be lower. Also, she would have more time to work to earn extra income to support her family and children. The findings imply that women's education would contribute a great deal to fertility reduction in all areas. Such contributions would occur through many channels, such as increasing mother's wages and the associated opportunity cost and the effectiveness of information utilization. Both mothers and children are exposed to greater risks when giving birth at a very young age. Moreover, educated mothers would utilize health information such as contraceptive method from the government or health organizations more effectively.

In addition, the upward pressure of child mortality on fertility found in the analysis would reflect the rationale of mothers for securing future family labor force and for their own security in retirement age, especially for women in rural areas where a social security system is absent.

Therefore, along with other poverty reduction policies, education at the grassroots level, especially for mothers, and child health care deserve more attention. Moreover, the study also finds that an effect of contraceptives on fertility varies among regions. Therefore, government should consider the differences among regions as an important factor in order to achieve greater efficient family planning policy.

APPENDIX 3 A: Polychoric PCA Score of Asset Index

Table A 3.1: Polychoric PCA score of Asset index

Variable	Categories	Score
Roof	Wood/Bamboo/Grass	-0.3697
	Zinc	0.0905
	Tile	0.5411
Wall	Bamboo	-0.3694
	Wood	0.1249
	Cement	0.5936
Floor	Wood/Bamboo	-0.1253
	Cement	0.5484
	Tile	0.9377
Electricity	No electricity	-0.3380
	Other	-0.0317
	Generator	0.0405
	Share miter	0.0972
	Own miter	0.3728
Cooking heat	Wood/sawdust	-0.0661
	Fuel/Charcoal	0.5530
	Gas	0.8532
	Electricity	0.9884
Latrine	No toilet	-0.2651
	Other	0.0300
	Dry toilet	0.2904
	Normal toilet	0.8467
Water sources	River/dam/stream	-0.1632
	Well with cover	0.0525
	Bore	0.1739
	Pipe water	0.3508
Radio	Not own radio	-0.0030
	Own radio	0.0036
Television	Not own Television	-0.2277
	Own Television	0.4185
Newspaper	Not own newspaper	-0.0080
	Own newspaper	0.4978

Source: Author's calculation

CHAPTER FOUR
DETERMINANTS OF CHILD MORTALITY

4.1 INTRODUCTION

Good health is a crucial component of overall well-being since it raises the productive level of human capital, and this has a positive effect on individual productivity and on economic growth (Savedoff and Schultz, 2000). In response to the important role of health issues on development, child health is addressed as one of the most important goals needed to be achieved in the MDGs between 1990-2015, Specifically, the United Nations has targeted reducing infant and child mortality by two-thirds (UN, 2000).

In Lao PDR, child health problems are crucial issues that need to be addressed in order to achieve sustainable development, because Lao PDR has a young population structure. To mitigate this problem, the government adopted the NGPES in October 2003, where health continues to be one of the top priority sectors. However, with a limited budget for health (merely around 4% of GDP), the progress on improving the health care system is quite slow. The Lao PDR human development index ranking is 133 out of 179 countries, with under-five child mortality ranking 50 out of 210 countries in the world (World Bank, 2010a). Even though child mortality rates in Lao PDR declined from 163 to 75 per 1000 live births during 1990-2005 (UN, 2010), the rates still rank second highest in Southeast Asian countries. The majority of deaths come from the preventable causes such as diarrhea, malaria, measles, and acute respiratory infections.

Because of the limited government budget, in order to allocate this small amount of funds effectively to combat child mortality, its determinants need to be identified. Case studies of empirical analysis on the determinants of child mortality in

Lao PDR are still rare. To contribute to this knowledge gap, our study intends to provide an empirical estimation of the determinants of child mortality in Lao PDR by addressing the following questions: (1) what are the differences of the factors that cause child mortality among regions?; (2) what determinants of child mortality does the government urgently need to intervene?, and (3) what policies would improve child health conditions in different regions?

4.2 Review of Literature on Child Mortality

From the large and growing literature, determinants of child mortality are roughly divided into three groups: biological, socio-economic, and demographic and environmental aspects. In biological determinants, breastfeeding is recognized as one of the most important factors affecting child survival. Breastfeeding not only provides protection against gastrointestinal and respiratory disease, but also meets infants' nutrition requirements. Therefore, from the previous studies, breastfeeding has a strong impact on reducing child mortality (Forste, 1994; Mustafa and Odimegwu, 2008). Moreover, maternal age at birth and birth order also tend to have impact on child survival. Women who gave birth to children at a very young age have a higher risk of maternal mortality and child mortality (Wolpin, 1997). In addition, gender of children also affects the child mortality rate. In general, the mortality rate of female infants is lower because of biological and genetic advantage (UNICEF, 2010a).

Regarding socio-economic factors, maternal education plays an important role in reducing child mortality. Education delays marriage, which prevents married women from having children at a very young age. Moreover, educated mothers tend to be able to utilize health information such as having better a perception of how to deal with ill children, providing better nutrition, and using contraceptive methods to space births. Most empirical literature supports that maternal education has an impact on improving child survival regardless the level of its effects varying among countries and regions.

For instance, mothers who complete secondary school in Cote d'Ivoire and those who finish middle school in Ghana have an impact on reducing child mortality (Benefo and Schultz, 1996). While in Kenya, to have a similar level of effect, mothers need to finish at least secondary school (Mustafa and Odimegwu, 2008). In Indonesia, improvement in child survival is only associated with mothers who have completed primary and secondary school levels (Mellington and Cameron, 1999).

There is evidence that household income affects child mortality negatively. It is believed that wealthier families can provide better nutrition, shelter and health services to children. On macro level, low income countries have higher rates of child mortality. For instance, in Indonesia, mother with lower expenditure per capita have a higher probability of experiencing child mortality (Mellington and Cameron, 1999). However, some cases such as the study of determinants of child mortality in Kenya of Mustafa and Odimegwu (2008) suggest that family wealth does not have an impact on infant and child mortality. There is no concrete support for effects of urban/rural residences, occupation status of mothers on child mortality since the results vary among countries and regions.

Environmental determinants, such as accessing to health facilities, drinking water sources, having access to latrines are also important factors for child survival. In Indonesia, accesses to pipe water and latrines have impact on reducing child mortality (Mellington and Cameron, 1999). This finding was also confirmed by Hala (2002) in the case study of Egypt. However, in the case study of Malawi, owning a pit latrine does not have any effect on reducing child mortality (Baker, 1999).

According to literature, there are endogeneity problems concerning unobserved variables that correlate with parental education such as parents' ability and family background (educational level of children's grandparents and family's wealth). There is a concern that girls might have less opportunity to study than boys because of family background (Breierova and Duflo, 2004, Schultz, 2009). Wolfe and Behrman

(1987) argue that there is no effect of mother's education on fertility and child health after controlling mother's from family background. In addition, a possible endogeneity problem concerning child mortality and fertility is addressed in the study of fertility and child mortality in Cote d'Ivoire and Ghana. Instrumental Variables (IV) is used to overcome this problem (Benefo and Schultz, 1996). High rate of child mortality can increase fertility because of died-child replacement mechanism of parents. On the other hand, high fertility might induce high child mortality because having more children means having higher risk of child mortality.

In summary, during the last two decades economic analysis of health, both theoretical and empirical, has addressed different types of child mortality's determinants and has covered many developed and developing countries. In the case of Lao PDR, however, in spite of the importance of health issues, studies were carried out only in forms of surveys mainly focusing on collecting statistical data and they just stopped providing summary reports based on collected data. Also health projects are largely formulated and designed based on ad hoc surveys and practical reports. To our best knowledge, the (academic) empirical analyses of child mortality determinants for this country are still rare. Recognizing this gap, this study is set to empirically examine and identify determinants of child mortality. The results of this study are expected to clarify the relation and the importance of those potential determinants of child mortality and consequently provide more information for better policy making to improve child health in Lao PDR.

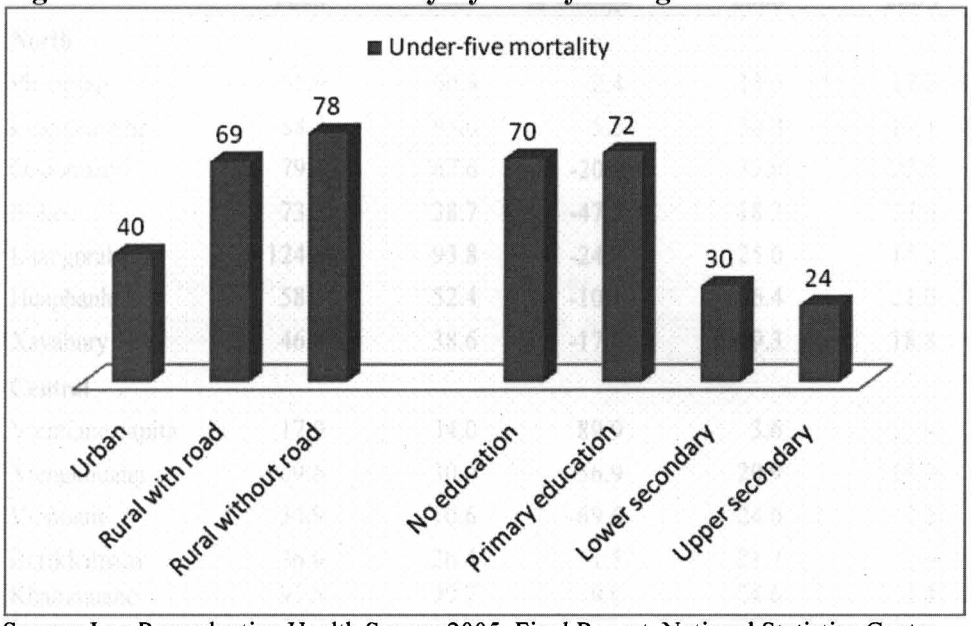
4.3 CHILD MORTALITY AND ACCESSING TO HEALTH CARE IN LAO PDR

4.3.1 CHILD MORTALITY SITUATION

Ranking 50th in the world and 2nd in Southeast Asia, the under-five child mortality rate in the Lao PDR has substantially declined from 235 to 79 per 1000 live births from 1960 to 2005 (World Bank, 2010a).

Looking at child mortality by family background in Figure 4.1, there is still a big gap of child mortality among the regions and among mother's education background. The highest under-five child mortality rates are found in rural areas without road access (78 per 1000 live births) where the lowest rates are in urban areas (40 per 1000 live births). Regarding child mortality by mother's education background, there are slight differences between the child mortality of uneducated mother and mother's with primary education level. However, there is a huge gap between mothers with primary education and secondary education (NSC, 2005).

Figure 4.1: Under-five mortality by family background



Source: Lao Reproductive Health Survey 2005, Final Report. National Statistics Centre.

The comparison between year 2000 and 2005 from Table 4.1 shows the declining trend in the infant mortality rate (IMR) and child mortality rate (CMR). IMR declined by 32.2% from 82.2 to 55.7 per 1000 live births. Considerable variations among provinces are apparent with the largest percentage of decline found in Bokeo, in which IMR declined from 73.3 in 2000 to 38.6 in 2005 or by 47.2 %, and in Saravane in which IMR declined from 75.8 to 42.3 per 1000 live births. Some provinces have

experienced an increase in IMR; and these provinces are Vientiane Capital, Luangnamtha, Borikhamxay, Khammuane, and Xaysomboon.

As shown in Table 4.2, the national level infant mortality rate in year 2005 was 55.7 infant deaths per 1000 live births, and the neonatal mortality rate was 25.9 and post-neonatal mortality rate was 29.8 per 1000 live births. This means that about half of infant deaths occur within the first month of life.

Table 4.1: Change in infant mortality rate and child mortality rate between 2000 and 2005

Province	IMR			CMR		
	2000	**2005**	**% change**	**2000**	**2005**	**% change**
North						
Phongsaly	61.9	60.4	-2.4	15.5	17.2	11.0
Luangnamtha	88.3	93.0	5.3	30.8	17.1	-44.5
Oudomxay	79.1	62.6	-20.9	32.0	22.5	-29.7
Bokeo	73.3	38.7	-47.2	18.3	27.6	50.8
Luangprabang	124.8	93.8	-24.8	25.0	15.2	-39.2
Huaphanh	58.3	52.4	-10.1	36.4	21.0	-42.3
Xayabury	46.8	38.6	-17.5	19.3	18.8	-2.6
Central						
Vientiane capita	17.9	34.0	89.9	3.6	-	
Xiengkhuang	69.6	30.0	-56.9	20.9	15.7	-24.9
Vientiane	34.9	10.6	-69.6	24.0	2.2	-90.8
Borikhamxay	26.0	26.4	1.5	21.7	-	
Khammuane	91.5	99.7	9.0	24.6	3.4	-86.2
Savannakhet	98.7	82.6	-16.3	25.1	18.3	-27.1
Xaysomboon SR	58.7	68.0	15.8	9.6	8.3	-13.5
South						
Saravane	75.8	42.3	-44.2	20.8	16.7	-19.7
Sekong	55.4	50.8	-8.3	15.3	9.6	-37.3
Champasack	77.8	66.8	-14.1	16.0	26.3	64.4
Attapeu	93.1	70.1	-24.7	18.6	26.9	44.6
Total	**82.2**	**55.7**	**-32.2**	**24.8**	**15**	**-39.5**

Source: Lao Reproductive Health Survey 2005, Final Report. National Statistical Centre.

Factors influencing neonatal mortality could be due to genetic factors while post neonatal mortality could be due to external factors such as improper feeding patterns, infectious diseases, etc (NSC, 2005b). The level of neonatal, post neonatal

and infant mortality rates varies among provinces. The highest IMR is found in Khammuane, which was 99.7, meaning that 99 to 100 babies out of 1000 live births did not reach their first birthday. 58.7 deaths out this figure are contributed to neonatal mortality, and the remaining of 41.1 are contributed to post-neonatal mortality. Slightly lower rates are found among provinces in Luangnamtha (93.0), Luangprabang (93.8), Savannakhet (82.6) and Attapeu (70.1). IMR over sixty is found in Phongsaly (60.4), Oudomxay (62.6), Xaysomboon (68.0), and Champasack (66.8). The lowest IMR is in Vientiane (10.6). The highest neonatal mortality rates are found in Luangnamtha (50.7), Khammuane (58.7) and Huaphanh (40.5). In these provinces, the neonatal mortality rate contributes to half of the IMR. In addition, post-neonatal mortality in some provinces was also high, which was around 40 per 1000 live births. These provinces are Phongsaly (41.1), Luangnamtha (42.3), Luangprabang (57.7), Khammuane (41.1), Savannakhet (44.2), Xaysomboon (40.8), and Champasack (51.7).

Table 4.2: Neonatal, post neonatal, infant and child mortality rate per 1000 live births for 5 years preceding the survey by province

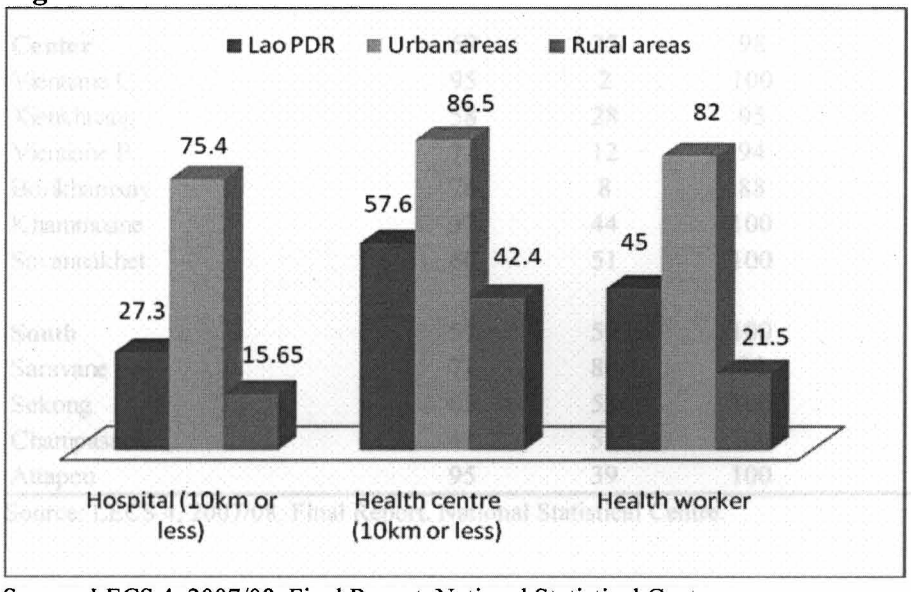
Province	Number of live births	Number of deaths <1 year	Neonatal mortality rate (NNMR)	Post neonatal mortality rate (PNMR)	Infant mortality rate (IMR)	Child mortality (CMR)
North						
Phongsaly	414	25	19.3	41.1	60.4	17.2
Luangnamtha	355	33	50.7	42.3	93	17.1
Oudomxay	431	27	30.2	32.5	62.6	22.5
Bokeo	310	12	6.5	32.3	38.7	27.6
Luangprabang	416	39	36.1	57.7	93.8	15.2
Huaphanh	420	22	40.5	11.9	52.4	21
Xayabury	337	13	26.7	11.9	38.6	18.8
Central						
Vientiane capital	235	8	29.8	4.3	34	-
Xiengkhuang	466	14	12.9	17.2	30	15.7
Vientiane	566	6	7.1	3.5	10.6	2.2
Borikhamxay	303	8	9.9	16.5	26.4	-
Khammuane	341	34	58.7	41.1	99.7	3.4
Savannakhet	339	28	38.3	44.2	82.6	18.3
Xaysomboon SR	294	20	27.2	40.8	68	8.3
South						
Saravane	449	19	29	13.4	42.3	16.7
Sekong	650	33	16.9	33.8	50.8	9.6
Champasack	464	31	15.1	51.7	66.8	26.3
Attapeu	428	30	30.4	39.7	70.1	26.9
Total	**7218**	**402**	**25.9**	**29.8**	**55.7**	**15**

Source: Lao Reproductive Health Survey 2005, Final Report. National Statistics Centre.

4.3.2 ACCESSING TO HEALTH CARE

Although access to health services has generally improved in the last two decades in the Lao PDR, increases in the public health have been insufficient and unevenly distributed. In Figure 4.2, 75.4% and 86.5% of the population live 10 km or less from a hospital and health centre respectively in urban areas, while only 11.3% and 27.1% of the population in rural areas without roads do. Moreover, only 12% of the population in rural areas without roads have access to Medical Worker compared to 82% of people in urban areas (NSC, 2008).

Figure 4.2: Access to health services



Source: LECS 4, 2007/08. Final Report. National Statistical Centre.

Water and sanitation is still a severe problem in Lao PDR. According to the national household survey in 2007/08 (Table 4.3), 34% of people were living without safe drinking water or latrines; only 23% of people in rural area (with no road access) have access to safe drinking water (piped water, protected well and purified water); and over 60% of rural people had no access to latrines. As a result, they had a larger potential to have diarrhea, cholera, or typhoid fever. Among those diseases, diarrhea is known as one of the three main causes of child mortality (the other two are malnutrition and respiratory infections).

Table 4.3: Health environment and prevention by provinces and Regions in 2007/08

	% of population		% of population covered by	
	having safe water in the village	without toilet	Immunization program	Anti-malaria program
Lao PDR	66	34	98	76
Urban area	88	11	97	80
Rural area with road access	61	41	99	75
Rural area without road access	23	66	95	68
North	66	32	97	74
Phongsaly	60	69	94	57
Luangnamtha	82	38	87	60
Oudomxay	68	30	98	81
Bokeo	65	33	92	35
Luangprabang	70	34	100	89
Huaphanh	63	38	100	81
Xayyaboury	58	6	100	80
Center	69	25	98	77
Vientiane C.	95	2	100	79
Xienkhuang	58	28	95	37
Vientiane P.	71	12	94	78
Borikhamxay	76	8	88	85
Khammuane	37	44	100	78
Savannakhet	60	51	100	82
South	57	59	100	78
Saravane	71	80	98	74
Sekong	65	53	100	56
Champasack	41	51	100	82
Attapeu	95	39	100	82

Source: LECS 4, 2007/08. Final Report. National Statistical Centre.

4.4 THEORETICAL FRAMEWORK, EMPIRICAL MODEL, AND DATA

4.4. 1 THEORETICAL FRAMEWORK

The theoretical framework in this Chapter follows framework of human capital investment (Becker, 1965) and household production function model. Child health demand function is derived from the health demand function developed Rosenzweig and Schultz (1983).

Parents obtain utility from their surviving children (CS), goods affecting child survival (Y) and consuming other goods (X), subject to budget constraint (where I is household total resource, p_x is price of others goods, p_y is price of consumption

goods affecting child survival and p_m is price of medical care) and child survival production function (CS). CS function consists of consumption goods affecting child survival (Y), medical care (M) augment utility only through CS function, biological endowment (B),household and parents' characteristics (Z), and health environment (G).

The utility maximization is expressed as follow:

$$MaxU(X,Y,CS)$$
$$S.t$$
$$CS = cs(Y,M,B,Z,G)$$
$$I = p_x X + p_y Y + p_M M$$

By solving this maximize utility function of the parents, we would obtain the optimum level of the choice variables as a function of all of the exogenous variables. The reduced form demands are:

$$X = x(p,I,B,Z,G)$$
$$Y = y(p,I,B,Z,G)$$
$$M = m(p,I,B,Z,G)$$

Substitute these into the child survival production function. The reduced form of optimum child's survival demand function can be written as:

$$CS^* = cs(y(p,I,B,Z,G),m(p,I,B,Z,G),B,Z,G)$$
$$CS^* = cs(p,I,B,Z,G)$$

With respect to the data used in this Chapter base on cross-sectional data, prices of all goods can be considered as a constant except for the price of health care such as ability of mother to provide health care or number of Medical Worker in each region. In this chapter, number of the Medical Worker in the district is used as a proxy of price for health care. The cost of medical care in Lao PDR is almost free, thus the more number of the Medical Worker available in their region, the lesser of opportunity cost of the patients.

