ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

SOCIO-ECONOMIC DETERMINANTS OF FERTILITY IN URBAN ETHIOPIA

FANAYE TADESSE

June, 2008

SOCIO-ECONOMIC DETERMINANTS OF FERTILITY IN URBAN ETHIOPIA

By

Fanaye Tadesse

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for Degree of Masters of Science in Economics (Economic Policy Analysis)

June, 2008

Acknowledgments

My sincere appreciation goes to my advisor, Dr. Mulat Demeke, for his unreserved support, encouragement and valuable comments throughout the course of this study.

I am indebted to my family for their support in everyway and for bearing with me all the way. I also wish to express my sincere appreciation to Dagim Asfaw and Hirut Taye for their extended help and valuable comments.

Finally, I would like to extend my deepest gratitude to AERC for their financial support and acknowledge all who have encouraged, advised and supported me in everyway during the period of my study.

Abstract

Fertility, being a major study unit in population dynamics, should be analyzed from different perspectives as it plays a pivotal role in understanding the complex issues integral to population growth. The main objective of this study was therefore to understand what the micro level major socio – economic determinants of fertility are in the case of urban Ethiopia. These determinants of fertility were initially hypothesized to include education, income, age at first marriage, marital status, child mortality and participation of women in income generating activities. The direction of relationship between the variables and fertility was expected to be positive for martial status and child mortality while a negative relationship was speculated for the other variables.

Count data models were used to estimate fertility, given by the number of children born by a woman, using two data sets: the Ethiopian Urban Socio-economic Surveys, a panel data conducted for five rounds comprising of 1,500 households, and the Ethiopian Demographic and Health Survey (2005), a nationally representative cross sectional data. The main findings of the result supported the hypothesis that education, income, age at first marriage and participation of women in income generating activity are negatively related to fertility. The expected positive relationship between marriage and fertility was also validated by the study. Child mortality was, however, found to be insignificant in explaining fertility in urban areas.

The findings of the study revealed that fertility decision is influenced by the analyzed socio-economic variables and achieving a low level of fertility rate requires an all rounded sustainable development process that could result in increased education, income, creation of employment opportunities and improved status of women in the society.

Table of Contents

List of Tables

Glossary of Abbreviations

CSA	Central Statistics Agency
EDHS	Ethiopian Demographic and Health Survey
EUSES	Ethiopian Urban Socio-economic Survey
SNNPRS	South Nations and Nationalities People Regional State
TFR	Total Fertility Rate
UNFPA	United Nations Population Fund
VIF	Variance-Inflation Factor

CHAPTER ONE

INTRODUCTION

1.1 Background

Every year, approximately 83 million people are added to the world we live in and most astoundingly nearly all of this net increase in population is in developing countries (Todaro and Smith, 2003). The world population is estimated to increase by 1.1 % on average every year while the rate of population growth for developing countries is 2.3%, which is by far higher than the world average (UNFPA, 2007). The question that follows from this, obviously, is what the implication of this high population growth rate is to the economic development of these developing economies.

The population growth – economic development nexus has remained to be an area of debate for quite some time. Whether high population growth rate is a real problem to the economic development of the developing economies remains to be an area of deliberation. Some have argued that the real problem of developing countries is that of not giving priority to deal with underdevelopment. If these countries are able to take care of underdevelopment, population will automatically take care of itself. It is also argued that it is not as such the population growth rate or the number of people that causes the problem but their distribution in space. Hence, bringing about a more spatial distribution of the population in terms of the available natural resources is the real challenge. Moreover, high level of population can also be seen as a very useful resource,

if the benefits that come with it such as a larger domestic market for consumer goods and technological innovations can be capitalized upon (Todaro and Smith, 2003).

On the other hand, although population growth is not the only source of underdevelopment and low level of living that is witnessed in developing countries, it is impractical to argue that it is not a serious cause and multiplier of the major components of underdevelopment (ibid). The explosive population growth in the low income economies today, with the growing relative scarcity of natural resources, presents a very serious problem since these economies highly rely on natural resource activities like agriculture (Hayami, 1997). With a growing population, the capacity of the governments of these economies to provide basic health, education and other public services is also going to be highly curtailed. Moreover, high population growth makes the task of maintaining, let alone improving, the living standards of people an exceedingly difficult task as achieving this target requires a rapid growth in GDP to keep up with or exceed the population growth.

Population growth rate or rate of population increase is measured as the sum of natural rate of increase (decrease) and net international migration. The natural increase (decrease) simply measures the difference between fertility and mortality or the excess of births over deaths. Though population movements or international migration played a significant role in the past, as in the development process of new continents, their role is unlikely to be significant in the world today (Hayami, 1997). Hence, considering the natural rate as an appropriate proxy for population growth rate can be considered reasonable.

Taking the natural rate of population growth as a proxy for the overall population growth rate, the high population growth rate that we observe in the developing countries is mainly due to the decline in mortality rate through the years. This decline in death rate was achieved through the rapid technological advances in medicine, the spreading of public health facilities, the discovery of modern vaccinations followed by major campaigns to spread them to all parts of the world, improved nutrition, public education and others.

However, while the death rate in developing countries has been declining through the years, the birth rate has started to decline only in recent years. The difference between the population growth rate of the developing and developed nations can, thus, be explained by the fact that the fertility in developing countries is higher than that of the developed ones. Though the average death rate in Africa is still greater than that of the developed countries, this difference is substantially smaller than the difference in birth rates (Todaro and Smith, 2003).