Therefore, the optimum child survival production function is influenced by the price of medical care (p_m*), total household resource (I), biological endowment (B), household's and parents' characteristic (Z), and health environment (G). The reduced form of health equation can be denoted as follow:

$$CS^* = cs(p_m^*, I, B, Z, G)$$

4.4.2. EMPIRICAL MODEL

Based on the above theoretical framework, the reduced form of determinants of child mortality used as empirical model in this chapter is shown as follow:

$$CS = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} \quad (1)$$

where CS is child mortality which is influenced by Price of medical care [number of Medical Worker in a district (x_1) is used as proxy], Family's wealth (I) [due to limitations of data, a household asset index (x_2) is constructed and used as a proxy of household wealth or income], Child biological endowments (B) [include child's gender (x_3), birth status (x_4), birth order (x_5), experiencing miscarriage of mother and mother age at birth (x_6)], Parents' characteristic and socio-economic status (Z) [parents' education (x_7), parents' occupation (x_8), living region (x_9), are chosen as explanatory variables], Variables for health environment (G) [include access to safe drinking water sources (x_{10}), and kind of latrines (x_{11}). Moreover, born after 1997 (x_{12}) and knowledge of contraceptive (x_{13}) are used to control the effect of family planning program.

Equation (1) applies the Probit model to estimate the impact of explanatory variables on the probability of child mortality.

4.4. 3 DATA

4.4.3.1 STATISTICAL DATA

Statistical data used for our analysis in this Chapter were obtained from the Lao Reproductive Health Survey 2005 (LRHS-2005), which was conducted from March 2004 to February 2005 by the National Statistic Centre (NSC) of Laos. The LRHS2005 sample is made up of 13107 married women aged between 15-49 years regardless of their married status which provide information of 33,040 children. The dataset includes information on household condition, reproduction, mortality, socio-economic background, etc.

Since this study focuses on the child mortality, the sample is limited to the children who were born five years before the survey. Upon removing incomplete data, the econometric analysis is based on 30,665 observations covering roughly 93% of the original samples, which is considered a very high ratio by any standard. Therefore, this sample size is deemed sufficient for analyzing the determinants of child mortality.

4.4.3.2 VARIABLE AND DEFINITION

The following are definitions of variables used in the empirical analysis:

- Under-five mortality: children who were born alive and the later die before reaching their fifth birthday at least five years before survey.
- Female dummy: this is a dummy variable and is defined as 1 if the gender of children is female and 0 otherwise. It is used as proxy of child health endowment.
- Twin dummy is defined as 1 if a child were twin born and 0 otherwise. This variable is expected to have positive sign with child mortality because a child who born twin tends to have weaker health status.
- Born after year 1996 is a dummy variable if a child were worn after the year 1996 and 0 otherwise. This dummy variable is used as proxy of family planning affect

on child survival rate because in 1995 the government of Lao PDR launched nation-wide family planning program.

- Child birth order: this is categorized into four groups: Birth order 1 (first child), Birth order 2-3, Birth order 4-5, and Birth order 6+. This variable is also used as a proxy of a child biological endowment and it is expected to have a positive correlation with child mortality.
- Mother age at birth is the age of mother at the time a child was born.
- Parents' education: this variable describes the years parents spent in school. It was divided into five groups/ranges: No education=1; with some primary school level (1-4 years of school) =2; finish primary school level (5-7 years of school) =3; finish lower secondary school (8-10 years of school) =4, and finish high school and higher education (11+ years of school) =5.
- Experiencing miscarriage is dummy variable and defined as 1 if a woman has experienced miscarriage and 0 otherwise. This dummy is used as proxy of mother health and expected to have a positive sign with child mortality.
- Contraceptive knowledge is a dummy variable and defined as 1 if a woman has ever heard about any modern contraceptive method and 0 otherwise. This variable is used to capture the impact of contraception on child mortality.
- The number of Medical Worker is the number of Medical Worker in the district where a child lives. It is used as proxy of price for health care.
- Wage earner worker dummy: this is a dummy variable and is defined as 1 if the father and mother of a child are wage earner workers and 0 otherwise.
- Similar to the analysis in Chapter 3 (assessment of determinants of fertility), asset index (capital index) is used as a proxy of family's wealth to control family's background regarding family's wealth in the estimation of child mortality. The index calculated in Chapter 3 is used in this analysis without modification.

- Access to safe drinking water: This dummy variable is a proxy for health environment and is defined 1 if a household has access to piped water, protected borehole, protected well, and 0 otherwise.
- Toilet: meaning the latrine type used in the household. There are three categories: normal toilet=1; dry toilet=2; and no toilet=3.
- Rural dummy: this is a dummy variable and is defined as 1 if a person lives in a rural area and 0 otherwise.
- Regional: there are three regions: northern region =1; central region =2; and southern region =3.

4.4.3.3 MAJOR CHARACTERISTICS OF SAMPLES

The variables for empirical analysis are calculated and compiled from LRHS2005 data applying the definitions in the previous section. Table 6 presents the means and standard deviations of certain variables.

Comparing to the average rate of Under-five child mortality, the rate in this Chapter (approximately 100 per 1000 live birth) is different from the report from National Statistic Centre. It is because the average mortality rate of children under-five is calculated by direct estimation method based on reports of children that are dead and alive at least five years before survey, while the average mortality rate of children under-five from the National Statistic Centre is calculated by indirect estimation method based on the total number of children born and still living (NSC, 2005b).

With regard to health input factor, averagely there are 48% of girls, with birth order of 3 children, and 8% of women age before 18 years old had experience of giving birth. This has shown that the percentage of early child bearing age among married women in Lao PDR is relatively high.

Table 4.4: Basic characteristics of variables in child mortality analysis

Variables	Obs	Mean	Min	Max
Under-five child mortality	32962	0.1001	0	1
Female dummy	32962	0.4841	0	1
Twin dummy	32962	0.0099	0	1
Born after 1997 dummy	32962	0.5419	0	1
Birth order order1st	32962	0.2849	0	1
2rd and 3rd	32962	0.4123	0	1
4th and 5th	32962	0.1973	0	1
6th and more	32962	0.1055	0	1
Mother age at birth	32737	25.0052	13	48
Wife's Education (year)	32962	2.9776	0	11
Wife's no education	32962	0.3628	0	1
Some priamry	32962	0.2967	0	1
Primry school	32962	0.2335	0	1
Lower secondary school	32962	0.0784	0	1
Upper secondary school and high	32962	0.0286	0	1
Husband's education (years)	31576	4.5543	0	11
Husband no education	31556	0.1753	0	1
Some priamry	31556	0.2842	0	1
Primry school	31556	0.3184	0	1
Lower secondary school	31556	0.1376	0	1
Upper secondary school and high	31556	0.0845	0	1
Used to misscarriage	32962	0.1697	0	1
Heard of contraceptive	32962	0.9016	0	1
No.health worker	32962	43.3269	6	113
Wage earner men	31510	0.1145	0	1
Wage earner women	32962	0.0325	0	1
No toilet	32962	0.5074	0	1
Normal toilet	32962	0.3888	0	1
Dry toilet	32962	0.1038	0	1
Access to safe water	32962	0.4980	0	1
Rural dummy	32962	0.8262	0	1
Northern	32962	0.3955	0	1
Central region	32962	0.3704	0	1
Sounthern region	32962	0.2341	0	1

Source: Author's calculation

Regarding socio-economic determinants, the samples have the following characteristics: 17% of men and almost 30% of women have not received education; there are 3% of women wage earner; and around 82% of samples are living in rural areas. Based on these characteristics, the estimation in this Chapter would be partly upward biased. With respect to health environment, almost 50% of the samples have no

access to latrines and only 38% of those having access have normal toilet, while main drinking water sources come from well without cover, river, rain, stream and dam.

This means that most of the households in the samples live in poor health environment. Moreover, the distance to the nearest health care facility is relatively far and it normally takes roughly 2.5 hours, which indicates a relatively harsh condition, particularly in rural and remote areas.

4.5 Empirical Result

Equation (1) is estimated by using the Probit model. The marginal effects and z-statistics are summarized in Table 4.5 and 4.6:

The empirical analysis consists of six cases. The first three cases analyze under-five child mortality at national level (general case) and separately between urban and rural areas as presented in Table 4.5. Table 4.6 displays the comparison among northern, central, and southern regions.

Child gender has significant impact on child mortality in the Lao PDR. A child who was born a girl has a lower mortal probability. In general, being girl decreases mortal probability by 0.95% at the 1% significance level compared to a boy. A similar result is also revealed for the case of girl in urban and rural area. This finding is consistent with many previous studies in various countries, such as Bobak (2000) in Czech Republic and Mustafa and Odimegwu (2008) in Kenya. The cause for such outcome can be explained by the fact that boys have biological disadvantage which result in a smaller number of boys surviving their fifth birth day than girls (UNICEF, 2010a). Comparing the differences among regions, the gender difference on child survival rates is not significant in the southern region.

Generally, children who were born in higher birth order have higher risk of child mortality. Comparing children who were born as the first child, the probability of surviving reduces by 0.08%, 4%, and 10% for children who were born as 2-3, 4-5, and

higher birth order, respectively, with statistical significance at the 10% or 1% level. The reason behind this may come from the fact that mothers who have given birth to too many children have weaker health which would affect the next child born. Moreover, higher birth orders imply bigger household size which would further lead to higher competition on food consumption among the household members.

Children who were born as twin have higher probability of dying before reaching their fifth birth day in the Lao case. The coefficient shows that the probability of child mortality of twin children is about 8% higher as compared to single case at the 1% statistical significance. Similar results are also found in urban and rural areas and all regions except for the South. The assumption behind this is that children who were born as twin have weaker health which need more care and medical attention comparing to children who were born alone.

With regard to mother's age at birth, mothers who have children at very young age tend to expose to higher probability of child mortality. Specifically, a difference in mother's age of one year is associated with 0.3% higher probability of child mortality at the 1% statistical significance level. Similar results are found in urban and rural areas, and in all regions. It is claimed that the main reason is the reproductive immaturity (Wolpin, 1997). Interestingly, the impact of mother's age at birth in urban areas is relatively weak as compared to other cases. This can be understood as mothers in urban areas have better access to health care services.

Maternal education is found to have strong impact on improving child survival. In general, comparing with children of mothers with no formal education, a child who belongs to mothers with complete primary, lower secondary and higher education has lower probability of child mortality by 2.3%, 3.7% and 2.0% points, respectively. This finding supports previous literature such as Mellington and Cameron (1999) in Indonesia's case. Comparing between urban and rural areas, it is found that mothers with primary and lower secondary educational level would be exposed to lower child

mortality in both urban and rural area, while higher education has effect only in urban areas. This may be because in rural areas the number of women with higher education is negligibly small and access to health care is very limited. In terms of regional disparity, primary education attainment shows difference in child mortality in all three regions. In Lao PDR, mothers' education starts to show some effect on reducing probability of child mortality at the primary school level.

Children who were born to mothers with miscarriage experience have higher risk of dying before reaching their fifth birthday. In general, being a child of mother who experienced miscarriage is associated with higher probability of under-five mortality by a difference of 4% points at the 1% significance level. This similar result is also found urban/rural areas, and among the three regions. This finding stresses the importance of mother health on child survival.

There is no difference on survival rate between children who belong to mothers having knowledge of contraceptives and those who do not.

The number of Medical Workers in a district shows a significant impact on reducing child mortality, especially in rural areas and the central region. Overall, an increase in number of Medical Workers in the district by 1 person would reduce probability of child mortality 0.02% points at the 5% level. Such a similar impact also occurs in rural areas and the central region with a somewhat different magnitude.

In regard to family's wealth, poverty tends to raise the child mortality rate in the Lao PDR. Comparing with the 20% lowest asset group (the lowest quintile), on average children born in the highest 20% group (the highest quintile) are exposed to lower probability of death by 2.5% point at 1% statistical significance level. Poverty exerts a strong negative impact on child survival in rural areas, the northern region and central region. For regional differences, the highest coefficient of wealth index (4.2%) is found in highest quintile in the North.

In terms of health environment, the presence of a normal toilet would reduce

probability of infant death, whereas using a dry toilet is associated with increasing child mortality in rural areas and at country level. The reason behind this is that having toilets might not provide sufficient sanitation and would instead create health problem if the latrines were not kept clean (Lahiri and Chanthaphone, 2003). However, the impact of this variable varies among regions. Having access to latrines induces lower probability of child mortality in the northern and southern region, while having access to normal toilet in the central region has contradicting effect. This may be attributable to the fact that having access to latrines does not totally reflect the impact of health environment on child mortality because the latrines may not be available at the time the children were born, especially in remote areas. Recently, there are many projects aim to provide latrines for people in poor villages and remote areas in order to improve population health status. Comparing between 2003 and 2008, the number of households having access to latrines sharply increased from 17% to 44% in rural areas without road access (NSC, 2008).

On the subject of drinking water sources, access to safe drinking water would decrease probability of child mortality in Lao PDR context, especially in the North. This result lends support to the findings in Mellington and Cameron (1999) for Indonesia and Hala (2002) for Egypt. Accessing safe drinking water sources also associates with preventing many diseases, such as diarrhea which is one of main cause of child mortality in many countries including the Lao PDR.

Table 4.5: Child mortality at national level, the difference between urban and rural areas

Under-five child mortality	Total dy/dx (z)	Urban dy/dx (z)	Rural dy/dx (z)
Female dummy	-0.0096***	-0.01*	-0.0095**
	(-2.98)	(-1.77)	(-2.53)
Twin dummy	0.0803***	0.1251***	0.0676***
	(3.67)	(2.57)	(2.81)
Born after 1997 dummy	-0.0442***	-0.02***	-0.0499***
	(-12.65)	(-3.54)	(-12.16)
Birth order order1st (Base category)			
2rd and 3rd	0.0082*	0.0066	0.0084*
	(1.91)	(0.9)	(1.66)
4th and 5th	0.0443***	0.029**	0.0473***
	(6.55)	(2.15)	(6.15)
6th and more	0.1029***	0.0557**	0.1117***
	(9.01)	(2.25)	(8.75)
Mother age at birth	-0.0036***	-0.0018**	-0.0039***
	(-9.16)	(-2.35)	(-8.78)
Wife's Education (0 year is Base category)			
Some priamry (1 - 4 years)	-0.0018	-0.0132	0.0009
	(-0.44)	(-1.64)	(0.2)
Complete primry school (5 - 7 years)	-0.0231***	-0.0195**	-0.0243***
	(-5.01)	(-2.29)	(-4.51)
Complete lower secondary school	-0.0377***	-0.0291***	-0.0398***
(8 - 10 years)	(-6.06)	(-3.6)	(-4.85)
Complete upper secondary school	-0.021*	-0.0271***	-0.0019
and higher (11 + years)	(-1.7)	(-2.76)	(-0.09)
Husband's Education (0 year is Base category)			
Some priamry (1 - 4 years)	0.0067	0.0343	0.0052
	(1.3)	(1.39)	(0.92)
Complete primry school (5 - 7 years)	0.0051	0.0403**	0.0021
	(0.94)	(1.84)	(0.34)
Complete lower secondary school	-0.004	0.0384	-0.0107
(8 - 10 years)	(-0.58)	(1.64)	(-1.34)
Complete upper secondary school	-0.0076	0.0329	-0.01
and higher (11 + years)	(-0.84)	(1.48)	(-0.84)
Used to misscarriage	0.0408***	0.014*	0.0485***
	(8.29)	(1.86)	(8.29)
Heard of contraceptive	-0.0027	0.0223	-0.0046
	(-0.49)	(1.32)	(-0.74)
No.health worker	-0.0002**	-0.0002	-0.0002**
	(-2.03)	(-1.25)	(-2.01)
Wage earner men	-0.0044	-0.0092	0.0013
	(-0.65)	(-1.4)	(0.14)
Wage earner women	-0.0093	0.0018	-0.0232
	(-0.74)	(0.15)	(-1.34)
Lowest quintile (Base category)			
Quintile 2	0.0055	0.0283	0.0042
	(1.07)	(0.88)	(0.75)
Quintile 3	-0.0027	0.0011	-0.0032
	(-0.5)	(0.05)	(-0.54)
Quintile 4	-0.0046	-0.0052	-0.0052
	(-0.79)	(-0.26)	(-0.79)
Quintile 5	-0.0255***	-0.024	-0.0251***
	(-3.79)	(-0.95)	(-3.25)
No toilet (Base category)			
Normal toilet	0.007	0.012	0.007
	(1.5)	(1.47)	(1.31)
Dry toilet	0.0241***	0.0082	0.0262***
	(3.85)	(0.58)	(3.75)
Access to safe water	-0.0063*	-0.0049	-0.0044
	(-1.75)	(-0.68)	(-1.06)
Rural dummy	0.0211***		
	(4.02)		
Northern (Base category)			
Central region	-0.0201***	-0.0255***	-0.0183***
	(-5.07)	(-3.48)	(-3.97)
Sounthern region	-0.0007	0.0129	-0.0055
	(-0.15)	(1.42)	(-1.08)
Observation	30665	5274	25391
Pseudo R-square	0.0442	0.0691	0.0358

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected z-statistics in parentheses. 3) * significant at 10% level. 3) ** significant at 5% level. 4) *** significant at 1% level.

Table 4.6: The difference of child mortality among regions

Under-five child mortality	Northern region dy/dx (z)	Central region dy/dx (z)	Southern region dy/dx (z)
Female dummy	-0.0115**	-0.0081*	-0.0091
	(-2.08)	(-1.81)	(-1.32)
Twin dummy	0.0735**	0.1614***	0.0376
	(2.06)	(3.17)	(1.17)
Born after 1997 dummy	-0.0432***	-0.0433***	-0.0495***
	(-7.31)	(-8.72)	(-6.3)
Birth order order1st (Base category)			
2rd and 3rd	0.0077	0.0062	0.0122
	(1.04)	(1.04)	(1.28)
4th and 5th	0.045***	0.033***	0.058***
	(3.96)	(3.41)	(3.94)
6th and more	0.1136***	0.085***	0.1091***
	(5.91)	(4.98)	(4.63)
Mother age at birth	-0.0043***	-0.0026***	-0.0037***
	(-6.39)	(-4.6)	(-4.46)
Wife's Education (0 year is Base category)			
Some priamry (1 - 4 years)	-0.0024	-0.0037	0.0017
	(-0.32)	(-0.64)	(0.2)
Complete primry school (5 - 7 years)	-0.0266***	-0.0162**	-0.0199*
	(-3.3)	(-2.55)	(-1.84)
Complete lower secondary school	-0.0377***	-0.0205**	-0.0589***
(8 - 10 years)	(-3.06)	(-2.38)	(-4.9)
Complete upper secondary school	-0.0162	-0.0046	-0.0605***
and higher (11 + years)	(-0.51)	(-0.31)	(-3.01)
Husband's Education (0 year is Base category)			
Some priamry (1 - 4 years)	0.0336***	0.0041	-0.0281***
	(3.65)	(0.53)	(-2.88)
Complete primry school (5 - 7 years)	0.0122	0.0022	-0.0041
	(1.31)	(0.29)	(-0.37)
Complete lower secondary school	0.0243*	-0.019**	-0.0076
(8 - 10 years)	(1.68)	(-2.28)	(-0.55)
Complete upper secondary school	0.0174	-0.0137	-0.016
and higher (11 + years)	(0.8)	(-1.28)	(-0.93)
Used to misscarriage	0.0237***	0.0482***	0.0468***
	(2.74)	(6.54)	(4.85)
Heard of contraceptive	-0.0072	-0.0167	0.0017
	(-0.76)	(-1.51)	(0.16)
No.health worker	-0.0002	-0.0002***	0.0003
	(-0.86)	(-2.75)	(1.27)
Wage earner men	-0.0015	0.0014	-0.0188
	(-0.11)	(0.15)	(-1.54)
Wage earner women	-0.052***	-0.0103	0.0606
	(-2.91)	(-0.71)	(1.55)
Lowest quintile (Base category)			
Quintile 2	-0.0004	0.0056	0.0035
	(-0.05)	(0.68)	(0.32)
Quintile 3	-0.0112	-0.002	-0.0012
	(-1.4)	(-0.24)	(-0.1)
Quintile 4	-0.0178**	0.0018	-0.0138
	(-1.89)	(0.21)	(-1.06)
Quintile 5	-0.0429***	-0.0204**	-0.0186
	(-4.22)	(-2.01)	(-1.12)
No toilet (Base category)			
Normal toilet	0.032***	-0.0196***	0.0216**
	(3.61)	(-3.14)	(2.12)
Dry toilet	0.0344***	0.0019	0.0533***
	(3.33)	(0.23)	(2.96)
Access to safe water	-0.0104*	-0.0001	-0.0002
	(-1.72)	(-0.02)	(-0.02)
Rural dummy	0.022**	0.0247***	0.0063
	(2.3)	(3.8)	(0.49)
Observation	12160	11313	7192
Pseudo R-square	0.0325	0.0718	0.0424

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected z-statistics in parentheses. 3) * significant at 10% level. 3) ** significant at 5% level. 4) *** significant at 1% level.

4.6 CONCLUSION

The issue of improving maternal and child health needs to be addressed in order to enhance population well being. Usually, healthy mothers deliver healthy children and healthy children would have high potential to become productive labor force in the future. Thus, both maternal and child health problems need to be solved and improved together to reduce child mortality rate.

It is shown here that birth order and mother age at birth are crucial to child survival. These two elements can be easily improved through family planning programs. In terms of socio-economic factors, education is highly associated with reduced child mortality, especially maternal education at the basic level such as primary and lower secondary level. Family wealth also plays a significant role in child survival. Regarding health environmental factor, the study provides evidence that Medical Workers contribute significantly to improving child survival rate, especially in rural areas. In addition, access to safe drinking water sources is seen as a crucial factor for reducing child mortality rate, since it directly associates with child health. In this aspect, it is essential that the government of Lao PDR implement appropriate policies and intervention on family planning programs. Meanwhile, it is recommended that there should be urgent improvement in the areas of women's basic education, as well as the number and quality of Medical Workers in all regions. Furthermore, it is also crucial to accelerate poverty reduction programs and projects and enhance sanitation situations in rural areas.

CHAPTER FIVE
DETERMINANTS OF CHILD NUTRITION STATUS: AN IMPACT OF POVERTY ON CHILD NUTRITION

5.1 INTRODUCTION

Until the second half of the 1990s, the role of human capital was mainly linked to education, although some researchers already recognized the importance of other factors such health and nutrition (Lopez-Casasnovas et al., 2005). Good health is a crucial component of overall well-being. Good health raises levels of human capital, and this has a positive effect on individual productivity and also on economic growth. Since income has a strong impact on health, there is a need to know how health benefits of economic growth are distributed in the population. If growth benefits a few people, its impact on health will also be limited to a few people. Information on effects of income on health across social groups can help design health policies that promote equality in health outcomes in the population (Gakidou et al., 2000).

For Lao PDR, improvement of child nutrition is still progressing at a very slow pace. In the past decade incidents of stunted and underweight children dropped by only 8% and 7% (NSC, 2008), respectively, despite impressive economic achievement. In the past decade, Lao PDR has achieved remarkable economic development with an average real GDP growth rate of over 6% (World Bank, 2010b) and the poverty headcount ratio declining from 46% in 1992/93 to 28% in 2007/08 (LECS; Anderson et al., 2006; Gaiha and Annim, 2010). Nonetheless, the country has a very low performance in social indicators, with a ranking of 133 out of 177 nations in 2010 (UN, 2010). Life expectancy was only 55.49 years in 2006. In the past, the government expenditure on health care was very low at 0.68% on average from 1988 to 1995. The budget allocation on health sector has drastically increased to 4.28% on average from

1997 to 2009 (World Bank, 2010a). In October 2003, the government adopted NGPES, where health continues to be stated as one of the top priority sectors.

Despite the urgent need of information on health care in Lao PDR, empirical analysis on poverty and health status has yet been conducted. This study firstly intends to provide an estimate of determinants of poverty (or income) and health and nutrition status in Lao PDR. The study could help address such questions as: How can the health of the poor be improved; what are the economic consequences of better health; and, what policies would improve intra-household distribution of health outcomes among regions?

5.2 LITERATURE REVIEW

Poverty affects health through many different channels. Most obviously, poor people do not have the money necessary to afford health care. Poor people are also more likely to be malnourished (insufficient caloric and protein intake) and, as a result, are more likely to be immune-deficient and vulnerable to infectious diseases. Moreover, they are more likely to have less education and to live in overcrowded areas without clean water and sanitation and in distant rural areas far away from doctors and hospitals.

The relationship between income (or poverty) and health at the micro- and macro-levels is widely studied. In the macro level, effects of income on health (the so-called "wealthier is healthier hypothesis") is well-documented in Pritchett and Summers (1996). In the micro level, a number of evidence shows that income affects health. Strauss (1984) finds significant effects of income on nutritional status in Sierra Leone. Similar results are also reported by Sahn (1990) in Cote d'Ivoire, Subramanian and Deaton (1996) in South India and Aturupane et al. (2006) in Sri Lanka. In general, the micro level evidence shows that increases in income raise caloric consumption, particularly at low levels of income (Strauss and Thomas, 1995, 1998). Regarding child health, household income or wealth also raise child nutrition status. Using cross-

sectional data, Garrett and Ruel (1999) find that expenditure per day per capita positively correlate with height-for-age z-core of children in Mozambique. Similar results are also found in Ethiopia (Christiaensen and Alderman, 2004), and in Columbia (Attanasio et al., 2004). In addition, using demographic health survey, asset index used as proxy of household wealth is also have positive impact on child nutrition status (Kabubo-Mariara et al., 2008; Silvia, 2005). How health and income proxy is defined, the role of measurement error, as well as endogeneity of income or expenditure, and the validity of instruments are all very important concerns. Recent studies argue that measurement of effects of health on income, and vice-versa, is complicated by endogeneity of both health and income in the estimated equations. Household income or consumption might induce better child nutrition status in household. On the other hand, parents might increase their consumption expenditure in order to overcome their child health problems. The instrumental variables (IV) method (Schultz, 2003) and experimental treatment designs (Thomas et al. (2006), Miguel and Kremer (2004) and Gertler (2004)) are two approaches that have been developed to deal with these problems.

In terms of parents' education, most studies report very strong positive association between parental educations on child health (Thomas, Strauss and Henriques, 1990). These effects persist after controlling for household and community resources such as income, assets and health infrastructure. In general, significant positive effects of maternal schooling have been reported for a series of inputs into child health than that of paternal schooling (Strauss and Thomas, 1995).

In addition to education and household resources, considerable attention has been paid to the effects of community level influences on health. These include infrastructure, such as quality of water, sanitation or local health facility; measures related to price and quality of health; and prices of other health or education inputs (Thomas, Lavy and Strauss, 1992; and Jimenez, 1995). Recently, literature on distance

or time traveled to health facilities to utilization of curative care and choice of type of provider is growing. For instance, Strauss (1990) shows that distance to facilities and the quality of local health infrastructure are orthogonal to child height or weight in rural Cote d'Ivoire. Similarly, Mwabu, Ainsworth and Nyamete (1993) find significant positive effects of drug availability on utilization of health care facilities in Kenya. Regarding water and sanitation, its impact on child health is ambiguous. Silvia (2005) asserts that access to safe drinking water and latrine is associated with better child nutrition status in Ethiopia. On the other hand, Kabubo-Mariara et al. (2008) or Christiaensen and Alderman (2004) cannot find any impacts of these factors.

In summary, in the last two decades economic analysis of health, both theoretical and empirical, has addressed different types of health determinants and covered many developed and developing countries. In the case of Lao PDR, there exist some studies of nutrition status, which focus on some selected areas and districts or ethnic groups, but research studies with nationwide coverage are proved rare or they dealt with merely nutrition (Phimmasone et al., 1996; Miyoshi et al., 2005). To our knowledge, there exists only one paper which studies the effects of socioeconomic factors on child nutrition status at the country level by using Multiple Indicator Cluster Survey 2006 (Kamiya, 2009). In his finding, there is weak evidence of mother education at secondary level affecting children's short-term health. In addition, he also finds that household asset and health environment at community level affect child health nutrition status. However, his paper has not addressed impact of poverty (household income) and government public health on child health because of limitation of the data.

Recognizing this gap, this study is set to empirically examine the effects of poverty or income on individual health and nutrition status. In addition, further determinants of health, such as price for health environment and public service, and

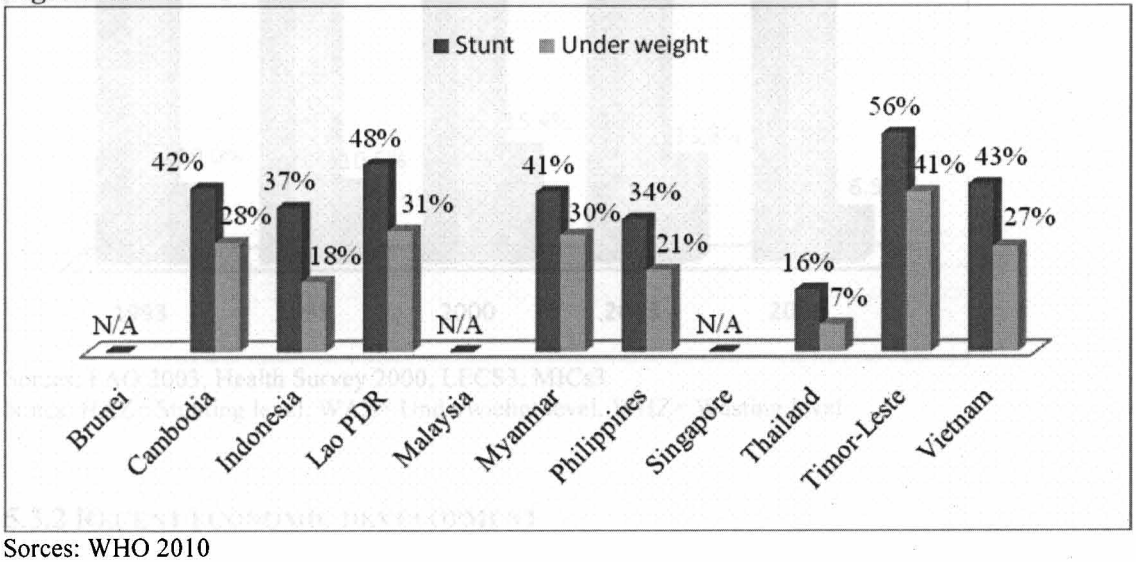
household and parents' characteristics are taken into account. Hence, this study could be considered as the first of its kind for the country.

5.3 CHILD NUTRITION STATUS AND ECONOMIC DEVELOPMENT IN LAO PDR

5.3.1 CHILD NUTRITION STATUS

Child nutritional status in Lao PDR ranks among the lowest group in the world. The stunting ranks 90th out of 97 countries and underweight ranks 97th out of 111 countries (World Bank, 2010c). Moreover, among Southeast Asian countries, the stunting and underweight level rank the 2nd highest after Timor (Figure 5.1).

Figure 5.1: Child health nutritional status in Southeast Asian countries

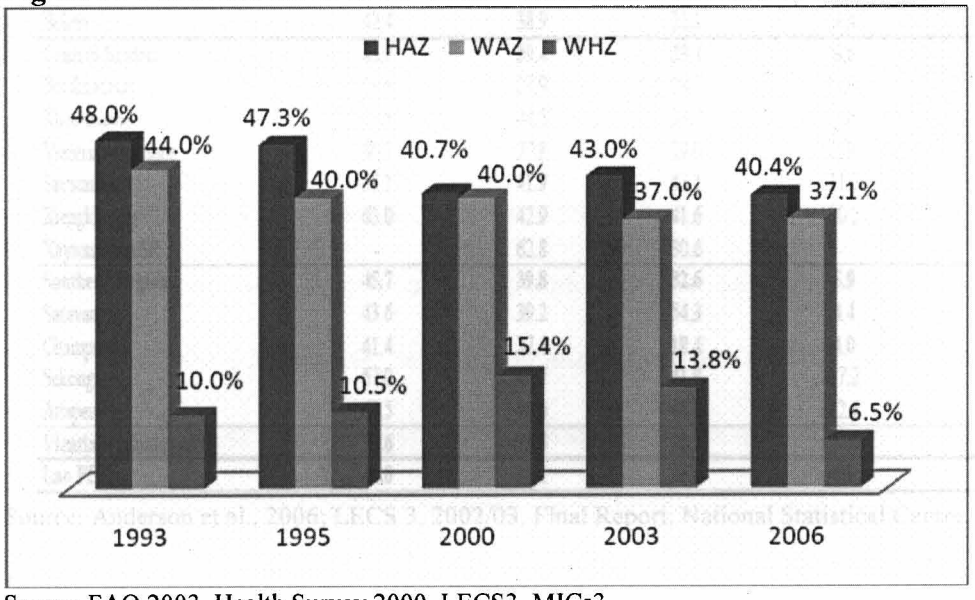


Sorces: WHO 2010

In 1993, the first nationally representative children nutrition status showed very high prevalence of stunting (height for age <-2SD) in children under five years in Lao PDR compared to all developing countries and ASEAN members. The study conducted by FAO (2003) also showed a similar result, 40% of children under five years were underweight (weight for age <-2SD), 47.3% and 10.5% were stunting and wasting (weight for height <-2SD) respectively. National Health Survey in 2000 showed an improvement in stunting rate from 47.3% to 40.7%. Children in the southern regions were more affected than their counterparts in central and northern regions (43.8%,

37.0% and 41.4% respectively). However, stunting rate increase to 43% before decline again in 2006 while underweight continues to drop to 37% in 2003 and remain the same until 2006. Interestingly, girls seem to have better nutritional status than boys (stunting of 38.4% compared to 42.8%). Comparing with the Health Survey 2000, the anthropometric outcome in Lao Expenditure and Consumption Survey 3 shows even higher prevalence of underweight (53.8%) and wasting (12%).

Figure 5.2: Movement of child health nutritional status in Lao PDR



Sorces: FAO 2003, Health Survey 2000, LECS3, MICs3
Notes: HAZ= Stunting level, WAZ= Underwiehgt level, WHZ= Wasting level

5.3.2 RECENT ECONOMIC DEVELOPMENT

On average, Lao PDR has achieved a relatively high economic growth rate of over 6% since 1990. In 2006, GDP growth rate is at 7%, in which 40% comes from natural resource sectors while the contribution of the agricultural sector is only 0.9% (World Bank, 2010b). The Lao economy is undergoing a notable degree of structural change. The share of agricultural sector in GDP decreased by 28.4% points from 61.2% in 1990 to 32.8% in 2009, the share of industrial sector increased sharply by 11% points from 14.5% in 1990 to 25.2% in 2009, and the share of service sector also increased about 17.7% points from 24.3% to 42% in 2009 (ADB, 2010). It is worth

noting that the agricultural sector remains predominantly subsistence in nature and it still absorbs about 79.6% of the total labor force (NSC, 2005a).

Table 5.1: Poverty Incidence during 1992 to 2003 in Lao PDR

Province	LECS1 1992/93	LECS2 1997/98	LECS3 2002/03	Change 92/93 to 97/98	Change 97/98 to 02/03
Northern Region	**51.6**	**47.3**	**37.9**	**-4.3**	**-9.3**
Oudomxay	45.8	66.1	45.1	20.3	-21.0
Luangnamtha	40.5	51.1	22.8	10.6	-28.3
Huaphanh	71.3	71.3	51.5	0.0	-19.8
Phongsaly	72.0	57.9	50.8	-14.1	-7.2
Luangprabang	58.5	40.8	39.5	-17.7	-1.4
Xayabury	22.4	17.7	25.0	-4.6	7.3
Bokeo	42.4	38.9	21.1	-3.4	-17.8
Central Region	**45.0**	**39.4**	**35.4**	**-5.6**	**-4.0**
Borikhamxay	16.6	27.9	28.7	11.3	0.8
Khammuane	47.1	44.5	33.7	-2.6	-10.8
Vientiane Province	30.7	27.8	19.0	-2.9	-8.8
Savannakhet	53.1	41.9	43.1	-11.2	1.2
Xiengkhuang	63.0	42.9	41.6	-20.2	-1.3
Xaysomboun SR	-	62.8	30.6	-	-32.1
Southern Region	**45.7**	**39.8**	**32.6**	**-5.9**	**-7.2**
Saravane	43.6	39.2	54.3	-4.4	15.1
Champasack	41.4	37.4	18.4	-4.0	-19.0
Sekong	67.0	49.7	41.8	-17.2	-7.9
Attapeu	60.5	48.0	44.0	-12.4	-4.0
Vientiane Municipality	**33.6**	**13.5**	**16.7**	**-20.0**	**3.2**
Lao PDR	**46.0**	**39.1**	**33.5**	**-6.9**	**-5.6**

Source: Anderson et al., 2006; LECS 3, 2002/03. Final Report. National Statistical Centre.

Overall, economic growth has contributed to a fall in poverty from 46% in 1992/93 to 33.5% in 2002/03 (LECS, Anderson, Engvall and Kokko, 2006) and a decline to about 27.6% in 2007/2008 (Gaiha and Annim, 2010). A large part of the country's population lives outside of the market economy and, as a result, the positive effects of growth were largely felt in urban areas and in lowlands. Only one half of provinces succeeded in reducing poverty over this period. Many provinces experienced the down and up trend of poverty incidence, and in the worse case, the poverty level of some provinces even kept on increasing. In terms of consumption pattern, it is observed that the total food expenditure has declined from 64.3% in 1992/93 to 46.1% in 2007/08, especially for own produced food (NSC, 2008). Surely, in opposite, the total non-food expenditure has increased from 35.7% to 54.0% in the same period. The

income effect on health care (medical and personal care) did not show a positive change, but slightly lower for the case of Lao PDR comparing to other Southeast Asian countries.

5.4 MEASURE OF CHILD HEALTH, THEORETICAL FRAMEWORK, EMPIRICAL MODEL AND DATA

5.4.1 MEASURE OF CHILD HEALTH

Health has been a major focus of the human capital (production function) literature in development economics. Health status is multi-dimensional and different dimensions of health are likely to have different effects on labor market outcomes. Thus, a range of health indicators have been adopted in empirical analyses including anthropometrics, self report and nutrient intakes. Self-health reports have been criticized as being subjective, misleading and biased due to personal backgrounds such as education level or self-health awareness of the respondent. Regarding nutrition intake, it has a limitation in observing long term health and is time consuming in collecting the data. Therefore, the anthropometry method is commonly used as a proxy of health status.

Child nutrition status is measured by the Anthropometry method based on the WHO standard. Anthropometric value is in the form of z-score which is calculated from the formula below:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j},$$

where X_{ij} is the observed value of i^{th} child; μ_j is the mean value of the reference population and σ_j is standard deviation of the reference population The reference population consists of 8500 privileged healthy children aged 0-5 years from six location around the world.

A child who has weight-for-age or height-for-age z-score below -2 is considered as underweight or stunting, respectively. In other words, children with z-score above -2 are consider relative normal comparing with reference population and a z-score below -2 means that the hypothesis of being normal is rejected at the 5% significance level.

Stunted height normally results from a long period of inadequate food consumption. Therefore, it is considered as a proxy of long term child health. Underweight is generally considered as child malnutrition status. This can be observed as short term health status.

5.4.2 THEORETICAL FRAMEWORK

The theoretical framework in this Chapter follows framework of human capital investment (Becker, 1965) and household production function model. Child health demand function is derived from the health demand function developed Rosenzweig and Schultz (1983).

Parents obtain utility from child health (H), goods affecting child health (Y) and consuming other goods (X), subject to budget constraint (where I is household total resource, p_x is price of others goods, p_y is price of consumption good affecting child health and p_m is price of medical care) and child health production function (H). H consists of consumption goods affecting child health (Y), medical care (M) augmented utility only through H function, biological endowment (B),household and parents' characteristics (Z), and health environment (G).

The utility maximization is expressed as follow:

$$Max U(X, Y, H)$$

$$S.t$$

$$H = h(Y, M, B, Z, G)$$

$$I = p_x X + p_y Y + p_M M$$

By solving this maximize utility function of the parents, we would obtain the optimum level of the choice variables as a function of all of the exogenous variables. The reduced form demands are:

$$X = x(p, I, B, Z, G)$$
$$Y = y(p, I, B, Z, G)$$
$$M = m(p, I, B, Z, G)$$

Substitute these into the child health production function, the reduced form of optimum child health demand function can be written as:

$$H^* = h(y(p, I, B, Z, G), m(p, I, B, Z, G), B, Z, G)$$
$$H^* = h(p, I, B, Z, G)$$

With respect to the cross-sectional data used in this Chapter, the prices of all goods can be considered as constant except for the price of health care such as ability of mother to provide health care or number of health worker in each region. In this chapter, number of the Medical Worker in the district is used as a proxy of price for health care. The cost of medical care in Lao PDR is almost free, thus the more number of the Medical Worker available in their region, the lesser of opportunity cost of the patients.

Therefore, the optimum child health production function is influenced by the price of medical care (p_m *), total household resource (I), biological endowment (B), household's and parents' characteristic (Z), and health environment (G). The reduced form of health equation can be denoted as follow:

$$H^* = h(p_m^*, I, B, Z, G)$$

5.4.3 EMPIRICAL MODEL

Based on the above theoretical framework, the empirical model of the determinants of child nutrition status which is generally used as proxy of child health (H) is shown as follow:

$$Stunt \text{ or } underweight = \beta_0 + \beta_1 age + \beta_2 female + \beta_3 Mage + \beta_4 Meduc + \beta_5 Feduc + \beta_6 \log C + \beta_7 HHsize + \beta_8 HW + \beta_9 Water + \beta_{10} Latrines + \beta_{11} Diarrhea + \beta_{12} rural + \beta_{13} region \quad (1)$$

where, stunt and underweight are used as proxy of child health (H), *age* and *female* child's age and gender; *Mage* is age of mother; *Meduc and Feduc* is education level of father and mother; *LogC* is logarithm of monthly consumption expenditure per capita; *HHsize* is household size; *HW* is availability of health workers in village; *Water* is type of water source; *Latrine* is toilet type; *Diarrhea* is diarrhea outbreak in the village; and *rural* and *region* are rural and region dummies.

A proxy of income used in this analysis, which is the monthly consumption expenditure per capita, may determine child health. However, child health may also determine consumption level in certain condition, for example in the case of sickness, parents might increase the consumption level for a child aimed at recovering from health shock. This two-way relationship may create endogeneity problem in the regression result.

To overcome the possible endogeneity problem between household consumption and child health, this analysis applies two procedures to deal with the problem. First household consumption is treated as exogenous and used as normal independent variable without using Instrument Variable (IV) method. This is because finding an appropriate and applicable instrument variable that is completely independent from child health is difficult for our dataset. The results from this model serve as the main findings in this Chapter.

Second, in view of providing persuasive statistical inferences attempts have been made to apply the IV method to the empirical analysis by using household asset as IV. The natural logarithm of monthly consumption expenditure per capita (Income) is instrumented by household asset index and numbers of cattle and buffalos. Similar to the analysis in Chapter 3 and Chapter 4, the Asset Index is constructed by the Principal

Component Analysis method. The assets used to construct an index include ownership of land, building business, building agriculture, car, motor cycle, refrigerator, two-wheeled tractor, four-wheeled tractor, television, satellite disc, and jewelry. The scores of asset index are presented in Table A 5.1.

For the estimation method in Equation (1), the Probit model and IV Probit model methods are applied to regress the explanatory variables on child's stunting and underweight.

5.4.4 DATA

5.4.4.1 STATISTICAL DATA

Statistical data for the empirical analysis in this Chapter are obtained from the Lao Expenditure and Consumption Survey 3 (LECS3) which was conducted from March 2002 to February 2003 by the National Statistic Centre (NSC) and the Swedish International Development Agency (SIDA). The LECS3 sample was made up of 8,092 households from 540 villages in all 18 provinces. It provides information of household transactions, consumption, production and social indicators such as education and health.

Upon removing incomplete samples and clearing the data, our econometric analysis is based on 3,512 samples of children aged 0-5 years, which have z-score between -6 to 6. Others who have z-score lower and higher than that are might be due to high probability of measurement error. Moreover, because of limitation of data, children in the sample are limited on child who is a son or daughter of head and spouse of the household. For the children who have other relationships with household head are dropped because it is impossible to match with their parents in the data set. The definition of each variable is presented in the next section.