Fertility can, therefore, be considered to be the most important component of population dynamics, playing a major role in determining the size and the overall structure of a population of a given area. Recent demographic surveys show that the average total fertility rate (TFR) – the average number of births a woman would have over her life at the prevailing childbearing rate – is estimated to be on average 4.71 for Africa, which is very high compared to the world average of 2.56 (UNFPA, 2007).

Sub-Saharan Africa is mainly characterized by high fertility rate due to the existence of cultural institutions that encourage high fertility. Caldwell et al (1992), highly stress the importance of

maintaining a lineage and leaving descendants, the spreading of child costs across the extended family and communal land tenure system that favor large families as reasons for the witnessed high fertility rate in the region. Other factors that are considered to be the cause for high fertility rate are also, among others, early marriage, low level of education of women, high level of child mortality rate and lack of access to family planning services.

Early studies of fertility transition in Sub-Saharan Africa indicated that starting from the 1980s the first evidence of significant decline in fertility was shown in Botswana, Kenya and Zimbabwe (Ainsworth, 1996). Even in these areas, the total fertility is high by all standards at four or more children per woman. Since the 1980s, fertility declines have also been recorded in countries such as Ghana, Tanzania, Sudan, South Africa and Southwestern Nigeria (Aase and Agyei-Mensah, 1998). However, fertility decline paths are mostly distinctive in different societies due to differences in social and political organization, economic conditions, cultural orientations and policy directions in each setting. Hence, a study on the socio-economic determinants of fertility in each societal setting is imperative to come up with relevant policy recommendations that would result in fertility rate decline.

1.2 Statement of the Problem

Ethiopia is the second populous nation in Africa with an estimated population of 77 million in 2007 (UNFPA, 2007). At an average annual increase of 2.7%, the population is growing at a rapid pace where nearly 2 million people are being added every year (ibid). With this growth rate, the population is expected to reach 170.2 million, more than double of the current level, by

year 2050. This population growth rate is mainly sustained by high fertility levels and declining mortality.

The high level of population growth rate combined with the low level of development has made the effort of bringing the country out of its deep poverty an extremely difficult, if not impossible, task. The Ethiopian Plan for Accelerated and Sustained Development to End Poverty (PASDEP) that was prepared in 2005 indicates that the current annual rate of population growth in the country undermines to a significant measure, if not entirely, the economic growth that the country achieves yearly. Noting this, therefore, the government of Ethiopia has been implementing a National Population Policy starting from 1993 with the goal of 'harmonization of the rate of population growth with the capacity of the country for the development and rational utilization of natural resources to the end that the level of welfare of the population is maximized over time'.

The policy further indicates that the major demographic factor behind the high population growth rate is the high fertility rate and expresses a concern that this high fertility rate is not showing a sign of decline. In addition to reducing the gap between population and economic growth rates, it also incorporates the objectives of reducing the current TFR to four, raising the social and economic status of women, increasing the participation of women in education and removing traditional or customary practices which restrict women's rights.

However, since the introduction of this policy, the fertility rate of the country has not shown a significant decline and the target of achieving a lower level of TFR still looks out of reach. During the 1990 National Family and Fertility Study the total fertility rate was reported to be 6.4 births per woman, showing a drop of only 0.5 children on average by 2005 (CSA, 2005). Ethiopia

is ranked as the 16th high fertility rate country in Africa and not considered to be among the countries at or near the start of the transition to low level of fertility (UNFPA, 2007; Sibanda et al, 2003).

Another significant fact about the fertility rate of the country is the striking difference observed between rural and urban areas. The total fertility rate in the rural areas is 6.4, twice as high as the total fertility rate in the urban areas which is about 3.3 (CSA, 2005). The significant difference in the TFR between the rural and urban and also among the different urban towns, gives indication that there are various socio-economic factors that are affecting the decision of households regarding fertility. Hence, achieving the objective of low fertility rate requires identifying which specific socio-economic variables significantly affect fertility decision of households.

1.3 Objectives of the Study

The main objective of the study is to identify the major socio-economic determinants of fertility which significantly explain fertility decisions of households in Urban Ethiopia and come up with relevant policy recommendations.

1.4 Hypotheses

The socio-economic variables that significantly affect fertility decisions of households are income, education, age at first marriage, child mortality and participation of women in income generating activity. The direction of relationship of these variables with fertility is expected to be positive for child mortality while it is negative for the other variables.

1.5 Data and Methodology

Micro data are going to employed to analyze the socio-economic determinants of fertility. The data sets to be used are the Ethiopian Urban Socio-economic Surveys (EUSES) and the Ethiopian Demographic and Health Survey (EDHS). The appropriate count data econometric models are going to be employed to understand the direction and significance of the variables that are expected to affect fertility at household level.

1.6 Significance of the Study

Researches done on fertility mostly tend to focus on the proximate determinants of fertility dealing with the behavioral and biological factors that explain fertility, mostly referred as the Bongaarts framework. It is also commonly believed that the widespread availability of contraceptive use is a frontline solution to reduce fertility rate in developing countries. However, it is also relevant to understand the socio-economic forces that affect the fertility decision of households that leads to their use of contraceptives to achieve their targeted number of children. This study, by looking into these socio-economic determinants of fertility, adds to the knowledge of all stakeholders and helps policymakers to come up with practical policy directions to achieve the goal of reduced fertility rate in Ethiopia.

1.7 Limitations of the Study

In the analysis of the study, fertility is measured by the number of children in a household or the number of children ever born by a woman. This measurement has its own drawback since it fails

to consider the children than the woman is likely to have in the rest of her reproductive period and hence could not be considered to be a complete measure of fertility for the woman.