5.4.4.2 VARIABLES AND DEFINITION

The definitions of variables used in the empirical analysis are as follow:

- Stunting and Underweight are children who have z-score of height-for-age and weight-for-age below -2, respectively, and are defined as 1 and 0 otherwise;
- Age is age of children;
- Female dummy: this is a dummy variable and is defined as 1 if the gender of children is female and 0 otherwise. It is used as proxy of child health endowment;
- Mother age is the age of mother;
- Parents' education: this variable describes the years parents spent in school. It was divided into four groups/ranges: No education=1; with some primary school level (1-4 years of school) = 2; completed primary school (5-7 years of school) = 3; complete lower secondary school (8-10 years of school) and higher = 4;
- Consumption expenditure per capita: The consumption expenditure is the average monthly expenditure for food and non-food consumption divided by the number of household members. In this Chapter, the consumption expenditure (in natural logarithm) is employed as a proxy for poverty of household;
- Household size: The size of a household is the number of members in the household;
- Health workers (Medical Worker and health volunteer) is dummy variable is defined as 1 if there is health worker available in village where a child lives and 0 otherwise;
- Access to safe drinking water: This dummy variable is a proxy for health environment and is defined 1 if a household has access to piped water, protected borehole, protected well, and 0 otherwise;
- Toilet: meaning the latrine type used in the household. There are three categories: normal toilet = 1; dry toilet = 2; and no toilet = 3;

- Diarrhea dummy is dummy variable defined as 1 if there is diarrhea outbreak in the village where a child lives;
- Rural dummy: this is a dummy variable and is defined as 1 if a person lives in a rural area and 0 otherwise; and
- Regional: there are three regions considered in the analysis: northern region = 1; central region = 2; and southern region = 3.

5.4.4.3 MAJOR CHARACTERISTICS OF SAMPLES

The variables for the empirical analysis are calculated and compiled from LECS3 data applying the definitions in the previous section. Table 5.2 presents the mean and standard deviation of certain variables.

Table 5.2: Basic characteristics of variables in child nutrition status analysis

Variable	Obs	Mean	Min	Max
Hight-for-age z-score	2695	-2.4482	-6	5.91
Stunting	2695	0.6245	0	1
Weight-for-age z-score	3521	-1.6425	-5.99	4.98
Underweight	3521	0.4093	0	1
Child's age 0-1 year	2695	0.1866	0	1
2 years	2695	0.1625	0	1
3 years	2695	0.2419	0	1
4 years	2695	0.2538	0	1
5 years	2695	0.1551	0	1
Female	2695	0.4928	0	1
Mother's age	2695	31.5896	16	53
Mother education (years)	2695	2.3570	0	16
Mother's education 0 year	2695	0.4983	0	1
1 - 4 years	2695	0.2571	0	1
5 - 7 years	2695	0.1636	0	1
8 - 10 years and higher	2695	0.0809	0	1
Father's education (years)	2695	4.3058	0	16
Father's education 0 year	2695	0.2386	0	1
1 - 4 years	2695	0.2887	0	1
5 - 7 years	2695	0.2805	0	1
8 - 10 years and higher	2695	0.1922	0	1
Logconsumption per capit	2695	114809.2	15140.91	1218250
Household size	2695	6.9002	3	19
Health worker in village	2695	0.2427	0	1
Access to safe water	2695	0.1885	0	1
No toilet	2695	0.1852	0	1
Normal toilet	2695	0.1250	0	1
Dry toilet	2695	0.6898	0	1
Diarrhea outbreak	2695	0.6813	0	1
Northern region	2695	0.4327	0	1
Central region	2695	0.3625	0	1
Southern region	2695	0.2048	0	1
Rural areas	2695	0.8891	0	1

Source: Author's calculation

On average, about 62% and 40% of samples are stunted and underweight, respectively. Average school years of father and mother are 4.3 and 2.3 years, respectively. There are 23% of fathers and 40% of mothers with no education. Overall, an average household in Lao PDR spends 114,809 Kip per capita per month for consumption (about USD 11.42). With respect to household characteristics, the age of household heads and spouses ranged between 35 and 45 years. An average household in Lao PDR has seven members. Most of the samples are in rural areas.

With respect to health environment and public service, children in the sample live in poor health environment. Only 18% of the samples have access to safe drinking water while 68% have no access to latrines. About 68% of children live in a village that experiences diarrhea outbreak incident. About 50% of children live in villages which have Medical Workers and Health Volunteers.

5.5 EMPIRICAL RESULTS

The empirical analysis of probability stunting and underweight consist of consists of 12 cases. The first six cases show the analysis of the Probit model and IV Probit model on child malnutrition in all areas (pooled set), and in urban and rural areas (separate datasets). The remaining six cases compare the situation among northern, central and southern regions by using the two models. The marginal effects of estimated results are summarized in Table 5.3, 5.4, 5.5 and 5.6.

On average, as a child gets older, the probability of being stunted and underweight increases. At country level, compared with children aged 0-12 months, children's aged 13-24, 25-36, 37-48, 49-59 months are significantly associated with increasing probability of being stunted and underweight at the 1% level. Similar results are found in urban/rural areas and in all regions (nation-wide). This finding shows an evidence of insufficient nutrition or food intake among Lao children. Similar findings

have been found in many developing countries such as Ethiopia (Silvia, 2005) and Kenya (Kabubo-Mariara et al., 2008).

Regarding the effect of gender difference on child malnutrition, in Lao PDR, there is no evidence of any discrepancy between boys and girls on probability of being stunted and underweight. This result also lends support to findings in previous studies on Lao PDR, such as Miyoshi et al. (2005) in two districts, one the North and one in the South, and Kamiya (2009).

In terms of parental education, maternal education plays significant role in improving child health for both short term and long term status. Such a positive relationship between maternal education and child health has also been found in many previous studies, such as Thomas, Strauss and Henriques (1990), Girma and Genebo (2002) and Kabubo-Mariara et al. (2008). On average, comparing with uneducated mothers, children, who belong to mothers with some primary and completed lower secondary education, has lower probability of being stunted by 7% and 9.5% points, respectively. Similar results are also found in urban areas. On the other hand, there is only basic mother's education associated with reducing probability of being stunted in rural areas. Regarding the differences among three regions, in addition to mother's basic education, maternal education at secondary and higher levels is associated with lower probability of stunting. However, maternal education does not seem to show any impact on long term child health in the south, while basic education plays a significant role in improving child health in the north.

With respect to short term child health, maternal education also shows similar impact on underweight. At country level, mothers, who have some primary, complete primary, lower secondary and higher education face lower probability of having underweight children, as compared mother who have no formal education. Similar result is also found in rural areas. Comparing among regions, mother's education tends to show a significant impact on reducing probability of being underweight.

In terms of paternal education, in general it does not show any impact on improving child health for both long term and short term. However, there is evidence that father's education at primary level is associated with lower probability of having stunted children by 6.9% points in the northern region.

The presence of health workers in the village has a positive impact on a child's long term health than short term health. In the general case, compared with villages without health workers, having health workers living in a village is associated with lower probability of stunting by 5% points at the 10% significance level. Comparing between urban and rural areas, health workers tend to have impact only in urban areas. The reason behind this is most probably the composition of health workers in the two locations under study. On one hand, 82% of the health workers in urban areas are Medical Worker and Health Volunteers comprise only 18%. On the other hand, the composition for rural areas is just reversed, with Medical Worker making up only 17% of health workers. Considering the differences among regions, it is found that the presence of health workers correlates with lower probability of being stunted in the central region.

For child health status, health environmental factors, such as access to safe drinking water, latrines and diarrhea outbreak, shows no impact on child health in Lao PDR. There is an argument that distance from village to the nearest health care centre, having access to safe water and toilet are environmental indicators, is not a measure of the quality of the environment in which children grow up (Kabubo-Mariara et al., 2008; Strauss and Thomas, 1995).

In relation to poverty, the result shows significant impact of income on improving both long term and short term child health. This finding lends support to a number of previous studies, such as Aturupane et al. (2004), Lawson (2004), and Skoufias (1998). At country level, an increase in income level is associated with reduced probability of being stunted and underweight by 8.4% and 11% points,

respectively. With respect to urban/rural differences, increasing income has a negative correlation with probability of being underweight children in rural areas. Concerning regional differences, income has a significant effect on reducing probability of stunting and underweight in the northern and southern regions. Moreover, the magnitude of the short-run impact of income on child nutrition appears to be stronger for the lowest income group. This is attributable to the fact that the share of expenditure on food of the poor is higher than that of the other groups, and hence, a percentage point increase would have a larger effect on nutrition. Also, children of parents with higher income would be able to consume higher quality food, which could cover the necessary nutrition intake of the body. Hence, a 1% point increase in parental income in this group would not have a noticeable impact on nutrition.

On the reliability of the estimation results, some studies raised the probability of having endogeneity problem of consumption as a concern of empirical analysis. In order to overcome this problem, the investigation uses asset index, number of cattle and buffaloes as instrument variables in an IV Probit model. The reason is that these variables can be considered as long term saving of a household and are closely related with household consumption expenditure, but they are not associated with random health shock of children. After running the Wald test of exogeneity of monthly consumption expenditure per capita, the null hypothesis (of exogeneity) is rejected in both stunting and underweight models. The results from the IV Probit model are quite consistent with those of the Probit model. The results show that the coefficients of household income on probability of being stunted and being underweight become statistically insignificant at the country level and in the South, respectively. On the other hand, the negative correlation of household income with the probability of being stunted in the southern region, probability of being underweight in rural areas and the northern region still prevails. For other determinants, such as mother education, availability of health staff in the village, children's age and gender, and health

environment variables, the coefficients are merely slightly changed which would not alter our results and conclusions.

Table 5.3: Stunt at national level, the difference between urban and rural areas

Stunt	Total dy/dx (z)		Urban dy/dx (z)		Rural dy/dx (z)	
	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit
Child's age 0-1 year (Base category)						
2 years	0.1351***	0.1365***	0.1375	0.1278	0.1317***	0.1324***
	(4.86)	(4.9)	(1.27)	(1.15)	(4.6)	(4.61)
3 years	0.2142***	0.2135***	0.1904**	0.1847*	0.2159***	0.2157***
	(8.85)	(8.8)	(2.03)	(1.95)	(8.69)	(8.68)
4 years	0.237***	0.236***	0.3957***	0.3827***	0.2186***	0.217***
	(10)	(9.92)	(5.07)	(4.75)	(8.81)	(8.64)
5 years	0.2811***	0.2824***	0.3901***	0.3851***	0.272***	0.2726***
	(12.55)	(12.6)	(4.88)	(4.74)	(11.73)	(11.73)
Female	-0.027	-0.0279	0.0051	-0.0041	-0.0331*	-0.0335*
	(-1.42)	(-1.47)	(0.08)	(-0.06)	(-1.66)	(-1.68)
Mother's age	-0.0023	-0.0021	0.0036	0.0035	-0.0029*	-0.0028*
	(-1.56)	(-1.42)	(0.66)	(0.62)	(-1.89)	(-1.82)
Mother's Education						
0 year (Base category)						
1 - 4 years	-0.07***	-0.0707***	-0.1847*	-0.1848*	-0.0637**	-0.0654**
	(-2.71)	(-2.74)	(-1.91)	(-1.91)	(-2.4)	(-2.46)
5 - 7 years	-0.0365	-0.0311	-0.0509	-0.053	-0.0445	-0.0446
	(-1.17)	(-0.98)	(-0.5)	(-0.52)	(-1.35)	(-1.32)
8 - 10 years and higher	-0.0956**	-0.0798*	-0.1749*	-0.1635*	-0.0692	-0.068
	(-2.12)	(-1.68)	(-1.89)	(-1.77)	(-1.25)	(-1.16)
Father's Education						
0 year (Base category)						
1 - 4 years	-0.0175	-0.0189	-0.062	-0.0713	-0.0124	-0.0126
	(-0.62)	(-0.67)	(-0.49)	(-0.57)	(-0.44)	(-0.44)
5 - 7 years	-0.0226	-0.0212	0.016	0.0023	-0.0253	-0.0254
	(-0.77)	(-0.72)	(0.13)	(0.02)	(-0.85)	(-0.84)
8 - 10 years and higher	0.024	0.0298	-0.009	-0.0134	0.038	0.0377
	(0.68)	(0.82)	(-0.08)	(-0.11)	(1.03)	(0.99)
Logconsumption per capita*	-0.0846*	-0.2061	-0.3153**	-0.4725	-0.0564	-0.0473
	(-1.79)	(-1.24)	(-2.43)	(-1.51)	(-1.1)	(-0.25)
Household size	0.0031	0.0003	-0.0417***	-0.0469***	0.0083*	0.0087
	(0.68)	(0.06)	(-2.67)	(-2.64)	(1.71)	(1.35)
Health Workers in village	-0.05*	-0.0477*	-0.1934**	-0.2037**	-0.0394	-0.0455
	(-1.9)	(-1.73)	(-2.41)	(-2.55)	(-1.4)	(-1.49)
Access to safe water	0.0177	0.0161	-0.0063	0.003	0.023	0.018
	(0.65)	(0.59)	(-0.09)	(0.04)	(0.76)	(0.59)
No toilet (Base category)						
Normal toilet	-0.0105	-0.0009	-0.0013	0.0176	-0.015	-0.0157
	(-0.36)	(-0.03)	(-0.02)	(0.19)	(-0.48)	(-0.45)
Dry toilet	-0.0036	-0.0055	-0.1065	-0.1068	0	0.0003
	(-0.12)	(-0.18)	(-1.02)	(-1.07)	(0)	(0.01)
Diarrhea	0.0081	0.0068	0.0949	0.1047	0.0012	0.0006
	(0.39)	(0.33)	(1.38)	(1.41)	(0.06)	(0.03)
North region (Base category)						
Central	-0.037	-0.0372	-0.0529	-0.0409	-0.0386	-0.0416*
	(-1.64)	(-1.63)	(-0.62)	(-0.47)	(-1.63)	(-1.75)
South	-0.0378	-0.0413	-0.0624	-0.0603	-0.0402	-0.0395
	(-1.33)	(-1.43)	(-0.57)	(-0.54)	(-1.37)	(-1.32)
Rural area	0.0776**	0.0557	-	-	-	-
	(1.99)	(1.29)				
Observation	2695		299		2396	
Pseudo R-square	0.0529		0.122		0.0458	

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected z-statistics in parentheses.
3) * significant at 10% level. 4) ** significant at 5% level. 5) *** significant at 1% level.
6) Log consumption expenditure per captita is instrumented by Asset index and number of cattle and buffalos in IV Probit model.

Table 5.4: The difference of Stunt among regions

Stunt	North dy/dx (z)		Central dy/dx (z)		South dy/dx (z)	
	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit
Child's age 0-1 year (Base category)						
2 years	0.1753***	0.1763***	0.0743	0.0641	0.1395**	0.1318**
	(4.69)	(4.69)	(1.44)	(1.21)	(2.21)	(2.01)
3 years	0.2054***	0.2071***	0.2174***	0.213***	0.2073***	0.2018***
	(6)	(6.05)	(5.01)	(4.89)	(3.68)	(3.48)
4 years	0.234***	0.2312***	0.1815***	0.1757***	0.3191***	0.3093***
	(6.99)	(6.82)	(4.01)	(3.85)	(6.41)	(5.95)
5 years	0.2667***	0.2667***	0.2829***	0.2778***	0.3033***	0.3116***
	(8.5)	(8.45)	(6.98)	(6.62)	(6.08)	(6.43)
Female	-0.0369	-0.0382	-0.0375	-0.03	0.0072	0.0096
	(-1.3)	(-1.34)	(-1.16)	(-0.91)	(0.17)	(0.22)
Mother's age	0.0005	0.0007	-0.0034	-0.004	-0.0062*	-0.0066**
	(0.24)	(0.32)	(-1.29)	(-1.36)	(-1.82)	(-1.96)
Mother's Education						
0 year (Base category)						
1 - 4 years	-0.0924**	-0.0778*	-0.0842*	-0.0831*	-0.0407	-0.0514
	(-2.26)	(-1.82)	(-1.91)	(-1.88)	(-0.73)	(-0.91)
5 - 7 years	-0.0281	-0.0043	-0.0647	-0.0676	0.0005	0.0142
	(-0.57)	(-0.09)	(-1.2)	(-1.27)	(0.01)	(0.22)
8 - 10 years and higher	-0.0791	-0.0559	-0.1052*	-0.1107*	-0.1064	-0.0548
	(-0.88)	(-0.59)	(-1.66)	(-1.72)	(-0.97)	(-0.47)
Father's Education						
0 year (Base category)						
1 - 4 years	0.0081	0.0023	-0.067	-0.0713	-0.0181	-0.0165
	(0.2)	(0.06)	(-1.29)	(-1.37)	(-0.28)	(-0.26)
5 - 7 years	-0.0693*	-0.0722*	0.0195	0.0133	0.0362	0.0566
	(-1.66)	(-1.72)	(0.38)	(0.26)	(0.5)	(0.79)
8 - 10 years and higher	0.0074	0.0081	0.0603	0.0462	-0.0048	0.0225
	(0.12)	(0.13)	(1.07)	(0.76)	(-0.06)	(0.28)
Logconsumption per capita	-0.009	-0.1414	-0.0443	0.1584	-0.3513***	-0.7147*
	(-0.12)	(-0.51)	(-0.59)	(0.51)	(-3.06)	(-1.87)
Household size	-0.0021	-0.005	0.003	0.0093	0.0031	-0.0104
	(-0.32)	(-0.62)	(0.36)	(0.78)	(0.25)	(-0.55)
Health Workers in village	-0.0064	-0.0011	-0.094**	-0.1088**	0.0067	0.0492
	(-0.16)	(-0.03)	(-2.12)	(-2.51)	(0.11)	(0.63)
Access to safe water	0.0192	0.0317	0.024	0.0153	0.0202	0.0224
	(0.32)	(0.53)	(0.57)	(0.36)	(0.42)	(0.46)
No toilet (Base category)						
Normal toilet	-0.0295	-0.0091	-0.0387	-0.0601	0.0419	0.0497
	(-0.63)	(-0.19)	(-0.81)	(-0.94)	(0.63)	(0.74)
Dry toilet	-0.0412	-0.0308	0.0255	0.0021	0.0158	-0.024
	(-0.91)	(-0.68)	(0.5)	(0.04)	(0.19)	(-0.27)
Diarrhea	-0.0373	-0.0415	0.0486	0.0494	0.0322	0.0296
	(-1.23)	(-1.36)	(1.35)	(1.38)	(0.63)	(0.58)
Rural area	0.1278	0.1342	0.0888	0.0885	0.0484	0.0085
	(1.58)	(1.54)	(1.62)	(1.26)	(0.49)	(0.09)
Observation	1166		977		552	
Pseudo R-square	0.0577		0.065		0.0742	

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected z-statistics in parentheses.
3) * significant at 10% level. 4) ** significant at 5% level. 5) *** significant at 1% level.
6) Log consumption expenditure per captita is instrumented by Asset index and number of cattle and buffalos in IV Probit model.

Table 5.5: Underweight at national level, the difference between urban and rural areas

Underweight	Total dy/dx (z)		Urban dy/dx (z)		Rural dy/dx (z)	
	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit
Child's age 0-1 year (Base category)						
2 years	0.0903***	0.0904***	0.0889	0.091	0.0913***	0.0953***
	(3.05)	(3.06)	(0.97)	(0.98)	(2.93)	(3.07)
3 years	0.1565***	0.1548***	0.1955**	0.2068**	0.1502***	0.1496***
	(5.84)	(5.8)	(2.34)	(2.43)	(5.33)	(5.35)
4 years	0.1278***	0.1269***	0.1081	0.1033	0.1288***	0.1339***
	(4.7)	(4.67)	(1.28)	(1.21)	(4.5)	(4.71)
5 years	0.2223***	0.2214***	0.1596*	0.1592*	0.2281***	0.2296***
	(7.46)	(7.45)	(1.67)	(1.67)	(7.33)	(7.46)
Female	-0.0146	-0.0163	0.0376	0.0467	-0.0214	-0.0233
	(-0.87)	(-0.97)	(0.8)	(0.98)	(-1.19)	(-1.31)
Mother's age	-0.0036***	-0.0033**	0.0002	-0.0001	-0.0038***	-0.0035**
	(-2.77)	(-2.52)	(0.06)	(-0.02)	(-2.77)	(-2.48)
Mother's Education						
0 year (Base category)						
1 - 4 years	-0.0466**	-0.0397*	-0.0906	-0.0851	-0.0433*	-0.0329
	(-2.13)	(-1.81)	(-1.36)	(-1.28)	(-1.89)	(-1.42)
5 - 7 years	-0.0713***	-0.0578**	0.0176	0.0293	-0.0862***	-0.0624**
	(-2.72)	(-2.15)	(0.25)	(0.41)	(-3.05)	(-2.12)
8 - 10 years and higher	-0.1053***	-0.0913**	-0.1058	-0.1171*	-0.0899*	-0.0529
	(-2.77)	(-2.23)	(-1.6)	(-1.78)	(-1.89)	(-1.03)
Father's Education						
0 year (Base category)						
1 - 4 years	-0.0044	-0.0087	0.0633	0.075	-0.007	-0.014
	(-0.18)	(-0.36)	(0.63)	(0.75)	(-0.28)	(-0.56)
5 - 7 years	0.0045	0.004	0.0273	0.0412	0.0084	0.0102
	(0.18)	(0.16)	(0.3)	(0.45)	(0.31)	(0.38)
8 - 10 years and higher	-0.0021	0.0074	0.0145	0.0126	-0.0016	0.0171
	(-0.06)	(0.22)	(0.17)	(0.15)	(-0.05)	(0.47)
Logconsumption per capita*	-0.1102**	-0.3063*	-0.0463	0.1134	-0.1178**	-0.5014***
	(-2.56)	(-1.87)	(-0.47)	(0.42)	(-2.47)	(-2.78)
Household size	0.0038	-0.0012	0.0163	0.023	0.0023	-0.0066
	(0.95)	(-0.22)	(1.5)	(1.62)	(0.54)	(-1.14)
Health Workers in village	-0.0223	-0.0086	0.0135	0.0319	-0.031	-0.0047
	(-0.96)	(-0.36)	(0.22)	(0.52)	(-1.23)	(-0.18)
Access to safe water	0.0074	0.0121	-0.0015	-0.0018	0.0179	0.0254
	(0.3)	(0.5)	(-0.03)	(-0.04)	(0.66)	(0.94)
No toilet (Base category)						
Normal toilet	-0.0628**	-0.04	-0.0076	-0.0301	-0.074***	-0.0351
	(-2.53)	(-1.42)	(-0.12)	(-0.44)	(-2.73)	(-1.14)
Dry toilet	-0.0329	-0.0231	0.0748	0.0902	-0.0361	-0.028
	(-1.22)	(-0.86)	(0.94)	(1.13)	(-1.23)	(-0.95)
Diarrhea	0.0061	0.0055	0.0617	0.0552	-0.0053	-0.0107
	(0.33)	(0.3)	(1.22)	(0.99)	(-0.27)	(-0.54)
North region (Base category)						
Central	-0.0062	0.0023	0.1158*	0.1083*	-0.0216	-0.0084
	(-0.31)	(0.12)	(1.89)	(1.73)	(-1.02)	(-0.4)
South	0.0584**	0.0583**	0.0891	0.0971	0.0561**	0.0526**
	(2.37)	(2.35)	(1)	(1.05)	(2.16)	(2.04)
Rural area	0.0452	0.0438	-	-	-	-
	(1.35)	(1.19)				
Observation	3521		392		3129	
Pseudo R-square	0.0347		0.056		0.0298	

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected z-statistics in parentheses.
3) * significant at 10% level. 4) ** significant at 5% level. 5) *** significant at 1% level.
6) Log consumption expenditure per captita is instrumented by Asset index and number of cattle and buffalos in IV Probit model.

Table 5.6: The difference of Underweight among regions

Underweight	North dy/dx (z)		Central dy/dx (z)		South dy/dx (z)	
	Probit	IV Probit	Probit	IV Probit	Probit	IV Probit
Child's age 0-1 year (Base category)						
2 years	0.1433***	0.1362***	0.0494	0.0498	0.082	0.075
	(3.07)	(2.91)	(1.04)	(1.03)	(1.25)	(1.14)
3 years	0.2199***	0.2152***	0.1147***	0.1157***	0.1048*	0.0987
	(5.39)	(5.28)	(2.62)	(2.64)	(1.73)	(1.62)
4 years	0.1737***	0.1742***	0.0887*	0.0845*	0.1319**	0.1309**
	(4.16)	(4.24)	(1.95)	(1.85)	(2.26)	(2.24)
5 years	0.2441***	0.2354***	0.2063***	0.2082***	0.2361***	0.2256***
	(5.37)	(5.19)	(4.16)	(4.17)	(3.6)	(3.39)
Female	-0.0324	-0.0346	-0.017	-0.0183	0.0202	0.0218
	(-1.24)	(-1.34)	(-0.62)	(-0.65)	(0.53)	(0.57)
Mother's age	-0.0045**	-0.0039**	-0.0044**	-0.0039*	-0.0035	-0.0036
	(-2.19)	(-1.94)	(-2.04)	(-1.66)	(-1.17)	(-1.18)
Mother's Education						
0 year (Base category)						
1 - 4 years	-0.0429	-0.0036	-0.0326	-0.0361	-0.0986**	-0.0987**
	(-1.19)	(-0.1)	(-0.91)	(-1.01)	(-2.16)	(-2.11)
5 - 7 years	-0.073*	-0.0254	-0.1**	-0.0984**	-0.014	-0.0134
	(-1.69)	(-0.56)	(-2.53)	(-2.46)	(-0.23)	(-0.21)
8 - 10 years and higher	-0.0871	-0.0368	-0.115**	-0.1152**	-0.089	-0.092
	(-1.18)	(-0.47)	(-2.3)	(-2.22)	(-0.91)	(-0.86)
Father's Education						
0 year (Base category)						
1 - 4 years	0.0048	-0.01	-0.0592	-0.0568	0.0383	0.0272
	(0.13)	(-0.28)	(-1.44)	(-1.38)	(0.67)	(0.48)
5 - 7 years	-0.0237	-0.0329	0.004	0.0041	0.0318	0.0256
	(-0.63)	(-0.87)	(0.1)	(0.1)	(0.49)	(0.39)
8 - 10 years and higher	-0.0022	0.0207	-0.0557	-0.0507	0.0706	0.0644
	(-0.04)	(0.37)	(-1.16)	(-0.98)	(0.96)	(0.85)
Logconsumption per capita	-0.1036	-0.6465**	0.0115	-0.0634	-0.43***	-0.4599
	(-1.45)	(-2.51)	(0.17)	(-0.25)	(-4.1)	(-1.32)
Household size	-0.0072	-0.0184**	0.0098	0.0077	0.0189*	0.0181
	(-1.24)	(-2.46)	(1.46)	(0.79)	(1.81)	(1.2)
Health Workers in village	0.0572	0.0813**	-0.0761**	-0.0681*	-0.0259	-0.0015
	(1.51)	(2.09)	(-2.13)	(-1.91)	(-0.45)	(-0.02)
Access to safe water	-0.0063	0.0068	-0.0288	-0.0328	0.0991**	0.1085**
	(-0.1)	(0.11)	(-0.81)	(-0.93)	(2.29)	(2.5)
No toilet (Base category)						
Normal toilet	-0.1102***	-0.0509	-0.0364	-0.0272	-0.0746	-0.0696
	(-2.76)	(-1.16)	(-0.95)	(-0.55)	(-1.2)	(-1.1)
Dry toilet	-0.048	-0.0466	-0.0176	-0.0079	0.0004	0.0053
	(-1.16)	(-1.13)	(-0.41)	(-0.18)	(0.01)	(0.07)
Diarrhea	-0.0136	-0.0241	0.0029	0.0029	0.0055	0.0178
	(-0.48)	(-0.85)	(0.1)	(0.1)	(0.12)	(0.39)
Rural area	0.1682***	0.1195	-0.0237	-0.0206	0.125	0.1513**
	(2.67)	(1.58)	(-0.51)	(-0.36)	(1.6)	(1.99)
Observation	1476		1304		741	
Pseudo R-square	0.0419		0.0392		0.0657	

Notes: 1) Heterosketdasticity has been tested and corrected. 2) Corrected z-statistics in parentheses.
3) * significant at 10% level. 4) ** significant at 5% level. 5) *** significant at 1% level.
6) Log consumption expenditure per captita is instrumented by Asset index and number of cattle and buffalos in IV Probit model.

5.6 CONCLUSIONS

Children are the future labor force of a nation. Good health is a prerequisite for smooth education and child development. Healthy children with good education would become productive labor force in future. In turn, education is also an important factor for nutrition. This two-way relationship has significant long-term impacts on the country's development. Recognizing the crucial role of child health care, our study assesses the impact of income and education on child health.

Our findings imply that income generation activities and poverty reduction efforts would have more significant impacts on short-term child health. The role of health workers especially Medical Workers is also proved to be significant for improving child health especially long-term child health. Moreover, the role of education in improving health care is evident in Lao PDR, particularly, maternal education at the primary level is critical for children's nutrition status. Derived from the findings, government policy on poverty reduction and income generation for the poor should be further promoted and coordinated with improving quality of health workers. Moreover, education at the grassroots level, especially for mothers with young children, deserves more attention, if health status of children and long-term human resource development are to be enhanced.

Our analysis faces a limitation due to a lack of mother's biological data which is closely related to child nutrition status. To enhance our understanding on child nutrition status in Lao DPR and to bolster the significance of my dissertation, a field survey was conducted in three villages to collect primary data on mother's biological endowment and social capital for analysis of child nutrition status. The field survey and the resulting empirical analysis are presented in the next chapter.

APPENDIX 5 A: PCA SCORE OF ASSET INDEX

Table A 5.1: PCA score of Asset index

Variable	Coeff. 1	Coeff. 2	Coeff. 3
Land	-0.0990	-0.8765	0.4169
	0.0188	0.1666	-0.0793
Buildings business	-0.0211	-0.0107	0.0075
	0.7837	0.3973	-0.2782
Buildings Agriculture	-0.0104	-0.0383	0.0309
	0.3049	1.1191	-0.9034
Care, Van	-0.0148	-0.0049	0.0038
	0.9598	0.3167	-0.2499
Motor cycle	-0.0714	0.0203	0.0019
	0.7181	-0.2042	-0.0189
Refrigerator	-0.0688	0.0315	-0.0146
	0.7628	-0.3493	0.1622
Two-wheeled tractor	-0.0289	-0.0553	-0.0923
	0.3220	0.6146	1.0267
Four-wheeled tractor	-0.0105	-0.0193	-0.0423
	0.3263	0.6028	1.3192
Television	-0.1314	0.0281	-0.0096
	0.5768	-0.1235	0.0421
Satellie disc	-0.0167	0.0138	0.0028
	0.9096	-0.7528	-0.1511
Jewelry	-0.0871	0.0869	0.1191
	0.2391	-0.2383	-0.3267

Source: Author's calculation

CHAPTER SIX
THE ROLE OF SOCIAL CAPITAL ON CHILD NUTRITION STATUS

6.1 INTRODUCTION

In the 1990s, in addition to the long recognized importance of physical and human capitals for development, the term "social capital" has became more popular as well (Woolock and Narayan, 2000). Past literature suggested that social capital generally refers to trust, norms and networks, which can generate benefits for development in developing countries where markets do not function well. It acts as a substitute for or complements formal institutions or markets such as insurance and credit for improving the life of people in the community (Ferrara, 2007).

In Lao PDR, there are many areas which still need to be improved in order to be closer in achieving sustainable development. This is especially applicable in rural areas, where a market system does not function well or exist in some places. In addition to relying on their capital endowments, people have to also rely on their community in order to overcome the shock such as crop failure and random health shock. In addition to study the orthodox factors, it is worth to give more attention on another alternative factor such social capital that might affect their well-being. Lao PDR's human development index ranks 133 out of 177 countries with under-five child mortality ranking at 50 in the world and child malnutrition ranking second highest in East-Asian countries (UN, 2010). Given these poor rankings, the health sector, especially in child health, is set as a priority sector urgently requires improvement. From literature and media, social capital also has a positive role in improving child health, where social network in the village can provide health information or protection by buffering impact of health shock (Kawachi and Berkman 2001).

To our best knowledge, the literature relating social capital to child health is still relatively small in developing countries and it is considered rare in Lao PDR's case. This Chapter aims to investigate the effect of social capital on child nutritional status by using field survey data conducted in three villages in Oudomxay province of Lao PDR. This study provides useful information on how social capital relates to child health for which policy makers can utilize this factor for promoting the health sector.

6.2 SOCIAL CAPITAL AND DEVELOPMENT

Not until the 1990s was the important role of social capital contributing to development widely recognized. Although the idea of social capital has important impact on development, it was firstly used by Hanifan (1916) for explaining the role of community participation on school performance. However, social capital is poorly defined and interpreted subjectively to the interest field of various authors (Woolock, 1998). In the main stream concepts of social capital, such as Putnam (1993) and Fukuyama (2001), social capital is defined as trust, norm and networks which enable collective action of the individual. Coleman (1988) views social capital as a resource or asset of individuals made from social relationship. According to Coleman, social capital consists of obligation and expectation, information sharing and norm produced by the trustworthiness of social a structure. According to Bourdieu (1992), social capital is the sum of actual or potential resources earned by being membership in a group or network. From the concepts above, social capital can be generally referred as trust, norms and network that provide resources and enhance collective action in order to generate benefit to a member of the group.

From the growing literature on social capital, several studies have documented a positive role of social capital on economic development. Using cross-country data of the World Value Survey, from a sample of 29 countries, Knack and Keefer (1997) find that social capital (measured by percentage of individuals who say most people can be

trusted), has positive impact on GDP per capita output growth. In addition, from a sample of 41 countries, Zak and Knack (2001) assert that social capital measured by trust increases investment rates. Social capital also makes contributions to community developments. Studying 52 community forests in Nepal, Sakurai et al. (2001) find that social capital improves management of community forests. Moreover, Sakurai et al. (2005) also confirm that social capital measured by the number of organizations/associations in a village has a positive correlation with the number of villages receiving aid from outside after a crisis of 208 villages in Burkina Faso.

In the case of health, social capital could affect health through many mechanisms such as providing support, community influence, and having access to resources (Smith and Christakis, 2008). Using aggregate state level of trust among citizens of the USA as proxy of social capital, Kawachi et al. (1999) find that people with low social capital have high risk of poor health. At the state level in USA, Putnam (2000) shows that the States with high social capitals positively correlates with better public health and negatively correlates with mortality rates. According to Lynch et al. (2000) and Kennelly et al. (2003), social capital measured by trust has a weak impact on health outcomes at cross the country level. However, in East Asia, Yamaoka (2007) argues that social capital measured by belonging to an organization has a positive relation with a higher number of self-reported somatic symptoms while lacking of trust in an organization correlates with poor health satisfaction. In the Indonesia Family Life Survey (IFLS) 1993 and 1997 in Indonesia, people who live in a community with strong social capital have higher self-rated health, a higher number of activities of daily living and a lower number of bodily pains (Miller and Rosenberg, 2005).

Regarding child health, one way that social capital may affect child health is through self-insurance for handling the health and economic shock in developing countries where an insurance market is usually absent. Moreover, social capital also influences child health by providing health information and supporting both the physical and

mental health of mothers. In Mexico, social capital proximate kinship networks and members in a household and provides support of resources to mothers with young children and maintains child health (Kanaiaupuni et al., 2005). Carter and Maluccio (2003) show that social capital, measured at village level, positively correlates with children under five nutritional statuses (Height-for-age z-score) in Kwazulu-Natal province in South Africa. Based on IFLS 1997 and 2000, the panel study of Nobles and Frankenberg (2005) finds that number of key community programs participation of a mother who has lower education and lower income positively impact Height-for-age of children age 0-10 years. The degree of impact of social capital varies among countries due to the difference of culture and social value. From the investigation of maternal social capital on child nutritional status of Peru, Vietnam, Ethiopia and India of one year old children, social capital measured by the level of trust and social harmony positively associates with child Weight-for-age for all countries except Peru. On the other hand, effects from other form of social capital such as membership in a community group, involvement in citizenship activities and support from individuals vary among the countries (Silva and Harpham, 2007; Harpham et al., 2006). In addition to these aspects of social capital, the role of kin is argued to be crucial for child nutrition status, especially for child height (Nobles and Frankenberg, 2005). In another study, Gryboski (1996) concludes that a significant proportion of child care is given by relatives. However, to our knowledge the relationship between kinship network and child nutrition status has been largely neglected in literature.

6.3 Measurement of social capital, Theoretical framework and Empirical models

6.3.1 Measure of social capital

According to the general definition of social capital, this Chapter defines social capital as resources enhanced by networks which can be potentially or actually used by

individuals. Kinship network is used as a proxy of social capital in this Chapter because it covers almost all aspects of social capital. Members of this network generally share the same norms and values. Kinship network also generates trust and provides resources for members. Moreover, the kin based network is acknowledged as the most fundamental and effective form of social capital (Coleman, 1991; Putnam, 1995). Family and kinship ties also make significant contributions for development, especially in developing countries. This kind of network establishes social norms, provides members insurance and credit to overcome shock (Ferrara, 2007). In Southeast Asia, the kinship tie is very strong, especially in rural areas and it is considered as a fundamental aspect of social capital, such as in Thailand where the culture is quite similar to Lao PDR (World Bank, 2006).

6.3.2 THEORETICAL FRAMEWORK

The theoretical framework in this Chapter follows framework of human capital investment (Becker, 1965) and household production function model. Child health demand function is derived from the health demand function developed Rosenzweig and Schultz (1983).

Parents obtain utility from child health (H), goods affecting child health (Y) and consuming other goods (X), subject to budget constraint (where I is household total resource, p_x is price of others goods, p_y is price of consumption good affecting child health and p_m is price of medical care) and child health production function (H). H consists of consumption goods affecting child health (Y), medical care (M) augment utility only through H function, biological endowment (B),household and parents' characteristics (Z), and health environment (G).

Regarding social capital, according to Becker and Murphy (2000), social capital (S) is exogenous and does not directly enter the parents' utility function. It is an input

in the household model that produces commodities such as providing good health for their children in this Chapter.

The utility maximization is expressed is expressed as follow:

$$Max U(X,Y,H)$$

$$S.t$$

$$H = h(Y,M,B,Z,G,S)$$

$$I = p_x X + p_y Y + p_M M$$

By solving this maximize utility function of the parents, we obtain the optimum level of the choice variables as a function of all of the exogenous variables. The reduced form demands are:

$$X = x(p,I,B,Z,G,S)$$

$$Y = y(p,I,B,Z,G,S)$$

$$M = m(p,I,B,Z,G,S)$$

Substitute these into the child health production function. The reduced form of optimal child health demand function can be written as:

$$H^* = h(y(p,I,B,Z,G),m(p,I,B,Z,G),B,Z,G,S)$$

$$H^* = h(p,I,B,Z,G,S)$$

With respect to the data used in this Chapter (cross-sectional data), the prices of all goods can be considered as constant except for the price of health care such as ability of mother to provide health care in each region. In this chapter, number of the Medical Worker in the district is used as a proxy of price for health care. The cost of medical care in Lao PDR is almost free, thus the more number of the Medical Worker available in their region, the lesser of opportunity cost of the patients.

Therefore, the optimal child health production function is influenced by the price of medical care (p_m *), total household resource (I), biological endowment (B), household's and parents' characteristic (Z), health environment (G) and social capital (S). The reduced form of health equation can be denoted as follow:

$$H^* = h(p_m^*, I, B, Z, G, S)$$

6.3.3 EMPIRICAL MODEL AND ANALYTICAL METHOD

From the theoretical framework above, child health is the function of price of health input, biological endowment, total household resource, parents' characteristics, health and social capital. The empirical model used in this chapter is shown as follow:

$$\begin{aligned} Stunt\ or\ underweight = {} & \beta_0 + \beta_1 female + \beta_2 age + \beta_3 Mheight + \beta_4 Mage + \beta_5 Fedu \\ & + \beta_6 Medu + \beta_7 SC + \beta_8 \log y + \beta_{19} infor + \beta_{10} HHsize + \beta_{11} village\ dummy \end{aligned} \quad (1)$$

where s*tunt* and *underweight* are used to indicate children's health status which are proxy of children health (H), *female* and *age* are child's gender and age; *Mheight* and *Mage* is mother's height and age; *FEduc* and *Meduc* are years of father and mother education; *SC* is social capital; log *y* is household income level; *info* is accessibility to health information; *HHsiz* is household size; *village dummy* is dummy for 3 sample villages.

Child nutrition status is measured by the Anthropometry method based on the WHO standard. Anthropometric value is in the form of z-score which is calculated from the formula below:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j}$$

where X_{ij} is the observed value of ith child; μ_j is the mean value of the reference population and σ_j is standard deviation of the reference population.

A child who has Weight for age or height for age z-score below -2 is considered as underweight or stunted respectively. Stunted height normally results from a long period of inadequate food consumption. Therefore, it is considered as a proxy of long

term child health. Underweight is generally considered as a child malnutrition status - this can be observed as a short term health status.

For the above method, Equation (1) is then applied to the Probit model to estimate the impact of explanatory variables on the probability of child nutritional status.

6.4 Data and Variables

6.4.1 Data

As previously mentioned, mother's biological endowment is said to have significant impact on child nutrition status. In particular, mother's height is widely used in literature as a proxy for mother's health and biological endowment to control child nutrition status in the estimation. However, to our knowledge, such information has not been used for analysis in the case of Lao PDR. Moreover, social capital is considered important for child health, particularly in rural and remote areas, owing to the lack of appropriate market mechanisms and lack of external assistance (external to the community) in case of health shock, for example.

In order to fill this data gap and to enhance the quality of the analysis in our research, a field survey was conducted to collect primary data. Specifically, the field survey was conducted in Odomxay province, the northern part of Lao PDR in August 2009 and early 2010. It covered three villages (Homxay village, Mainatao village and Nasavang village) and has yielded a sample of 245 households. Upon removing incomplete samples and cleaning the data, there are 214 children below age 10 years available for econometric the analysis. Another advantage of the dataset is that it contains annual income data which is invariant to random health shock over the year, and can overcome the problem of endogeneity in our analysis.

6.4.2 VARIABLES AND DEFINITION

Dependent variables:

Stunt and Underweight are children who have z-score of height-for-age and weight-for-age under -2 respectively.

Independent variables:

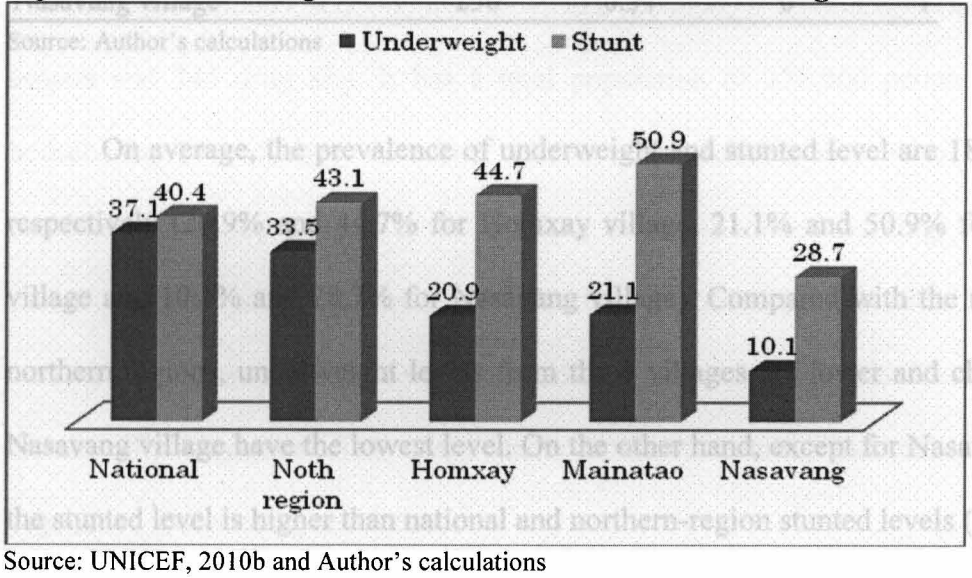
- Female dummy: this is a dummy variable and is defined as 1 if the gender of children is female and 0 otherwise.
- Age: is the age of sample groups. Here, the children's age is divided into 3 age groups (0-11 months, 1-5 years, and 6-10 years) to capture the feeding effect in each age period. Children between 0-11 months old are exclusively in the breastfeeding period; Child has some breastfeeding with other food for supplement during 1-5 years; 6-10 years is school age and no longer breastfeeding.
- Mother's height: this is the height of the mother in centimeters. This variable is used as proxy of child biological endowment to control genetic factors on child health. On the other hand, despite its availability mother's weight is not applied for analysis, because it fluctuates over time and would not reflect her long term health status.
- Mage: is the age of the mother in years.
- Feduc and Meduc are the father's and mother's educational level. It is divided into five groups: No education=1; with some primary school level (1-4 years of school) =2; finished primary school level (5-7 years of school) =3; finished lower secondary school (8-10 years of school) =4, and finished high school and higher education (11+ years of school) =5.
- SC is the number of a child's families of relatives living in his/her village. This variable is used as proxy of social capital for measuring the network of kin. In

terms of proxy for social capital, the kin network is more appropriate because in the context of the samples village, other forms of social capital such as voluntary participation in community activities is controlled by the regulation in the village that every household must send one representative to join the activity.