The other limitation is the unavailability of a single comprehensive data that incorporates all the variables of interest forcing the study to use two data sets and compare their results. Though education of women can serve as a proxy for income for the EDHS model, the fact that an objective measure of income is not included in the model may result in omitted variable bias in the regression result.

The fact that in the EUSES the total income of the household, proxied by consumption expenditure, was taken to see its effect on fertility has also its own limitations. To capture the impact of income on the fertility decision of households, it is advised that the income of the husband or other income sources of the household be separated from that of the mother. This is mainly based on the argument that the effect of an increase in other source of income could be different from that of the mother since her income reflects the opportunity cost of rearing children. However, this could not be done in the study as it was difficult to disentangle the consumption expenditure of the household between the different sources of income. Nevertheless, the possible implication of this problem on the result is minimized as the whether the woman is engaged in income generating activity or not is included as a separate variable.

The prevalence of HIV/AIDS in developing countries like Ethiopia is also expected to have an implication on the population dynamics of the country by affecting both fertility decisions and mortality rates. However, the effect of this variable could not be analyzed in the study due to unavailability of data.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature

2.1.1 Macroeconomic Framework

The relationship between fertility and economic development has captured the interests of many economists and still is a controversial subject which is viewed differently among different economic schools. Maltus (1798) relied on the classical economics concept of diminishing marginal returns as labor is applied to a fixed natural resource such as land for agriculture. Holding the supply of agricultural land constant, as fertility contributes to population growth, the long run marginal product of labor diminishes thereby reducing the wage rates. In Malthus' framework, fertility imposes a social cost on society because individuals overlook the social consequences of their decisions to marry earlier and have more children.

In the two decades which followed the Second World War, the low income countries were faced with a potential constraint on their economic development due to high levels of fertility. The increase in the rate of population growth, though caused by reduced mortality rate rather than increased fertility, threatened the capacity of these countries to accumulate capital that is required to productively employ their growing population (Schultz, 2007a).

Empirical studies that follow, however, showed that the link from rapid population growth to slower economic development was not confirmed to be a major impediment to economic development, except in situations where the rapid population growth affected the availability of

health services and schooling to a significant level (Johnson, 1999). According to Schultz (2007a), this doesn't contradict the classical diminishing returns to population growth but only implies that technological and behavioral changes have outweighed the Malthusian constraints on economic growth as evidenced by the success of Asian and Latin American countries.

Another framework used by economists to assess the implications of fertility decline focuses on the consequences that changes in the age composition of a national population has on saving and growth following the demographic transition. It is commonly assumed that adults maximize a separable sum of their discounted utility, where the marginal utility of consumption decreases with increased level of consumption. These assumptions imply that adults would display a life cycle consumption-smoothing behavior suggesting that they will be saving a larger proportion of their saving during their most productive years. If therefore, birth cohorts follow this behavior, a change in the age composition of a nation would definitely affect its national saving rate in the absence of growth in economic productivity (Schultz, 2007a). Schultz (2007a) further indicates that a study by Bloom and Williamson (1998) has strongly argued that the rise in the saving rate of East Asian countries form 1970 to 1990 can be explained by the increase in the proportion of population aged between 35 and 55 following the fertility decline of these countries from 1960 to 1980.

These macro economic frameworks attribute social benefits to a decline in fertility. Many economists, on the other hand, have tried to understand fertility as a household decision process. As early as the 18th century, Adam Smith (1776) noted that families were larger in settings where labor was scarce and child labor is of great importance to parents. Alternatively, Malthus (1798), due to his strong belief that birth control was not effective, viewed fertility not as individual

choice but a result of social institutions. He argued that fertility was mainly governed by the requirement that society places on couples before allowing them to marry. Once couples are married the 'constant passion of the sexes' would lead to unregulated fertility behavior. Hence, society restricted those with potential for higher income earning and asset accumulation from entry into marriage so that they are able to support children that follow from their marriage. Historians were able to add to Malthus evidence and confirmed that Europe exhibited a late median age at marriage (Schultz, 2007b). This delay in childbearing led European women to have four or five births over their life time rather than six or seven if they had married five years earlier. This added with the short life expectancy that prevailed in the pre-industrial Europe significantly diminished the rate of population growth.

After the 1960's, the dissemination of modern family planning methods resulted in lower levels of fertility even if higher growth rate of income was being evidenced and the Malthusian framework needed to be amended to fit this experience in Europe and other low-income countries (ibid). The different explanations provided for the decline in fertility rate were the low mortality rate that started to manifest in the 19th century, which reduced the number of children that parents needed to give birth to replace those that might have died from different diseases; increased price of rearing children and increase in the opportunity cost of rearing children (shadow price of children) brought about by the increase in women's wage.

2.1.2 Microeconomic Theories

The microeconomic determinants of fertility are considered to be better suited explanations to the declining fertility observed at the third stage of demographic transition. Economists have used the

traditional neoclassical theory of household and consumer behavior and the popular principle of optimization to elucidate family size determination in a given household. The conventional theory of consumer behavior assumes that a rational utility maximizing individual with a set of preferences for a set of goods tries to maximize the satisfaction derived from consuming these goods subject to a given budget constraint and the relative prices of all goods in the utility function.