- Log (y) is a natural logarithm of household annual income per capita from wage earning and agricultural output. This proxy is used as household income resources.
- Info is the dummy variable for having access to health information and is defined as 1 if the household has a television and 0 otherwise.
- HHsize is household size. It represents the number of household members who are living together.
- Village dummy: this is the dummy variables of the 3 villages. These variables are used for controlling the effect of each village on child health status. They are also used to control the impact of health and sanitation environments because most households in each village share the same health environment.

6.4.3 MAJOR CHARACTERISTICS OF THE SAMPLES

Figure 6.1: Under weight and stunt at national, northern region and village level



Source: UNICEF, 2010b and Author's calculations

Table 6.1: Basic characteristics of variables in child nutrition status analysis in Homxay, Mainatao and Nasavang village

Variables	Obs	Mean	Min	Max
Underweight	236	0.18	0	1
Stunting	236	0.41	0	1
Female	235	0.46	0	1
Age (months)	236	63.38	0	120
0-12 months	236	0.17	0	1
1-5 years	236	0.33	0	1
6-10 years	236	0.50	0	1
Mother's weight	225	49.56	31	75
Mother's height	225	149.96	134	172
Father's age	227	34.25	19	65
Mother's age	235	29.68	17	50
Father's year of school	226	5.75	0	12
No education	227	0.07	0	1
Someprimary	227	0.15	0	1
Primary school level	227	0.44	0	1
Higher level	227	0.34	0	1
Mother's year of school	235	3.83	0	12
No education	235	0.28	0	1
Someprimary	235	0.18	0	1
Primary school level	235	0.38	0	1
Higher level	235	0.15	0	12
Number of relative	235	6.32	0	20
Homxay village	235	4.77	0	20
Mainatao village	235	6.37	0	20
Nasavang village	235	8.34	0	20
Yearly per capita income	234	1166148.0	25500	4488000
Have television	236	0.70	0	1
Household size	236	6.55	3	16
Homxay village	236	0.44	0	1
Mainatao village	236	0.22	0	1
Nasavang village	236	0.34	0	1

Source: Author's calculations

On average, the prevalence of underweight and stunted level are 18% and 41% respectively (20.9% and 44.7% for Homxay village, 21.1% and 50.9% for Mainatao village and 10.1% and 28.7% for Nasavang village). Compared with the national and northern regions, underweight levels from the 3 villages are lower and children from Nasavang village have the lowest level. On the other hand, except for Nasavang village, the stunted level is higher than national and northern-region stunted levels (Figure 1).

The average age of the children is 5 years old while the average age of the father and mother are 34 and 29 years respectively. On average, the schooling years of father is 5.75 years with 7% of the sample having no education. The average years of the mother's education years are 3.8 and uneducated mothers are 28% of the samples. The number of relatives living in the same village is 7 families and yearly income per capita is 1,166,148 kip (UDS 141.7). Among the 3 villages, households in Mainatao village have the lowest average annual income per capita (USD 102.1), while the highest is in Nasavang village (USD 205.3). In terms of the number of kin networks, on average a household in Nasavang village has the largest network (9 families of relatives), while the smallest network is in Homxay village (5 families of relatives).

6.5 Development and social capital in Oudomxay province and the three villages

Oudomxay province is the second poorest in northern regions. It surrounded by Phongsali, Lungnumtha, Bokeo Xayabouri, and Lungprabang province, and is considered as a junction to the Northern provinces in Lao PDR. The capital district is Xay district. It has road access to Vietnam, China and Thailand, but it only shares a border with China. Oudomxay province has 473 villages with 121 of the villages having no access to roads and only 96 villages having access to electricity. There are 196 complete primary schools, one provincial hospital, 6 district hospitals, 41 health centers and 345 drug kits. It has a total population of 276,960 people and 46,244 households, 244 villages, of which 31.2% of households and 90 of villages are considered poor. Agriculture in the province is mostly upland farming, with a strong subsistence orientation and there is still widespread shifting cultivation. Recently the number of Chinese merchants who come to do contract farming with local farmers has dramatically increased. The crops under contract farming include, for example, vegetables, fruits, corn, and tobacco.

Homxay village which belongs to Xay district is considered as an urban area. The village was established in 1976 by expanding the small village to the main road. Now the village is located along the side of the main road which is 7 km from the capital village of the province. The geographical area consist a mix of lowlands and uplands, but agriculture plots are mostly in the upland area. The village has one complete primary school and one lower secondary school. There are 165 households and 886 people who are mostly ethnic Keumu. There are two waves of migrants to this village. The first wave of migration occurred in 1976 when the village was first established, where most of the migrants were farmers. The second wave of new migration happened during the early 1980s, in which most of them were former soldiers who came to work at the government sawmill while the government provided them some land for cultivation. Although most of the villagers are farmers, there are civil servants such as soldiers and police officers. Only some households in this village grow rice just for their own consumption. The main crop in this village is corn, which is part of doing farming contracts with the Chinese merchants. After the cultivation season, recently, some villagers also have temporary work at a rubber plantation. People in this village also highly dependent on non-timber forest products as sources of additional food and income. They sell banana leaves, mushrooms, and bamboo shoots in the market which is 7 km away from the village in order to earn extra money for daily consumption. In terms of health facility utilization, people in the village are able to access the district hospital in the case of serious injury; otherwise they treat themselves by buying medicine from the nearest pharmacy. According to the survey, the main reason that mothers give birth at the hospital is for hysterectomy because they have enough children. Generally, children in the village are born at home with assistance of the only birth attendant in the village who is a former soldier medical doctor. The main water drinking source is from the reservoir (water from a mountainous stream) and most of the households use dry toilets.

Mainatao village, established in 1977, is located about 20 km away from the paved road under Namor district. The village has only 41 households and 223 people with a majority of Kuemu. All of the villagers moved to this village almost during the same period. Recently there are still some household migrants from more remote villages to this village, with most of them having relatives living in this village. Most of the villagers are farmers and there are only two civil servants who are primary school teachers. The village has one incomplete primary school and shares a lower secondary school with Nasavang village, which it is about 5 km away. 95% of the geographical area is upland and the main crops in this village are rice and corn. Rice is mostly used for their own consumption while corn is mostly sold to a Chinese merchant who conducts contract farming with them. Beside corns, after the rainy season, they also grow vegetables such as chili, watermelon, and pumpkin, depending on the demand from the Chinese merchant; and in 2010 they started to grow tobacco. The incomes from contract farming, especially in vegetables, vary each year due to the lack of negotiation power. The merchant completely controls the price and there is no market in the village. In the worst season, the merchant did not even come to buy the crop from them. In terms of health service and facility, the people in this village depend on Health Volunteers and drug kits from Nasavang village. They use the service of a healthcare center which is about 5 km from their village only in the case of serious of illness and injury. Most people in the village were born at home with the assistance from their relatives. Self awareness of sickness is low according to the answers provided to the interviewer about their children's health. Most cases of child mortality occur because of parents not identifying unusual symptoms in their children before dying. There was a German project which provided funds for water and sanitation in this village, by constructing the reservoir system used as a drinking water source and building a common pit latrine for the village.

Nasavang village has such a long history of settlement that even the elders in the village do not know exactly when the village was established. It used to be called Ai village before changing to Nasavang village in 1992. It belongs to Namor district and is located 24 km away from a paved road. There are 204 households and 749 people, who are mostly ethnic Yang. The village has one complete primary school and one lower secondary school. Among the three villages, Nasavang village is the only village that can produce enough rice for their own consumption and sells the rest because they have better land quantity and quality. Nasavang village is also set as a base for Chinese merchants who come to offer contract farming in the region. Thus, there are varieties of crops grown in the village during the dry season such as chili, pumpkin, water melon and tobacco. The merchant provides seeds, fertilizer, and technicians for the farmers. Passionfruit, corn, chili and tobacco are the main crops grown every year. In the village, the merchants also hire some villagers to work for them as coordinators and managers for each plant. During the harvesting period, a truck comes directly from China to the village and buys the products in the village which can generate cash income for the villagers. For example, during the passionfruit harvesting season, the merchant comes to buys the fruit every week for three months. However, in some years the merchant does not come to buy the products, especially vegetables. Therefore, most of the products have to be thrown away because there is no permanent market in the surrounding region. In addition, people in this village also raise livestock such as pigs and chicken for their own consumption as well as sale. A number of merchants often come from outside the village to buy these livestock in the village. In terms of health service, Nasavang village is set as the center to promote a primary health care program to the surrounding villages which are difficult to access. The village has drug kits and two Health Volunteers who were trained in Luangprabang province for the primary health care program. They can provide villagers consultation and medicine for minor health problems. For serious injuries,

patients are transferred to a healthcare center which is about 3 km away. In terms of sanitation, all households have pit latrine and use water from the reservoir as a drinking water source, which is under the fund of the German project.

In terms of community activities, there is a common rule in the village where every household must send a representative to join any community activity such as meetings, participation in health promotion campaigns and improving the road. An absent household is charged with a fine. Moreover, Nasavang village has a distinct culture that might relate to the health nutrition status of people in the village. According to Yang ethnic culture, there are two days every month called "Wan Sin" (full moon ritual) based on Buddhism, in which one household in each unit of the village must hold a ritual ceremony and invite all the people in the village to join (on average one household has to hold the ceremony once a year). The households normally share money for buying meat from outside the village to provide food for the ritual. The two days of ritual are the only time that people in the village eat meat because, in general the main food for villagers is rice and vegetables. In the aspect of kinship networks, Nasavang village has stronger and larger kin networks because the village has a longer settlement period and the people rarely migrate to other villages. Kin networks tend to play an important role for Nasavang and Mainatao villages in comparison to Homxay village due to lack of access to a market and outside help.

6.6 ESTIMATION RESULTS

Because there is a lack of data and information at the national level on child genetic determinant factors, especially social capital which is considered as an important factor for the well-being of people, particularly in developing countries. Therefore, the field survey was conducted mainly to study the impact of social capital on child health in villages in order to provide some evidences to fill this gap. The

marginal effects and z-statistics of probability of be stunted and underweight are shown in Table 6.2.

At the village level, the estimation result shows evidence that social capital plays an important role in reducing child malnutrition, especially on long term child health. The estimated coefficient for social capital shows that children who have one more families of relatives in the village are less likely to be stunted and underweight by 1.8% and 1.5% at 10% and 5% significant levels, respectively. This finding supports previous studies about the impact of social capital on child nutritional status, such as Nobles and Frankenberg (2005) and Silvia and Harpham (2006). This result can be explained by the fact that relatives might help provide food or credit to the child's family when they are facing a crisis, particularly in terms of child health in Mainatao and Nasavang villages which have limited contact with the outside. In Nasavang village, there is evidence of food sharing, especially rice during a crop failure or food crisis. From the interviewed sample, the affected people who had a financial problem tend to borrow money from their relatives, and almost 80% of the samples borrow without making any formal document procedure or paying interest. According to the previous literature, there is evidence that social capital make a significant contribution to accessing credit (Grootaert, 2001). Moreover, it is also believed that there is sharing of health information among the group.

Comparing the three villages, the estimated coefficients show that children who live in Homxay and Mainatao villages have a probability of being stunted and underweight at 22.8% and 34.4% respectively, compared with children in Nasavang village. This finding tends to show some child health effect of relative strength of the kinship network in Nasavang village, because this village has a much longer history. The longer the village has been established, the better and the stronger is the village organization, which in turn strengthened kinship networks in that village.

There is no difference between boys and girls being stunted and underweight. The age of children is confirmed as a crucial determinant for both stunting and malnutrition which are similar to the findings above. Comparing children aged below 1 year old, with children aged between 1-5 and 6-10, the probability of being stunted increases by 22% and 33%, respectively, while children aged between 6-10 have a higher risk of being underweight by 21%. This finding shows the evidence of insufficient food intake for children in the villages. The results indicate a significant increase in the probability of being malnutrition as children become older. From our observation, the foods in each meal are mainly rice and vegetables while the source of protein such as fish or meat is rare and varies depending on ability and luck at finding it in the river and forest.

Mother's height which is used to control the genetic factor of children shows significant impact on reducing child malnutrition, particularly on child long term health status. The coefficient estimate for mother's height finds that mothers with higher height are less likely to have stunting and underweight children by 1.2% and 1% with statistical significance at the 10% and 5% levels respectively. This finding is supported by previous studies, such as Silvia (2005), Nobles and Frankenberg (2005), and Kabubo-Mariara et al. (2008). Furthermore, mother's age is also a crucial determinant factor of child health. The coefficient has a negative impact on a child being stunted and underweight by 2.9% and 2.3% respectively at 1% statistically significance. This can be explained by the fact that an older mother knows how to take care her child better. Moreover, it is interesting to note that an older mother who decides to have her last birth prefers to give birth at the hospital because she tends to ask the doctor for a hysterectomy after giving her last birth.

In terms of parental education, maternal education does not show any impact on children being stunted and underweight, unlike the finding in the national and northern region cases. However, parental education tends to play a crucial role on child health in

the both long-run and short-run. The positive impact of parental education on improving child health supports the previous literature such as Thomas et al. (1990), and Strauss and Thomas (1995). Children whose to father has some primary, primary and higher educational level decreases the probability of stunting by 42%, 39%, 42% respectively and being underweight by 12%, 25% and 19% respectively compared with uneducated fathers. This finding confirms the evidence of father's education on child nutrition status in the North from previous Chapter. The intuition behind this might come from the fact that a Keumu husband mostly stays at home and takes care for their children while the wife works in the field. Hence, father's education plays a more important role for utilizing health information and distributing food among the family members in this case.

Table 6.2: Stunt and Underweight in Homxay, Mainatao and Nasavang village
Probit regression

	Stunt		Underweight	
Independent variables	dy/dx	z	dy/dx	z
Female	-0.0353	-0.47	-0.0606	-1.41
Age 0-6 moth as ref.				
Age 1-5	0.2217*	1.94	0.1053	1.24
Age 6-10	0.3382***	2.95	0.218***	2.71
Mother's height	-0.0113*	-1.95	-0.0104**	-2.58
Mother's age	-0.0295**	-3.87	-0.0237**	-4.28
Father education (No education as ref.)				
Some primary	-0.4265**	-5.55	-0.1246**	-2.94
Primary	-0.3984**	-2.69	-0.2578**	-2.69
Higher	-0.4216**	-3.14	-0.1943**	-2.77
Mother education (No education as ref.)				
Some primary	-0.0141	-0.11	-0.052	-0.85
Primary	-0.017	-0.14	-0.1099	-1.59
Higher	0.049	0.3	-0.0869	-1.52
Number of Relative	-0.0186**	-2.1	-0.0154**	-2.46
Log Total income capita	0.1464	1.21	0.0094	0.14
Television	0.0253	0.29	-0.0827	-1.31
Houshold size	0.0243	1.6	0.0091	1.03
Homxay	0.2287***	2.31	-0.0109	-0.17
Mainatao	0.3441***	2.74	0.0411	0.46
Number of obs	214		214	
Pseudo R2	0.1671		0.2745	
Log likelihood	-119.4		-72.61	

Source: Author's calculations

Family income in this case shows no impact on child nutrition status. The underlying reason is that people in the sample depend on their own production for consumption while the income from annul sales production is spent for assets. From the estimation, household size is not statistically significantly in correlation with the child nutrition status, even though larger households show positive signs on malnutrition.

6.7 CONCLUSION

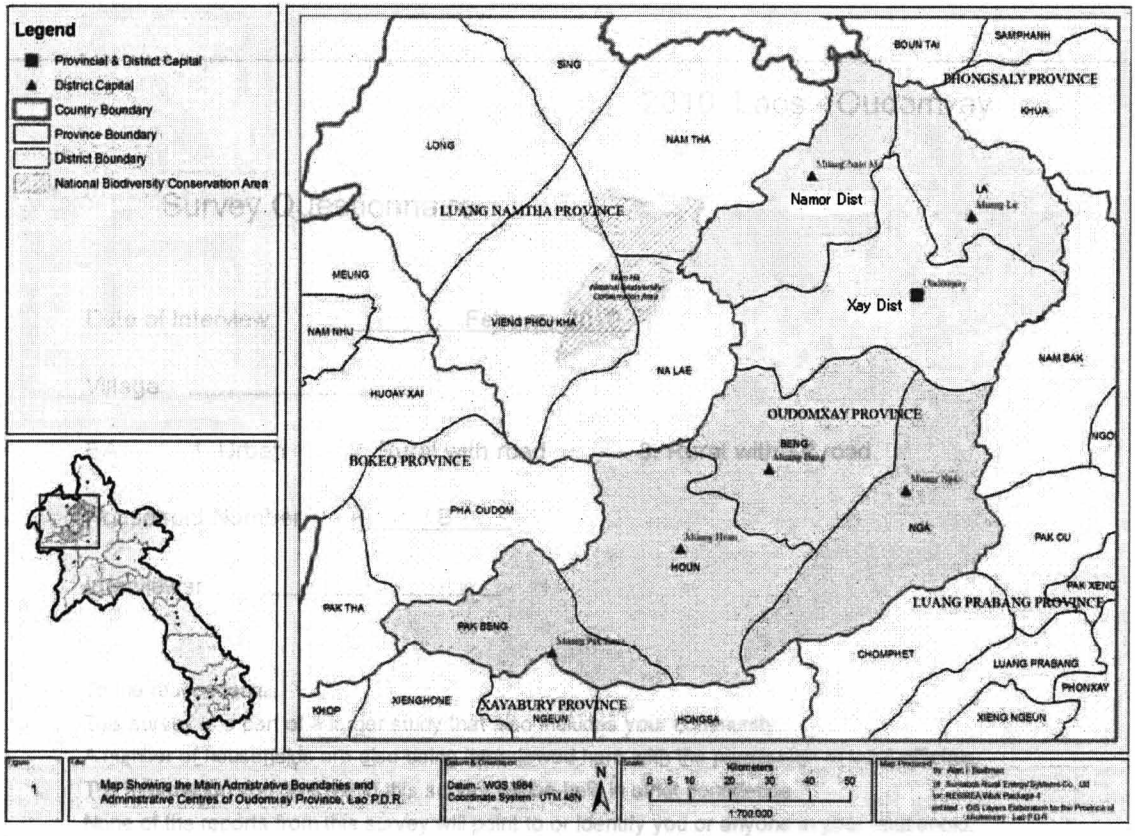
Our study provided an analysis on social capital as a determinant of child nutrition status. The research has found evidence that kinship network, which is acknowledged as the foundation to social capital, is one of the mechanisms of people in rural areas use as a buffer to economic and health shocks. From the analysis, kinship network shows an impact on improving child health status, especially for long term child health.

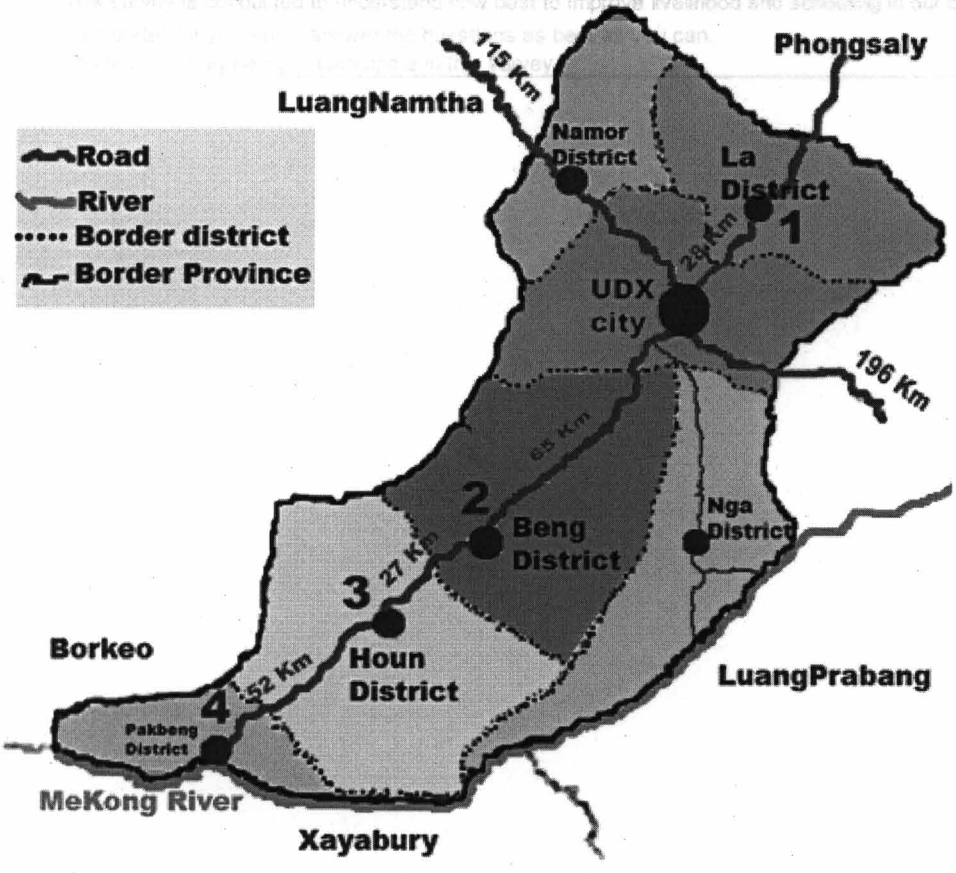
Consequently, the government must be aware of the importance of this social capital. These traditional kinship networks or social relations among household units or communities may be altered gradually under an increased market-transition economy as the Government has strongly and continuously pursued economic development. Inappropriate economic development, particularly macro-development projects without proper social and environmental assessments, would severely impact people especially in rural areas where people mostly rely on community and natural resources to live. As their ability to survive is affected at a larger scale (e.g. at the community level), social capital like kinship network would not function well, especially when acting as a buffer to social and economic shocks. As a result, widespread child malnutrition would seem unavoidable. Moreover, toward urbanization, a family network tends to be smaller and more independent. Thus, a challenge for policymakers is whether to create an appropriate supporting mechanism to substitute or complement this traditional social

capital. Formal institutions such as microfinance or community funds, recently, seem to be options for boosting social capital at the community level and used as a tool for handling shock in villages. However, as in literature, the effects of these kinds of tools on rural development still vary among countries. Therefore, further study of other types of social capital would be useful for development. A further study on (i) how social capital like traditional kinship network has been affected or deviated by increasingly market-transition economic forces and (ii) what the social and economic implications and effects of changing such social capital on child health appear to be useful so that appropriate government intervention programs can be introduced to mitigate any deteriorating rural households' and communities' social capital.