In a basic microeconomic analysis of fertility, as given by the exposition of Todaro and Smith (2003), children are assumed to be one kind of consumption good, or investment goods as the case may be, so that fertility is a rational economic response to the consumer's decision to 'consume' children relative to other goods and the usual income and substitution effects are assumed to operate. The household chooses the combination of goods and children, among all attainable combinations, that maximizes family satisfaction on the basis of the subjective preferences. If children are assumed to be normal good, their 'consumption' increases with increase in income. However, if the source of increase in income is female employment then the increase in income may affect the number of children inversely. On the other hand, the price of children and the strength of taste for other goods affect the demand for children negatively.

Becker and Lewis (1973) emphasize that fertility is determined by the interaction between quantity and quality of children as separate arguments in a utility function. This quality–quantity approach highlights that there is a likely substitution from quantity to quality as family income increases. To understand the interaction between quality and quantity of children the assumption that quality and quantity are more closely related than any other two commodities is crucial.

The key feature of their analysis is that

> *Shadow prices of children with respect to their number i.e. the cost of an additional child, holding their quality constant, is greater the higher their quality is. Similarly, the shadow price of children with respect to their quality i.e. the cost of a unit increase in quality holding number constant is greater, the greater number of children. (P. S279)*

For illustrating their analysis, they specify the following simple utility function

$$U = U(n, q, y)$$

n = the number of children

q = their quality (assumed to be the same for all children)

y = rate of consumption of all other commodities

The simple budget constraint is given as:

$$I = nq\pi + y\pi_y$$

where I = the full income
π = the price of nq
π_y = the price of y

No special assumption is needed about the elasticities of substitution among n, q, y in both the utility function and in the household production function. The first order conditions for maximizing the utility function subject to the budget constraint are

$$MU_n = \lambda q\pi = \lambda p_n$$
$$MU_q = \lambda n\pi = \lambda p_q$$
$$MU_y = \lambda \pi_y = \lambda p_y$$

Where the MU's are marginal utilities

P's are the shadow prices or marginal costs

λ is the marginal utility of money income

An important point to be noted is that the shadow price of children with respect to number (p_n) is positively related to their quality (q) and the shadow price with respect to quality (p_q) is also positively related to the number of children (n). The economic implication of these is that an increase in quality is more expensive when there is larger number of children since the increase has to apply to more units. On the other hand, the increase in quantity is also more expensive when there are more children because higher quality children cost more.

The more suitable income concept is the total expenditure of n, q and y calculated at the shadow prices, hence, the correct measure of income is

$$\begin{aligned} R &= np_n + qp_q + yp_y \\ &= I + nq\pi \end{aligned}$$

According to their analysis, if income increases while holding π and π_y constant, the direct effect of the increase in *I* is to increase *q* while leaving *n* unchanged. As *q* increases the shadow price with respect to quantity, $p_n = q\pi$, will rise while the shadow price of quality ($p_q = n\pi$) and *y* ($p_y = \pi_y$) remain unchanged. This causes *q* and *y* to be substituted for *n*, and therefore *n* will decline.

To analyze the price effect, the budget constraint can be generalized as

$$\begin{aligned} I &= n\pi_n + nq\pi + q\pi_q + yp_y \\ p_n &= \pi_n + q\pi \end{aligned}$$

Shadow prices or marginal costs are given as

$$p_n = \pi_n + q\pi$$
$$p_q = \pi_q + n\pi$$
$$p_y = \pi_y$$

The component $n\pi_n$ consists of child costs that depend on quantity but not on quality while the component $q\pi_q$ depends on quality but not quantity. Increase in π_n leads to an increase in shadow price of quantity relative to both the shadow price of quality and shadow price of y and hence *n* would fall. The fall in the number of children, *n*, reduces the shadow price of quality ($p_q = \pi_q + n\pi$) which leads to substitution in favor of quality. This would result not only in a decline in quantity but also a rise in quality relative to other commodities. If π_q falls due to an increase in parents' education, it induces the shadow price of quantity ($p_n = \pi_n + q\pi$) and hence resulting in a relatively large decrease in quantity. Increase in the education of mothers has a significantly strong positive impact on the quality and a strong negative impact on the quantity (number of children). Quantity and quality of children are inversely related as the shadow price of quality depends on quantity and the shadow price of quantity also depends on quality.

Leibeinstein (1975), on the other hand, argued that Children would be considered to be inferior 'goods' if they were thought to be durable 'goods', if higher income groups 'buy' fewer children than lower income groups and if family size declines with economic development. He contributed to the development of alternative economic theory of family size determination by designing a theory that explains the fertility decline that accompanies economic development.

According to Leibeinstein, the belief that a population has homogeneous tastes (tastes do not depend on status or 'life style') makes cost of children implausible to explain the inverse relationship between income level and family size given the large income gap and income growth evidenced in developing countries. Hence, his theory is based on the assumption that a population does not have homogenous tastes or a given population is divided into social status groups that have different tastes. By different tastes, it is meant that the different social status groups may, to some degree, have different desire for children. The different social status groups may also see their set of expenditure, including expenditures for children, from different preference structures. According to this theory, the likely indexes of status are occupation, skill content or education, and asset per household.

The analysis of the theory further distinguishes ordinary consumption expenditures from status (life style) goods. Since people live in hierarchical social groups, consumption has a broad social status aspect beyond basic provisions. This is because people want to maintain their social status or lifestyle through expenditure. If income distribution becomes more equal at later stages of development, the interstatus-income ratio falls leading to relative income compression effects.