APPENDIX 6 A: MAP OF OUDOMXAY PROVINCE

Figure A 6.1: Map of Oudomxay province





APPENDIX 6 B: SURVEY QUESTIONNAIRE

2010 Laos - Oudomxay

Survey Questionnaire

Date of Interview: Febuary 2010

Village: _____

EA: 1. Urban 2. Rural with road 3. Rural without road

Household Number: A / B

Interviewer: _____

To the respondents:
This survey is a part of a larger study that also includes your community.
A number of households are also being interviewed here with the permission of local officials.
The information you give me in this survey will be held in strict confidence.
None of the reports from this survey will point to or identify you or anyone in your household.
This survey is conducted to understand how best to improve livelihood and schooling in our country.
I am grateful if you would answer the questions as best as you can.
Thank you for agreeing to participate in this survey.

Q1. Household members who live together

ID	Name	Relation	Sex	Age at Last Birthday			Ever Go	Literacy	Can you		Education		Occupation		Activity in Pass 12 months				Ethnicity	Ethnic	Migration
				Age	Year	Month	School?	Campaign	Read	Write	Level	Class	Main	Subsidiary	Paid Job	Farm	Study	Other		Group	
1		1. head																			
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

Informant ◎

2.spouse 1; Male 19XX 1; Yes 1; Yes 1; Can not 0. no No = 0 in Name 1=lao loum
3.parent// 2; Fema 20XX 2; No 2; No 2; Difficult 1. primary Yes = No. of months 2=lao theung
4.son-daughter 3; Easily 2. lower sec 3=lao soung
5.son//
6.brother-sister 3. upper sec
7.brother// 4. vocational
8.other relatives 5. technical
9.non relative //=in law 6. university
99. don't know

Q2. Household members who live apart elsewhere

ID	Name	Relation	Sex	Age at Last Birthday			Ever Go	Literacy	Can you		Education		Main Occupation / Place		Earnings	Remittance	Labor Contributio	Location
				Age	Year	Month	School?	Campaign	Read	Write	Level	Class					to Farming	
13																		
14																		
15																		
16																		
17																		
18																		

Education (Under age of 15)

	1	2	3	4	5	6	7		8	9
ID CODE	Have you ever bee to school *Yes = 1* *>> 3* *No = 2*	Which is the main reason why have you never attended school? *Too young =* 1 *Too expensive =* 2 *No interest =* 3 *Had to work =* 4 *School too far =* 5 *No teachers/ supplies =* 6 *Illness =* 7 *Language =* 8 *Other, specify…* 9 *>>Next person*	Did you attend preschoo (at least one year) before beginning primary school? *Yes = 1* *No = 2*	Are you enrolled in school now? *Yes = 1* *>> 7* *No = 2* *>> 5*	Highest Complete Grade/ Class?	*If* Why were you not continued your study? *Too expensive =* 1 *No interest =* 2 *Work =* 3 *School too far =* 4 *No teachers/ supplies =* 5 *Illness =* 6 *Language =* 7 *Other, specify…* 8	What grade are you enrolled in now? LEVEL / CLASS *Preprimary =0* / *0* *Primary =1* / *1 - 5* *Lower secondary=2* / *1 - 3* *Upper secondary=3* / *1 - 3* *Vocational train.=4* / *1 - 3* *Informal Eduction=5* *Other* LEVEL / CLASS		What type of scho are you attendi ? *Public = 1* *Private= 2* *Other = 3*	In what year did you begin Class 1 of Primary School? YEAR

Education, cont (Under age of 15)

If no household members enrolled in school go to next.

Ask Question 10- 16for all household members enrolled in school nowor last school-year. First record ID code.

ID CODE	10 How much has your household spent on NAME's education in the last school-year for: *Include monetary value of in-kind payments* *After asking individual amounts, calculate total and ask:* "So, altogether you have spent ___ kip on (NAME's) education in the last school-year. Is that right? *Probe and*							11	12	13		14	15	16	
	A. Tuition and other required fees?	B. Parent associa-tion fees?	C. Uni-forms and other clothing?	E. Study materials (exercise books, pens, etc.)	F. Meals transpor-tation and or lod-ging?	G. Other expenses (extra classes, optional fees)?	H. TOTAL	Where does Name stay during school days? 1=home 2=dorm 3=relatives	How far away from NAME'S home is the school NAME has attended most recently? *If less than one kilometer put meter with 'M'*	How long does it take NAME to go to school from home		Does NAME ha complete set of a textbooks for his/her use? *Yes, complete=1 No, only some=2 No, none = 3*	Does NAME sha these textbooks with other students or are they for his/her exclusive use? *Shared = 1 Exclusive use = 2*	Does NAME rent text book?	
	AMOUNTS IN KIP								KILOMETERS	HOURS	MINUTES				Cost

Child Health

May we ask you about health status including alive and dead of all children in your households?

Q1. For children, age 1to 15 years old, in the household

Father ID	Mother ID	Child ID	Birth order	Sex	Where did you give birth	who assisted with the delivery	Is he/she alive or not?	If not how old when he/she die	Mother age at dilivery	Length of breastfeeding in months	Vaccinations	Age (in X years Y months)	Height in Cm	Weight in Kg	How to treated when got sick

Sex: 1; Male 2; Fem

Where did you give birth: 1;Hospital 2;House

who assisted with the delivery: 1;Health worker 2;TBA 3;Relative 4;No one

Is he/she alive or not?: 1:alive 2:dead

Vaccinations: 1; BCG 2; DPT (1-3) 3; Polio (0-3)

Age (in X years Y months): 4; Measles 5; All 6; None

How to treated when got sick: 1; Go to the medical doctor 2; buy modern medicine 3; By the traditional method 4; Did nothing (stay at home) 5; Others (Specify)

Q2. For the parent who has children age 1 to 15 years old in the household

Father ID	Mother ID	Health information source	Health programme		Long term health problem	Drinking water		Toilet facility	Height measured in cm	Weight measured in kg
			Times of participati	Kind of health program		Source	Usage			

Health information source: 1;Health worker 2; school teacher 3; Listen to the radio 4; Watch television 5; Read a newspaper, poster 6; Others

Long term health problem: 1; Yes 2; No

Drinking water — Source: 1; Pond 2; Well 3; Piped water 4; Others

Drinking water — Usage: 1; boiled 2; Not boile

Toilet facility: 1; Own 2; Near the house 3; Not use

Health

Q1. Is there any traditional healer in the village? ☐ Yes ☐ No

Q2. When you get sick where do you oftenly visit during the past 12 months?

☐ Health care center ☐ Traditional healer

Q3.If TBA or Relative assisted you to dilivery, where did they learn about this? ☐ Used to be trained by health worker ☐ From their experience

Q4. Have you ever give brith at hospital ☐ Yes ☐ No

Q5.1. If yes, why did you gave birth at hospital? ☐ For safety ☐ Had difficulty of giving birth ☐ others

Q5.2 If no, why you did not give birth at hospital? ☐ Did not necessary ☐ Heavy burden on costs ☐ others

Q6. Have you ever plan the number of children you want to have? ☐ Yes ☐ No

Q7. Who makes decision about number of children you have? ☐ Your husband ☐ Your wife ☐ others

Q8. What is the ideal number of children do you want? _____

Q9. Do you want to have ? ☐ More children ☐ Enough ☐ Less children

Q10. Why?

Q11. Have you ever use contraceptive method? ☐ Yes ☐ No

Q12. Why?

Q13. What kind of contraceptive method do you use?

Social Capital

Q1. How many years ago did your ancestors start to live in this village? _____ years ago

Q2. How many relatives do you have in this village? _____ persons

Trust and Cooperation

Q1. Do you think that in this village people generally trust one another when they borrow or lend money?

1. Do trust 2. Do not trust

Q2. Do you lend the money with document and interest?

	Yes	No
Relative		
Non-relative		

Q1. Do you join any public survice group? ☐ Yes ☐ No

Q2. If yes what is it? _____

Q3. Do you join any saving group? ☐ Yes ☐ No

Networks and Cooperation

Q1. When you cultivate your farm or paddy field last season, were there any friends come to help you? ☐ Yes ☐ No

Q1.1. If yes, How many people do you borrow money from in the pass 12 months? _____

Q4. In the pass 12 months, how many people do you lend the money? _____

Q5. During the past 12 months did you or any one in your household participate in any communal activities, in which people come together to do some work for the benefit of the community? ☐ Yes ☐ No

Q5.1. If yes, How many time do you attend? _____

Crops planted and harvested in the last season *Dry*

PLOT CODE	1						2	3		4	5		6	7		8	
	Now some questions about what was planted in your plot(s) in last season.																
	Record: Name and code of crop per plot *Record all crops circled*		Area planted	Area harvested	Production in kg	Agricultur shock	Have you sold any (.....) ? *Yes = 1 No = 2*	If sold: How much?		What wa the price you got from sale?	If lost: How much?		Was any (. given to pay labo or make ot payments? *Yes = 1 No = 2*	If given: How much? in kind in cash		Do you have stored rice	
	CROP NAME	CROP CODE	HECTARE	HECTARE	KG			KG	OTHER UNIT	Price per kg	KG	OTHER UNIT		KG	OTHER UNIT	Seed	Own-Consumption
	Glutinous rice	1															

1. Flood 3. Insecticide
2. Drough 4. Other

Agricultural Input

Plot Code	CROP NAME	CROP CODE	9 Labor HH	9 Labor Non-HH	10 Seed (kg)	11 Variety Name	11 Variety Type	11 Variety Expected Yield	12 Fertility Y/N	12 Fertility Kg	13 Irrigation Y/N	13 Irrigation %ofArea	14 Land quality Water	14 Land quality Land	15 Machinery Y/N No.	15 Animal Y/N No.	16 Agriculture Extension Y/N	16 Technical	Inputs
	Glutinous rice	1																	
							1; New 2; Old		1; Yes 2; No		1; Yes 2; No		1.enough 2.Not enou	1. Good 2.Bad	1; Yes 2; No			1; Yes 2; No	

Fishery and Forestry

1. Fishery

1	Does your household have any fish culture or is engaged in fishi	*Yes = 1*	
2	Does your household have fish pond?	*No = 2*	

If no go to 2.

3			4			5	
What types of fish culture? Are there			Was the fishing in			How much have your household	
	Yes	*No*		*Yes*	*No*	received from	
1 Rice - cum?	*1*	*2*	1 In rivers?	*1*	*2*	sales of fish	
2 Pond?	*1*	*2*	2 In lakes, reservoirs?	*1*	*2*	during the past	
3 Fish seed production?	*1*	*2*	3 In swamps, seasonal			period?	
4 Other types? *Specify:*	*1*	*2*	floodplain?	*1*	*2*		
	1	*2*	4 In rice field?	*1*	*2*		
	1	*2*	5 Other places? *Speci*	*1*	*2*	Total sales	
	1	*2*					month
							season
							year

2. Forestry

1	2			3			4	5	
Do you ente any forest?	Did you from enter fores in the last 12 months obtain			Have you from this forest in the last 12 months gathered			How much has your household received from sales of animals hunted in the for during past peric	How much has your household received from sales of forest product during past period?	
		Yes	*No*		*Yes*	*No*			
	1 Timber	*1*	*2*	*1 Timber*	*1*	*2*			
	2 Fuel wood	*1*	*2*	*2 Fuel wood*	*1*	*2*			
1 = Yes	*3 Bamboo*	*1*	*2*	*3 Bamboo*	*1*	*2*			
2 = No	*4 Hunting*	*1*	*2*	*4 hunting*	*1*	*2*			
	5 others	1	2	*5 others*	*1*	*2*	Total sales	Total sales	
									month
									season
									year

Housing conditions

1	2	3	4	5	6	7	8	9	10	11	12
What is the majo construction mat external walls?	What is t material roof?	What is the primary material of the floor?	What is the main source of drinking water in the rainy season?	What is the distance drinking water source in the rainy season?	What is the main sourc drinking water in the dr season?	What is the distance drinking water source in the dry season?	What kind of latrine is mainly used?	What is the household's source of en for cooking?	What is the household's source of energy for lighting?	House size	House area
Brick/Concrete =1	*Wood = 1*	*Floor cement =1*									
Wood =2	*zinks =2*	*Wood =2*	*Piped water in/outside = 1*	*Piped water in/outside = 1*		none=1		*Electricity = 1*	*Electricity from public*		
Bamboo =3	*Tile = 3*	*Bamboo = 3*	*Well/borehole = 2*	*Well/borehole = 2*		*normal toilet=*		*Wood = 2*	network = 1		
Other, specify =4	*Grass = 4*	*Earth/clay = 4*	*River, dam, lake etc. = 3*	*River, dam, lake etc. = 3*		*dry toilet=3*		*gas = 3*	*El. From generator = 2*		
	Other = 5	*Other = 5*	*Rain water from tank/jar = 4*	*If in/outside*	*Rain water from tank/jar = 4*		*Other=4*	*Other = 4*	*El. From battery = 3*		
			Other, specify = 5	*house or in*	*Other, specify = 5*				*Kerosene lamp = 4*		
				yard near					*Candle = 5*		
FIRST	SECOND			*house = 0 meter*					*Other = 6*		
				METERS		METERS					

Durables

1			1 (CONT.)				1 (CONT.)		
Which of the following goods does household have access to or own?		*ask only for urban areas	Which of the following goods does this household have acces to and own?				Which of the following goods does this household have acces to and own?		
ID	*Item*	*Owned Yes=1 No = 2*	ID	*Item*	*Access Yes = 1 No = 2*	*Owned Yes = 1 No = 2*	ID	*Item*	*Owned Yes = 1 No = 2*
Transport equipment			7	Electric rice cooker		*	14	Pig, chicken, duck	
1	Vehicle (Car, Van ..-.)		8	Electric gerator			15	Television	
2	Motor cycle/Tuk-tuk		Agriculture/businesses				16	Radio/ VCD, etc	
3	Bicycle		9	Two-wheeled tractor			17	Mobile phone	
House equipment			10	Four-wheeled tractor			18	Jewelry	
4	Refrigerator/freezer	*	11	Fishing net			19	Mosquito net	
5	Sewing machine		12	Cart					
6	Washing machine	*	13	cattle/buffalo					

CHAPTER SEVEN
SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

7.1 SUMMARY AND CONCLUSIONS

Good quality human capital is a key component to sustainable development. Health, especially child health, is a crucial determinant for good quality human capital. Good health is a prerequisite for smooth education and child development. Healthy children with education would become productive labor in the future. This dissertation investigates fertility in Chapter three, child mortality in Chapter four and child nutrition status in Chapters five and six. These topics are closely connected to each other and are key components that determine the quality of children, which is the quality of human capital in the future. In order to have healthy children, firstly, the demand for children needs to be observed. High fertility directly concerns child health because high fertility, especially in developing countries with lack of public health services, can ruin maternal and child health. Secondly, after children are born, it is important to keep them alive and raise them with upmost care. Thus, better understanding of factors influencing child mortality and child nutrition status is required. The studies in this dissertation use both primary and secondary data to cover all major aspects of child health issues.

In summary, the findings of this research study imply that maternal education, especially basic education, appears to be the most important socio-economic determinant for maternal health and for child health at all development phases covered in this study. Education helps mothers to effectively utilize health information (e.g. use of contraceptives) which is vital for future family planning. Education also plays a significant role in reducing child mortality via effective use of health information for preventing diseases and raising self awareness of diseases, which would further result in lower demand for children. Mother's education can also help improve child nutrition

status by making use of relevant health information provided through various health programs.

Another important socio-economic determinant is the ability of a household to generate income. This determinant has long been a focal point for the government poverty reduction programs. Poverty, especially food poverty, directly affects children's short-term health status which makes children vulnerable to diseases and death. If children suffer from malnutrition for a long period, it will unavoidably affect the child's long-term health. In addition to poverty reduction, improving the quality and quantity of health workers (medical doctors, nurses, and health volunteers) is crucial for reducing child mortality and improving child health in the long term. Not only can health workers directly affect fertility by providing health information to mothers, they can also reduce fertility by means of lowering child mortality rates. In another dimension, social capital, particularly kinship network, is shown to be an important factor for maintaining child health in rural and remote areas where access to outside help is limited. Overall, understanding these issues and their complex interrelations are crucial for health improvement of mothers and children, particularly in rural areas where access to public infrastructures is difficult, if not absent.

7.2 POLICY IMPLICATIONS

Four important policy implications that can be drawn from this research: expanding health education and adult literacy programs; improving the quality and increasing the quantity of health workers; expanding poverty reduction activities related to child health; and recognizing the role of social capital in development. They are discussed as follows:

- Expanding health education and adult literacy program

More efforts should be made to continue promoting health information by focusing on women. Even though many health promotion campaigns exist at the

village level, in most cases households would send only one representative, who is usually male regardless of the topic. In order to fully utilize health promotion programs related to child health, mothers should be encouraged to participate.

To increase the quality of health promotion programs, improving maternal education is necessary. Improving and expanding adult literacy program focusing on women, at least in primary education, would be able to improve maternal and child health.

- Improving the quality and increasing the quantity of health workers

Improving the quality and increasing the number of trained health workers is important for improving child health. Currently, the number and quality of health workers is too low to meet the need. Our research shows that relying on health volunteers is not sufficient to improve child health, rather, upgrading medical workers from low-level to mid-level and training health volunteers to become low-level health workers (especially in rural areas) would be the best option for the current situation. For long-term objectives and sustainability, however, increasing the number of high level health workers in rural areas is required for better child health.

- Expanding poverty reduction activities related to child health

The recently "Lunch Program" for primary school students aims to overcome the food poverty problem amongst children. It is important to maintain and expand this kind of program nation-wide, and giving priority to rural remote areas, because this policy would help improve long-run child health. In the short-run, income generation policies, such as job creation programs, are also needed.

- Recognizing the role of social capital in development

Any policy implementation related to child health should account for the impact on social capital. Promoting health campaigns through kinship networks can extend the impact of campaigns.

7.3 SCOPE FOR FURTHER RESEARCH

Our research did face some constraints due to lack of available data. The empirical results produced in our research are based on cross-sectional data, meaning the causality between socio-economic variables is ambiguous. Therefore, applying longitude data to our analysis, when available, should show a clearer causality between out socio-economic variables. Moreover, our findings showed that Medical Workers play a crucial role in improving the children health. Thus, further studies on the relationship between Medical Workers and children health would be essential for policy maker to efficiently tackle children health problem in Lao PDR.

BIBLIOGRAPHY

ADB. (2007). LAO: Health sector development reform. *Final Report TA32313-01,* Manila, Philippines.

ADB. (2010). Key Indicators. Available Online: http://www.adb.org/Statistics/ki.asp (October 18, 2010).

Alderman, H. (1986). *Effect of price and income increases on food consumption in low income consumers: International food policy research institute.* Washington D.C.

Andersson, M., Engvall, A., and Kokko, A. (2006). Determinants of Poverty in Lao PDR. EIJS Working Paper Series 223. Sweden, Stockholm: Stockholm School of Asian Studies, Stockholm School of Economics.

Athukorala, P. and S. Jayasuriya. (1994). *Macroeconomic Policies, Crises and Growth in Sri Lanka: 1969-90.* The World Bank, Washington D.C.

Attanasio, O., Battistin, E., Fitzsimons, E., Mesnard, A., and Vera-Hernandez, M. (2004). How effective are conditional cash transfers? Evidence from Colombia. The Institute for Fiscal Studies. Briefing Note No. 54.

Aturupane, H., Deolalikar, A. B., and Gunewardena, D. (2006). The determinants of child weight and height in Sri Lanka: A quantile regression approach. Online Available: http://www.bristol.ac.uk/cmpo/events/seminar/deolalikar.pdf (March 17, 2009).

Baker. R. (1999). Differential in Child Mortality in Malawi. University of Pennsylvania. Social Network Project. Working Paper No.03.

Basta, S. S., Soekirman, M. S., Karyadi, D., and Scrimshaw, N. S. (1979). Iron deficiency anemia and productivity of adult male in Indonesia. *American Journal of Clinical Nutrition*, 32, 916-925.

Bautista, C. M. (2007). Socioeconomic factors affecting fertility in the Philippines: Reexamining parental education. *Loyola Schools Review*, 6, 89-114.

Becker, G. S. (1960). An economic analysis of fertility. In: G. S. Becker (Eds.), *Demographic and Economic Change in Developed Countries*. Princeton, N.J.: Princeton University Press.

Becker, G. S. (1965). A theory of the allocation of time. *Economic Journal*, 75, 493-517.

Becker, G. S., and Lewis, H. G. (1974). Interaction between quantity and quality of children. In T.W Schultz. (Eds.). *The Economics of the Family*. Chicago: University of Chicago Press.

Behrman, J. R., and Deolalikar, A. B. (1987). Will developing country nutrition improve with income? A case study for rural South India. *Journal of Political Economy*, 95, 492-507.

Benefo, K., Schultz, T. (1996). Fertility and Child Mortality in Cote D'Ivoire and Ghana. *The World Bank Economic Review*, 10, No.1.

Blake, J. (1968). Are babies consumer durables? A Critique of the economic theory of reproductive motivation. *Population Studies*, 22, 5–25.

Bobak, M., Pikhart, H., and Koupilova, I. (2000). Maternal socio-economic characteristics and infant mortality from injuries in the Czech Republic 1989-92. *Injury Prevention*, 6, 195-198.

Bongaarts, J. (2003). Completing the fertility transition in the developing world: The role of education differences and fertility preferences. *Population studies*, 57, 321-335.

Bongaarts, J., Frank, O., and Lestheghe, R. 1984. The proximate determinants of fertility in Sub-Saharan Africa. *Population and Development Review*, 10, 511-537.

Booyson, F., Berg, S., Burger, R., Maltitz, M., and Rand, G. (2008). Using an Asset Index to Assess Trends in Poverty in Seven Sub-Saharan African Countries. *World Development*, 36, 113–1130.

Bouis, H. E., and Haddad, L. J. (1992). Are estimates of calorie-income elasticities too high? A recalibration of plausible range. *Journal of Development Economics*, 39, 333-364.