By employing a detailed analysis, this theory tries to show if all goods were ordinary goods, then the family size for the higher status group would be higher than those in the lower group However, once we introduce status goods into the analysis we can see the higher status group will choose lower number of children. It attempts to show having additional children would mean sacrificing the high-status good utility which could threaten the status position of the higher status household implying, therefore, that higher income households will have fewer children (Refer Leinbenstein, 1975 for detailed analysis).

Becker and Barro (1988), on the other hand, developed an economic analysis that looks into the linkage in fertility rates and accumulation of capital across generations. Their model is based on the assumption that parents are altruistic toward their children. The utility of parents not only depends on their own consumption but also on the utility of each child and the number of children. They developed a 'dynastic' utility function that depends on the consumption and number of descendents in all generations. Given the budget constraint, the first order conditions that maximize the utility function imply that 'fertility in any generation depends positively on the real interest rate and the degree of altruism, and negatively on the rate of growth in per capita consumption from one generation to the next' (Becker and Barro, 1988:2).

Further consideration is also made on the effects of child mortality, subsidies to children, and social security and other transfer payments to adults on fertility. Though, during the translation to low mortality rate, the demand for surviving children rises, the demand for surviving children reduces as the mortality rate begins to decline. Their analysis also extended to show that fertility is not a function of expenditures that simply raise the consumption of children but a function of expenditures on the subsistence and human capital of children.

In the study of micro economic determinants of fertility, it is argued that child mortality also plays a significant role. According to Ben-Porath (1976), the effect of child mortality on fertility is considered to be broken into two components. It can first be assumed that the preferred family life cycle is not affected by child mortality and fertility is an attempt to attain the preferred family size. Second, the possible effect of mortality can be taken into account in the choice of family size. The desired number of children is defined as 'the desired number of surviving children by

age of parents, with specification of relevant characteristics such as sex, education, labor force participation and earning' (Ben-Porath, 1976: S164). Hence, obviously, mortality raises the number of births necessary to arrive at the desired number of surviving children. Hoarding and replacement are the two types of reactions to child mortality where hoarding is the response of fertility to *expected* child mortality while replacement is the response to *experienced* child mortality.

Easterlin and Crimmins (1985) have also developed a model that incorporates the supply of, demand for and the cost of fertility regulations for fertility determination. These three variables are seen to mediate between the social and economic determinants on the one hand and fertility on the other. According to this model socio-economic variables affect fertility through these variables. These variables are defined as:

Demand: The number of surviving children a family would want to have

Supply: The number of children a family would have if no deliberate attempt is made to limit family size

Cost of fertility regulation: The economic, psychic, health and social costs of using contraceptives or abortion.

These variables are expected to change during development process and hence determine the number of children couples would have. The transition from the low to high level of development can take place in three phases.

(1) Excess demand – In traditional societies the number of children families demand is high and they may not even be able to achieve their objective family size i.e. demand exceeds supply. In such case, there is no motivation to reduce fertility and the family size is limited to the supply level.

(2) Excess supply, no control – as the society modernizes, families start to demand lower number of children due to change in the cost and benefit of children. Supply on the other hand will be rising because of decline in child mortality. This produces an excess-supply condition. However, at an initial stage, couples would not be able to reduce the supply due to the high cost of fertility regulation resulting in unwanted children to the extent that supply exceeds demand.

(3) Excess Supply with birth control – with declining demand and increasing supply, couples would reach to a point where their motivation to have lower family size exceeds the cost of regulation, and they would start adopting birth control.

This theory, though appreciated for its clarity, fails to quantify what the exact determinants of fertility actually are (Bongaarts, 1993).

2.2 Empirical Literature

The mostly applied micro economic theory of fertility developed by Becker (1960) and Becker and Lewis (1973) has attracted much attention in different empirical studies. According to this model, an increasing marginal cost of quality leads to a tradeoff between quality and quantity of children. Li et al (2005) note that different studies have attempted to test the quantity-quality tradeoff and have found a negative correlation between family size and child quality. However, they argue that these studies take family size to be exogenous while in actual facts family size and child quality are endogenous variables since they both are chosen by parents and are affected by unobserved parental behaviors and household characteristics. Hence, one important method of

dealing with the endogeneity of the variables is to use exogenous variation in family size caused by the natural occurrence of twins.

Acknowledging the endogeneity of family size and child quality decisions, a pioneer study using twins as a means of identification was conducted by Rosenzweig and Wolpin (1980). This study tests the quantity-quality model of fertility empirically using household data from India. To test whether there indeed is a trade-off between quality and quantity of children, the study uses 'twins' as instrument for change in family size to simulate the constraint. The result of the study shows that exogenous increase in fertility, which is captured by the 'twins' variable, decreases child quality and suggests that a decrease in family size brought about by exogenous factors increases the quality of children. Li et al (2005) also find supporting evidence to the quality-quantity tradeoff by examining the effect of family size on child educational attainment in China. Using educational attainment and school attainment as a measure of child quality the study finds a negative correlation between family size and child quality providing an empirical support to the quality –quantity model of fertility.

Different social theories also argue that education is a major determinant of fertility behavior. Most studies indicate women education to be consistently related to low fertility levels and a wide range of empirical studies also show the existence of a link between spread of mass education or raising levels of education and fertility (Axinn, 1993). Though both theory and empirical studies agree on the importance of education in influencing fertility, the mechanism through which education affects fertility remains ambiguous.

Bledsoe and Cohen (1993) put the different arguments as follows:

> *How, precisely, does education work this reproductive magic? Does it teach a woman Western scientific facts about reproduction and health, instruct her in the national language in which radio messages about contraception are broadcast, expose her to ideals of low fertility, extricate her from the authority of kin who demand high fertility, imbue her with career aspirations outside the home, embolden her to ask for contraceptives from intimidating family planning personnel or in the face of an irate husband? (p.89)*

According to Jain (1981), education affects fertility through two mechanisms. One explanation for the negative effect of female education on fertility is through increasing the potential for educated women to participate in labor force of the modern sectors of the economy. This is expected to increase the opportunity cost of women to rear children and, hence, reduce fertility. Second, education of women can also affect fertility through two important intermediate variables- breastfeeding and use of contraception. Using data from Bangladesh, Chaundhury (1984) finds supporting evidence that education is a variable most strongly correlated with the use of contraception and is also one of the significant variables that explain fertility behavior.

The empirical evidences that show a negative relationship between education of mothers and fertility, through any of the intermediate variables, may shed light on the long term impact that educating women may have in the demographic transition to low fertility if education of women leads to increased education of the coming generations. Berhman (1997) indicates that investment in women's education is greatly linked with increased schooling of the next generation. On the other hand, Berhman and Rosenzweig (2002), using a micro data from the US, find a result which

indicates that an increase in the schooling of women would not have a significant effect in terms of increasing the schooling of children and argue that the positive cross sectional relationship between the schooling of mothers and their children may be upwardly biased due to the strong correlation between schooling and heritable unobserved ability. However, they do not all together rule out the possibility that in other labor market setting and culture increased women's education leads to increased child schooling. If this holds true, then it can be safely argued that educating women can impact not only the fertility behavior of the current generation but also that of the coming generations.

Axinn (1993) further argues that not only the education of mothers but the schooling experience of family members, especially children, affects fertility preferences and family limitation behavior. A study done on the rural community in Nepal shows that children's education is an important determinant of parents' decisions to limit their fertility. The study finds a consistent result with the existence of a link between education and fertility decline by way of children's schooling.

Children's schooling is also found to have a large positive effect on parents' use of contraception and a significantly negative effect on their desire for more children. Caldwell (1982) argues that in addition to the pecuniary costs involved in educating children, which usually includes school fees, uniform and stationery costs, children's schooling reduces the potential for child's work both inside and outside the home hence reducing the demand for children as a source of labor for the household. In the presence of active family planning program the cost of educating children over a relatively short period of time is the most significant element in limiting family size (ibid).

The household production model, which is often applied by economists, provides a framework that can analyze the decisions regarding the number and quality of children in a given household and gives a plausible explanation for the evidenced negative relationship between schooling of children and family size. In this framework children are 'produced' in the home and investment on children is also made inside the household. Since both quantity and quality of children yield positive utility and have positive costs, the fertility of the household is determined by the income and shadow price of children. Hence, increasing the investment in child capital will have an obvious negative effect on the quantity of children.

Another determinant of fertility that is commonly employed in empirical studies is age-at-marriage. When women get married at a younger age the probability that they are likely to have more children is going to be high since the exposure to the risk of childbearing in their reproductive years is higher. Early marriage also makes it difficult for women to attain higher level of education. Field and Ambrus (2006), using a data from rural Bangladesh show that women attain less schooling as a result of marrying young. Hence, age-at-marriage may also affect fertility through the intermediate variable- education of women.

Income of households is another determinant of fertility emphasized in both theoretical and empirical works. However, the relationship between income and family size has remained elusive in many empirical studies. If children are assumed to be normal goods then as the income of couples increase, they maximize their utility by 'consuming' more children as they would with other consumption goods. However, although some macro-studies tend to support the positive income – fertility relationship, studies using micro data show little or no support for such relationship (Freedman and Thornton, 1982). To explain the absence of a positive income-

fertility relationship, Becker (1960) attributed this positive relation to the better access of high income groups to contraceptive use, increasing their ability to plan their family size effectively. However, he argued that more widespread contraceptive use, where uniform adoption is observed across income groups, would lead to a positive income-fertility relationship. On the other hand, Willis (1973) has stressed the tradeoff between the demand for quality and quantity of children to elucidate the lack of a positive income – fertility relationship. Leinbenstein (1975), as mentioned earlier, has also tried to explain the negative relationship by stressing that couples with rising incomes tend to spend a larger amount of their income on consumption goods to maintain their social position relative to other social groups.

A paper by Freedman and Thornton (1982) examines the relationship between income and fertility using a longitudinal data set which allowed them to assess the extent to which the income experience of couples have influenced their childbearing plans over 15-year period. Specifically, their paper investigates the husband's income and family size decisions experience over 15 years. Husband's income was chosen because its impact on fertility is expected to be unambiguously positive while the effect of the wife's earning has a mixed expectation. The wife's income may increase the overall earning of the household resulting in increased ability to support more children. However, the increase in the wife's income may also have a counter effect by increasing the opportunity cost of rearing children. The study further controls for education, a common proxy for opportunity cost of children, and contraceptive efficacy. Nevertheless, the result of the study did not support a strong or consistent relationship between husband's income and fertility.

Another determinant of fertility decisions, as discussed in the theoretical literature is infant mortality. An article by Benefot and Schultz (1996) in analyzing individual, household, and

community characteristics that may affect fertility in contemporary Cote d'Ivoire and Ghana tries to look into the relationship between child mortality and fertility. Treating child mortality as exogenous, they found out that fertility responds directly to child mortality, but by a smaller proportion than estimated in studies of East Asia and Latin America.