Breierova, L., Duflo E. (2004). The Impact of education on fertility and child mortality do fathers really matter less than mothers?. National Bureau of Economic Research. Working Paper No10513.

Bulatao, R. A. (1984). Reducing fertility in developing countries: A review of determinants and policy levers. World Bank. Population and Development Series. Working Papers No. 680.

Caldwell, J. C. (1976). Toward a restatement of demographic transition theory. *Population and Development Review*, 2, 613-630.

Carter, M.R., and Maluccio, J.A. (2003). Social Capital and Coping with Economic Shocks: An Analysis of Stunting of South African Children. *World Development*, 31, 1147–1163.

Christiaensen, L. and Alderman, H. (2004). Child malnutrition in Ethiopia: Can maternal knowledge augment the role of income? *Economic Development and Cultural Change*, 52, 287-312.

Cochrane, S. H. (1983). Effects of education and Urbanization on fertility. In: Bulatao RD, Lee RD (Eds.), *Determinants of Fertility in Developing Countries*, Vol. 2. Academic Press, New York, 587-626.

Coleman, J. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, 94, 95-120.

Coleman, J. (1991). Prologue: Constructed social organization. In: P. Bourdieu and J. Coleman., (Eds.), *Social Theory for a Changing Society*. Boulder, CO: Westview Press.

Dreze, J., and Murthi, M. (2000). Fertility, education and development. DEFPS. Discussion Paper No. DEDPS 20.

Easterlin, R. A. (1975). An economic framework for fertility analysis. *Studies in Family Planning,* 6, 54-63.

FAO. (2003). Nutrition country: Laos. Nutrition country profile. Food and Agriculture Organization. Rome, Italy.

Ferrara, E.L. (2007). Family and kinship ties in development an economist perspective. Fifth AFD/EUDN Conference, Paris. Online Available: http://www.afd.fr/jahia/webdav/users/administrateur/public/eudn2007/laferrara.pdf (August 18, 2009).

Filmer and Pritchett. (2001). Estimating weather effects without expenditure data- or tears: An application to educational enrollment in states of India. *Demography,* 38, 115-132.

Forste, R. (1994). The effect of breastfeeding and birth spacing on infant and child mortality in Bolivia. *Population Studies*, 48. 497-511.

Fukuyama, F. (2001). Social capital, civil society and development. *Third World Quarterly*, 22, 7– 20.

Gaiha, R., and Annim, S. (2010). Agriculture, GDP, and prospect of MDG 1 in Lao PDR. The University of Manchester. Economics School of Social Sciences. Disscussion Paper No. EDP-102.

Gakidou, E. E., Murray, C. L., and Frenk, J. (2000). Defining and measuring health inequality: An approach based on distribution of health expectancy. *Bulletin of the World Health Organization*, 78, 42-54.

Gamboa, L. F., and Ramírez, N. F. (2008). Fertility and Schooling: How this relation changed between 1995 and 2005 in Colombia. Working Paper No. 004711. Faculty of economics, Universidad del Rosario Colombia.

Garrett, J. L., and Ruel, M. T. (1999). Are determinants of rural and urban food security and nutritional status different? International Food Policy Research Institute (IFPRI). Discussion Papers No. 65.

Gertler, P. (2004). Do conditional cash transfers improve child health? Evidence from progresa's controlled randomized experiment. *American Economic Review*, 94, 336-341.

Girma, W and Genebo, T. (2002.). *Determinants of Nutritional Status of Women and Children in Ethiopia.* Calverton, Maryland, USA: ORC Macro.

Grootaert, C. (2001). Doses social capitals help the poor? A synthesis of findings from the local level institutions studies in Bolivia, Burkina Faso and Indonesia. Local Level Institutions. Working Paper No. 10.

Gryboski, K. L. (1996). Maternal and nonmaternal time allocation to infant care, and infant care during illness in rural Java, Indonesia. *Social Science and Medicine*, 43, 209–219.

Hala, A. (2002).The effect of water and sanitation on child mortality in Egypt. Gothenburg University, Environmental Economics Unit. Department of Economics, Sweden.

Handa, S. (2000). The impact of education, income, and mortality on fertility in Jamaica. *World Development*, 28, 173-186.

Hanifan, L.J. (1916). The rural school community centre. *Annals of the American Academy of Political and Social Sciences*, 67, 130-38.

Harpham, T., Grant, E., and Thomas, E. (2002). Measuring social capital within health surveys: key issues. *Health Policy and Planning*, 17, 106–111.

Harpham, T., Silva, M.J., and Tuan, T. (2006). Maternal social capital and child health in Vietnam. *Journal of Epidemiology and Community Health*, 60, 865-871.

Harris, M. (1989). *Our kids*. New York: Harper & Row.

Jimenez, E. (1995). Human physical infrastructure: Public investment and price policies in developing countries, Chapter 43. In: J. Behrman and T. N. Srinivasan(Eds.), *Handbook of Development Economics* (Vol. 3). Amsterdam: North-Holland.

Jones, A. M. (2000). Health Econometrics, Chapter 6. In: Newhouse, J.P and Culyer, A.J (Eds.), *Handbook in Health Economics* (Vol.1A). Amsterdam: North-Holland.

Kabubo-Mariara, J., Ndenge, G., and Mwabu, D. (2008). Determinants of children's nutritional status in Kenya: Evidence from demographic and health surveys. *Journal of African Economics*, 18, 363-387.

Kakwani, N., Sisouphanhthong, B., Souksavath, P., and Dark, B. (2001). Poverty in Lao PDR. Laos, Vientiane: Committee for Planning and Cooperation. National Science Foundation.

Kakwani, N., Sisouphanhthong, B., Souksavath, P., and Dark, B. (2001). Poverty in Lao PDR. Laos, Vientiane: Committee for Planning and Cooperation.

Kamiya, Y. (2009). Economic analysis on the socioeconomic determinants of child malnutrition in Lao PDR. OSIPP, Discussion Paper No. DP-2009-E-007.

Kana'Iaupuni, S. M., Donato, K. M. Thompson-Colon, T., and Stainback, M. (2005). Counting on kin: Social networks, social support, and child health status. *Social Forces* 83, 1137-1164.

Kanack, S., and Keefer, P. (1997). Does social capital have an economic payoff? A cross-county investigation. *The Quarterly Journal of Economics,* 112, 1251-1288.

Kanaiaupuni, S.M., Katharine M. D., Theresa, T.C., and Melissa, S. (2005). Counting on kin: Social networks, social support and child health. *Social Forces*, 83, 1137-1164.

Kawachi, I., Kennedy, B.P., and Glass, R. (1999). Social capital and self-rated health. *American Journal of Public Health*, 89, 1187-1193.

Kawachi, I., and Berkman, L.F., (2001). Social ties and mental health. *Journal of Urban Health*, 78, 458–467.

Kennelly, B., O'Shea, E., and Garvey, E. (2003). Social capital, life expectancy and mortality: A cross-national examination. *Social Science and Medicine*, 56, 2367-2377.

Lahiri, S., and Chanthaphone, S. (2003). Water, sanitation and hygiene: a situation analysis paper for Lao PDR. *International Journal of Environmental Health Research*, 13, 107-114.

Lawson, D. (2004). The Influence of ill health on chronic and transient poverty: Evidence from Uganda. Chronic Poverty Research Centre. Working Paper No 41.

Leibenstein, H. (1954). *Economic Backwardness and Economic Growth: Studies in theory of economic development*. New York: Wiley & Sons.

Lopez-Casasnovas, G., Rivera, B., and Currais, L. (2005). *Health and Economic Growth: Findings and Policy Implications*. Cambridge: MIT Press.

Lynch, J., Due, P., Muntaner, C., and Smith, D. G. (2000). Social Capital - Is it a good investment strategy for public health? *Journal Epidemiology Community Health*, 54, 404-408.

Matthiessen, P. C., and McCann, J. C. (1978). The role of mortality in the European fertility transition: Aggregate-level relations. In: S. H. Preston, (Eds.), *The Effect of Infant and Child Mortality on Fertility*. New York: Academic Press.

Mellington, N., and Cameron, L. (1999). Female education and child mortality in Indonesia. *Bulletin of Indonesian Economic Studies*, 35, 115-44

Miguel, E., and Kremer, M. (2004). Worms: Identifying impacts on education and health in the presence of treatment externalities. *Econometrica*, 72, 159–217.

Miller, D.L., and Rosenberg, R. (2005). Social capital and health in Indonesia. *World Development*, 34, 1084–1098.

Mincer, J. (1963), Opportunity costs and income effects. In: C. F. Christ and G. Yehuda (Eds.), *Measurement in Economics*. Stanford, CA: Stanford University Press.

Ministry of Health. (2008). Review of ongoing health financing reform in Lao PDR and challenges in expanding the current social protection schemes. Lao PDR, Vientiane: Health Financing Technical Working Group.

Ministry of Health. (2009). National Health Sector Development Plans 2011-2015. Lao PDR, Vientiane: Ministry of Health.

Miyoshi, M., Phommasack, B., Nakamura, S., and Kuroiwa, C. (2005). Nutritional status of children in rural Lao PDR: Who are the most vulnerable? *European Journal of Clinical Nutrition, 59,* 887-890

Mohammad, A. (1985). Age at first marriage and cumulative fertility in Pakistan. *Asian Population Studies Series*, 59, 40-50.

Moser and Felton. (2007). The Construction of an Asset Index measuring asset accumulation in Ecuador. Chronic Poverty Research Centre. Working paper No.87.

Mustafa, H and Odimegwu, C. (2008). Socio-economic Determinants of Infant Mortality in Kenya: Analysis of Kenya DHS 2003. *Journal of Humanities and Social Sciences,* 2, 1-13.

Mwabu, G. (2007). Health Economics for Low-Income Countries. Yale University, Economic Growth Centre. Discussion Paper No.55.

Mwabu, G., Ainsworth, M., and Nyamete, A. (1993). Quality of medical care and choice of medical treatment in Kenya: An empirical analysis. *Journal of Human Resources*, 28, 838-862.

NSEDP. (2010). Seventh National Socio-Economic Development Plan. Lao PDR, Vientiane: Ministry of Planning and Investment.

National Statistic Centre. (2003).Final report on Lao Expenditure and Consumption Survey3. Lao PDR, Vientiane: Ministry of Planning and Investment.

National Statistic Centre. (2008). Final report of Lao Expenditure and Consumption Survey4. Lao PDR, Vientiane: Ministry of Planning and Investment.

National Statistics Centre. (2005a). Final report of population census 2005. Lao PDR, Vientiane: Ministry of Planning and Investment.

National Statistics Centre. (2005b). Final report of Lao Reproductive Health Survey 2005. Lao PDR, Vientiane: Ministry of Planning and Investment.

National Statistics Centre. (2008). Final report of Multiple Indicator Cluster Survey 2006. Lao PDR, Vientiane: Ministry of Planning and Investment. Online Available: http://www.childinfo.org/files/MICS3_Lao_FinalReport_2006_Eng.pdf (September 8, 2010).

Nguyen-Dinh, H. (1997). A socioeconomic analysis of the determinants of fertility: The case of Vietnam. *Journal of Population Economics,* 10, 251-271.

Nobles, J and Frankenberg. E. (2005). Maternal social capital and child health. Paper presented at the annual meeting of the American Sociological Association. Online Available: http://www.allacademic.com/meta/p23213_index.html (August 28, 2009).

Onphanhdala, P. (2009). Farmer education and rice production in Lao PDR. *Journal of International Cooperation Studies*, 16, 105-121.

Onphanhdala, P. (2010). Farmer education and agricultural efficiency in Lao PDR: Further results. *Journal of International Cooperation Studies*, 17, 27-47.

Osili.O., Long. T. (2007), Does female schooling reduce fertility? Evidence from Nigeria. National Bureau of Economic Research. Working Paper No.13070.

Parnell, A. M. (1990). C*ontraception and Reproduction: Health Consequences for Women and Children in the Developing World.* Committee on Population, National Research Council. NW: Washington DC.

Phimmasone, K., Douangpoutha, I., Fauveau, V., and Pholsena, P. (1996). Nutritional status of children in the Lao PDR. *Journal of Tropical Pediatirics, 42,* 5-11.

Pholsena, S., and Thome, J. (2009). Lao People's Democratic Republic: Health financing reform and challenges in expanding the current social protection schemes. UN ESCAP. Economic and Social Commission for Asia Pacific. Discussion paper 2529. 71-102.

Pitt, M. (1983). Food preferences and nutrition in rural Bangladesh. *Review of Economics and Statistics*, 65, 105-114.

Pitt, M., and Rosenzwieg, M. R. (1986). Agricultural prices, food consumption and health productivity of Indonesian farmers, In: I. Singh, L. Squire, and J. Strauss, (Eds.). *Agricultural Household Models: Extensions, Applications, and Policy.* Baltimore: John Hopkins University Press.

Pritchett, L., and Summers, L. H. (1996). Wealthier is healthier. *Journal of Human Resources*, 31, 841-868.

Putnam, R. D. (1993). The prosperous community: social capital and public life. *American Prospect*, 13, 35 – 42.

Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy*, 6, 65–78.

Putnam. R. D., (2000). *Bowling alone: The Collapse and revival of American community.* Simon & Schuster, New York.

Randall, S. C., and Legrand, T.K. (2000). Is child mortality important? Reproductive Decisions, Stratefies and Outcome in Senegal. Department of Anthropology, University College London.

Rosenzwieg, M. R., and Schultz, T. P. (1983). Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth. *Journal of Political Economy*, 91,723-745.

Sakurai, T. (2005). Social capital no social safety net kino - Burukina Faso no jirei (Social safety net function of social capital: The case of Burkina Faso). Proceedings of the 16th Annual Conference of Japan Society for International Development, 164–167.

Sakurai, T., Kijima, Y., Pokharel, R.K., Rayamajhi, S., and Otsuka, K. (2001). Timber forest management in Nepal and Japan. In: K. Otsuka and F. Place (Eds.), *Land Tenure and Natural Resource Management: A Comparative Study in Agrarian Communities in Asia and Africa*. Baltimore, MD: Johns Hopkins University Press, 315–355.

Sanderson, S.K., and Dubrow, J. (2000). Fertility decline in the modern world and in the original demographic transition: Testing three theoretical with cross-national data. *A Journal of Interdisciplinary Studies*, 21, 511-537.

Savedoff, W.D., and Schultz, T.P. (2000). Earning and elusive dividends of health - in: William D. Savedoff and T. Paul Schultz, (Eds.). *Wealth from health: Linking social investment to earning in Latin America*. Inter-America Development Bank. Washington, D.C.

Schultz, P. T. (2009). Population and health policies, Yale University, Department of Economics. Working Papers No.66.

Schultz, T. P, and Tansel, A. (1992). Measurement of Returns to Adult Health: Morbidity Effects on Wage Rate in Cote D'Ivoire and Ghana. Yale University, Economic Growth Centre. Discussion Paper No.663.

Schultz, T. P. (1973). A preliminary survey of economic analysis of fertility. *American Economic Review*, 63, 71-78.

Schultz, T. P. (1980). An economic interpretation of the decline in fertility a rapidly developing country. In: R. A. Easterlin, (Eds.). *Population and Economic Change in Developing Countries*. Chicago: University of Chicago Press.

Schultz, T. P. (1981). *Economic of Population*. Reading MA: Addison-Wesley Pub.

Schultz, T. P. (1984). Studying the impact of household economic and community variables on child mortality. *Population and Development Review*, 10, 215-235.

Schultz, T. P. (1990). Testing the neoclassical model of family labor supply and fertility Yale - Economic Growth Center. Working Papers No.601.

Schultz, T. P. (2002). Fertility transition: Economic explanations. In: Smelser, N. J., and Baltes, P. B. (Eds), *International Encyclopedia of the Social and Behavior Sciences*. Pergamon, Oxford, 5578-5548

Schultz, T. P. (2003). Wage rentals for reproducible human capital: Evidence from Ghana and Ivory Coast. *Economics and Human Biology*, 1, 331-366.

Schultz, T. P. (2008). Population policies, fertility, women's human capital, and child quality - in: Schultz, T and J. Strauss, (Eds.), *Handbook of Development Economics*, Vol. 4. Amsterdam, North-Holland, 3249-3303.

Schultz, T.W. (1974) *Economics of the Family: Marriage, Children and Human Capital*, Chicago: Chicago University of Press.

Schwartz. B., and Viravong. V. (2006). Health care financing in Lao PDR: Sub-sector analysis. Lao TA 4608. Health Sector Development Program. Lao PDR

Silva, M. J., and Harpham, T. (2007). Maternal social capital and child nutritional status in four developing countries. *Health and Place*, 13, 341–355.

Silvia, P. (2005). Environmental factors and children's malnutrition in Ethiopia. World Bank. Working Paper No. 3489.

Smith, K. P., and Christakis, N.A. (2008). Social network and health. *Annual Review of Sociology*, 34, 405-429.

Spurr, G. B. (1983). Nutritional status and physical work capacity. *Yearbook of Physical Anthropology*, 26, 1-35.

Stein., Zena., Susser, M., Saenger, G., and Marolla, F. (1975). *Famine and Human Development: The Dutch Hunger Winter of 1944-1945*. London: Oxford University Press.

Strauss, J. (1984). Joint determination of food consumption and production in rural Sierra Leon: Estimates of a household firm model. *Journal of Development Economics*, 14, 77-103.

Strauss, J. (1986). Does better nutrition raise farm productivity? *Journal of Political Economics*, 94, 279-320.

Strauss, J. (1990). Household, communities and preschool child nutrition outcome: Evidence from rural Cote D'Ivoire. *Economic Development and Cultural Change*, 38, 231-261.

Strauss, J., and Thomas, D. (1990). The Shape of the Calorie Expenditure Curve. Yale University, Economic Growth Centre. Discussion Paper No.595.

Strauss, J., and Thomas, D. (1995). Human resource: Empirical model of household and family decisions. In: J. Behrman and T. N. Srinivasan. (Eds.). *Handbook of Development Economics,* (Vol. 3A). Amsterdam, North-Holland, 1883-2023.

Strauss, J., and Thomas, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature*, 36, 766-817.

Subramanian, S., and Deaton, A. (1992). *The demand for food and calories: Further evidence from India.* Woodrow Wilson School, Princeton University.

Subramanian, S., and Deaton, A. (1996). The demand for food and calories. *Journal of Political Economy*, 104, 133-162.

Thomas, D., Frankenberg, E., Frieman, J. P., Habicht, J., Hakimi, M., Ingwersen, N., Jaswadi., Jones, N., McKelvey, C., Pelto, G., Sikoki, B., Seeman, T., Smith, J. P., Sumantri, C., Suriastini, W., and Wilopo, S. (2006). Causal effect of health on labor market outcomes: Experimental evidence. Online Available: http://www.unc.edu/the/archives/thomas.pdf (February 8, 2010).

Thomas, D., Lavy, V., and Strauss, J. (1992). Public Policy and Anthropometric Outcome in the Cote D'Ivoire . World Bank. Working Paper no. 89.

Thomas, D., Strauss, J., and Henriques, M.-H. (1990). Child survival, height for age and household characteristic in Brazil. *Journal of Development Economics*, 33, 197-234.

Thomas, D., Strauss, J., and Henriques, M.-H. (1990). Child survival, height for age and household characteristic in Brazil. *Journal of Development Economics*, 33, 197-234.

Thomas, D., and Strauss, J. (1992). Price, infrastructure, household characteristics and child height. *Journal of Development Economics*, 39, 301-331.

UN. (2000). Millennium development goals. United Nation Development Programme. Online Available: http://www.undp.org/mdg/basics.shtml (August 18, 2009).

UN. (2008). Millennium development goals: Progress report of Lao PDR. The United Nations in Lao PDR. Online Available: http://www.unlao.org/Blog/post/Lao-PDR-Millennium-Development-Goals-Progress-Report-2008-(Executive-Summary).aspx (August 8, 2009).

UN. (2010). United Nation Statistics Division. Online Available: http://data.un.org/Data.aspx?d=GenderStat&f=inID%3A14 (October 18, 2010).

UNICEF. (2010a). Progress for children: Achieving the MDGs with equity. United Nation Children's Fun. Online Available: http://www.unicef.org/publications/index_55740.html (May 8, 2010).

UNICEF. (2010b). Statistics: Lao PDR. Online Available: http://www.unicef.org/infobycountry/laopdr_statistics.html (November 8, 2010).
WHO. (2010). Programmes and Project. Online Available: http://www.who.int/gho/mdg/maternal_health/countries/en/index.html#L (November 8, 2010).
Wolfe, B. L., and Behrman, J. R. (1982). Is income overrated in determining adequate nutrition? *Economic Development and Cultural Change*, 31, 525-549.
Wolfe, B. L., and Behrman, J. R. (1987). Women's schooling and children's health: Are the effects robust with adult sibling control for the women's childhood background? *Journal of Health Economics*, 6, 239-254.
Wolfe, B. L., and Behrman, J. R. (1987). Women's schooling and children's health: Are the effects robust with adult sibling control for the women's childhood background? *Journal of Health Economics*, 6, 239-254.
Wolpin K. (1997). Determinants and consequences of the mortality and health of infants and children. In: M. Rosenzweig and O. Stark (Eds.), *Handbook of Population and Family Economics*. Elsevier Science B.V.
Woolcock, M. (1998), Social capital and economic development: toward a theoretical synthesis and policy framework. *Theory and Society*, 27, 151-208
Woolcock, M., and Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. *The World Bank Research Observer*, 15, 225-249.
Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data.* Cambridge: MIT Press.
World Bank. (2006). Thailand Social Capital Evaluation: A Mixed Methods Assessment of the Social Investment Fund's Impact on Village Social Capital. EASE. World Bank.
World Bank. (2010a). Database: Indicators. Available Online: http://data.worldbank.org/indicator (October 18, 2010)
World Bank. (2010b). Database: Lao PDR. Online Available: http://data.worldbank.org/country/lao-pdr (November 8, 2010)
World Bank. (2010c). Database: Indicator, Malnutrition prevalence data. Online Available: http://data.worldbank.org/indicator/SH.STA.MALN.ZS (October 18, 2010)
Yamaoka, K. (2007). Social capital and health and well-being in East Asia: A population-based study. *Social Science and Medicine*, 66, 885-899.
Zak, P. J., and Knack, S. (2001). Trust and Growth, *Economic Journal, Royal Economic Society*, 111, 295-321.