The household economic model also gives a strong emphasis on the opportunity cost of childbearing, which is female wages, as a determinant of fertility (McNown, 2003). Female wages are assumed to have counter-acting effect on fertility. On the one hand, the increase in income from the participation of the woman in the labor force affects fertility positively while on the other hand it has a negative substitution effect by making childbearing a costly activity for the woman. McNown (2003), using a macro data from the US, employs a cointegration model of fertility and female labor supply and finds no causal relation between the variables. However, his finding shows that both fertility and female labor force participation exhibit negative relationship and are both highly responsive to certain economic factors like female wages, male relative incomes, women's unemployment and educational attainment.

Kogel (2006), on the other hand, makes mention of recent literature that find a puzzling positive and significant correlation between the total fertility rate and female labor force participation in Western European countries. He argues that while time series data since the 1960's are consistent with the standard economic models of fertility, where fertility and female employment are negatively related, this is not true for cross- country data. However, in his finding he shows that this positive relationship may have been brought about by the omission of two important variables- purchased child care use and female long-term unemployment rate of the countries under consideration. According to him, once this is corrected for and the total fertility rate

accounts for an increasing age of childbearing, the relationship is in line with micro economic theory depicting a negative relationship.

Though both the economic theory of fertility and also empirical studies agree that there indeed is a relationship between labor force participation and fertility, the most important problem is the direction of relationship between the two (Cramer, 1980). Engelhardt et al (2004) examine causality and parameter instability in the long run relationship between fertility and women's employment using a macro-level time-series data from developed countries. In this study they find that there in fact is causality between the two variables and their finding support the micro explanation that women's fertility and their labor force participation affect each other. However, earlier study by Smith-Lovin and Tickamyer (1982) estimated a non-recursive model with number of children ever born and number of years employed as the interdependent endogenous variables and find that the fertility of women has strong effect on their work behavior but there was no effect from work to fertility.

From the macro economy perspective though it is mostly argued that economic development of a country is accompanied by a large decline in fertility, according to Caldwell (1983), fertility decline will occur in situations where women have a greater control over their own fertility. Hence, a development process that raises the status of women will most likely be accompanied by a declining fertility.

Though economic growth affects fertility through various channels like increase in health services, nutrition, sanitation and education, a paper by Whittington and Stapleton (1995) focuses on the impact of growth on the status of women and how it ultimately influences fertility.

According to this paper, it is not simply growth that leads to fertility decline but the sector in which the growth occurs has important implications. The theoretical perspective of the paper is that economic growth is most likely to have a negative effect on fertility if it improves employment opportunity, thereby improving the status of women and increasing the opportunity cost of childbearing. Using data for 51 countries, they found out that agricultural development decreases the status of women and hence the opportunity cost of rearing children as it brings about better opportunities for men than for women. On the other hand, growth in the manufacturing sector creates better opportunities for women, increases the opportunity cost of childbearing and, therefore, results in fertility decline.

Another study by Jejeebhoy (1991), tests the argument that improvement in the status of women affects the fertility transition using micro data from a town in India. The underlying argument for the hypothesis is that though the status of women cannot affect fertility directly, it does so through three sets of intervening variables. These variables are reduction in the demand for children, positive attitude toward fertility regulation and easily accessible means of fertility regulation, and child survival prospects. The variables used as indicators for status of women were level of education, work status, family type, interspousal age difference, participation in domestic decision making and extent of freedom of movement. The main conclusion derived from the study is that not all of the selected factors associated with women's status are associated with fertility behavior. The study further suggests that at early stages of the fertility transition, the relationship between women's status variables and fertility is ambiguous. However, the women's status indicators are found to be related, in the expected direction, with intervening variables as marital duration, fecundity, regulation costs and deliberate fertility control which further are likely to affect fertility.

The other determinant of fertility that is becoming most prevalent in developing countries is the spread of HIV/AIDS. 'Africa with about 13% of the world's population has 68 % of global HIV/AIDS cases' and close to 94% of the world 3.2 million child AIDS mortality has occurred in Africa (ECA, 2002a). Being the most severely affected world region by the epidemic, growing evidence shows that HIV infection is having a significant impact upon fertility in Sub-Saharan African countries (Gregson, 1998).

In addition to the direct biological effects that HIV/AIDS has on the fertility of women, it affects fertility decisions indirectly through different behavioral factors. One of such evidences is an empirical study done on Tanzania which offers an evidence of both positive and negative fertility response to AIDS related mortality (Ainsworth et al, 1996). This study shows that the death of female household members affects fertility negatively while child mortality has a positive effect on fertility. Another study on Ivory Coast also shows that HIV-infected women become pregnant less often than HIV-negative women and HIV positive women are also likely to have more miscarriages than other women (Desgrees du Low et al, 1997). Zaba and Gregson (1998) also find that in populations that do not use contraceptives, HIV positive women have lower fertility than other women.

Women are also likely to delay their marriage which exposes them to sexual relation, for fear of being infected by HIV/AIDS (ECA, 2002b). There is also a possibility for girls to postpone their marriage or may even decide not to marry at all. Women who are already married may also get divorced from unfaithful spouses. Moreover, those widows who lose their spouses for HIV/AIDS

will not find it easy to remarry resulting in reduction in their reproductive lifetime. All these factors related to HIV/AIDS affect fertility negatively.

The way HIV affects fertility can also be examined from the perspective of the decision of parents on the number of children they want to have. A high level of anxiety about AIDS or high risk of contracting HIV leads to a decision to have fewer children (Baylies, 2000). The likelihood of HIV infected women to use contraceptives is very high mainly due to their fear of transmitting their infection to their babies and to avoid leaving additional children as orphans. Families are often afraid about leaving orphans for others and hence adjust their decision on the number of children downwards. On the other hand, the effect of HIV/AIDS on fertility could be positive. Those parents who experience child mortality may desire more children to ensure that their desired number of surviving children is met by replacing the dead ones.

Though all the above mentioned variables are expected to affect fertility with different magnitude, one study done for Ethiopia uses the proximate determinants of fertility to explain factors affecting fertility patterns. These proximate determinants of fertility that account for the major variation in fertility across populations identified by Bongaarts (1978) are marriage, contraception, induced abortion and postpartum infecundability. These proximate determinants of fertility mainly refer to the behavioral and biological mechanisms by which fertility is reduced below the biological maximum.

The study done by Sibanda et al (2003) tries to identify the reason for the decline of total fertility rate in the capital city of Addis Ababa. The most striking fact the paper tries to look into is the fact that the decline occurred in the absence of a strong and effective family planning program.

The components of the fertility decline are identified using the Bongaarts framework and it was found out that the single most important factor for the decline in the fertility rate is the rise in the proportion of unmarried women. This increase is attributed to late marriage and to a greater proportion of the women who remain single at their twenties and early thirties. However, the Bongaarts framework only looks into the proximate determinants which refer to only the behavioral and biological mechanisms while it does not account the socio-economic variables that are likely to affect fertility.

CHAPTER THREE

MODEL SPECIFICATION AND ESTIMATION METHODS

The most prominent micro economic model that is commonly used as a springboard in works related to fertility is the model developed by Becker and Lewis (1973). This model defines a utility function of a household to be maximized subject to a budget constraint. However, this model focuses on explaining the quality–quantity tradeoff of a given household rather than understanding most of the socio-economic determinants of fertility. Hence, in the effort to identify the most significant socio-economic determinants of fertility, it is better suited to integrate different models and empirical works to come up with a comprehensive model that will better help understand which of the variables are in fact significant in the Ethiopian urban context.

As indicated in the literature review, different theories and empirical studies consider income, education, age at first marriage child mortality, labor force participation of women as major determinants of fertility behaviors. Though incorporating all these variables in one model could have been more plausible, the unavailability of a single data set that incorporates all these variables has forced this research to apply two models using two different data sets.

3.1 Data Sources

The first data set used for this study is the Ethiopian Urban Socio-Economic Surveys conducted by Addis Ababa University Department of Economics in collaboration with the Department of

Economics of Goteborg University and Michigan State University. These surveys are conducted in five waves during the years 1994, 1995, 1997, 2000 and 2004. A sample of 1,500 households is included in the survey. The sample is selected to represent the major socioeconomic characteristics of the urban population in the country (Bigsten et al, 2003). The households incorporated in the survey are comprised from seven major urban towns of the country, namely: Addis Ababa, Diredawa, Awassa, Behir-Dar, Dessie, Jimma and Mekele. Allocation of households in each town was made according to their respective contribution to the total population. The surveys include information on household demographics, income, consumption, employment, migration, health and other relevant household socio-economic information.

The second data set used is the Demographic and Health Survey that is conducted by the Central Statistical Agency of Ethiopia in year 2005. The Ethiopian Demographic and Health Survey (EDHS) is a national representative survey of 14,070 women between the age of 15 and 49 and 6,033 men between age 15 and 59. The EDHS is the second comprehensive survey conducted in Ethiopia as part of the worldwide Demographic and Health Survey project (CSA, 2005). This cross sectional data is mainly intended to provide up-to-date and detailed information on fertility, family planning, mortality rates, maternal and child health, nutrition and knowledge of HIV/AIDS.

3.2 Estimation Methods

In the econometric estimation the dependent variable is the number of children born by a woman, which is used as the measure of fertility. In such economic contexts where the dependent variable of interest is a nonnegative integer or count, unlike the classical regression model, the response

variable is discrete where the distribution places probability mass at nonnegative integer values only (Wooldridge, 2002).

Given the discrete and non-negative nature of our dependent variable, number of children, the OLS model is obviously inappropriate as the conditional mean it specifies, $x_i'\beta$, may take negative values and a variance function that is homoskedastic. For count data, linear models exhibit similar shortcomings as they do for binary or corner solution responses. This is because $y \geq 0$ and we know that $E(y/x)$ should be nonnegative for all *x*. If β is the OLS estimator, there usually will be values of *x* such that $x\beta < 0$—so that the predicted value of y is negative, which should not be the case when the dependent variable is of count nature. In count data settings the variables are often skewed to the right and the variance are intrinsically hetroskedastic as the variance increases with the mean. Hence, the appropriate model of estimation are count data models. Accordingly, the basic Poisson and negative binomial models for cross sectional data are discussed followed by the descriptions of their extended panel specifications.

The natural starting point of estimation of count data models is the Poisson model where the stochastic model is a Poisson point process for the occurrence of the event of interest. This implies a Poisson distribution for the number of occurrences of the event, with a probability function given as:

$$pr[Y = y/\lambda] = \frac{e^{-\lambda}\lambda^{y}}{y!}, \qquad y = 0,1,2.....N$$

Where λ is the intensity of rate parameter and the first two moments are defined as:

$$E[Y] = \lambda$$
$$V[Y] = \lambda$$

which shows the equi-dispersion (equality of mean and variance) property of the Poisson distribution. The Poisson regression model is therefore derived from the Poisson distribution by using parameterizing the relation between the mean parameter and the regressors where the standard assumption is to use the exponential mean parameterization.

$$\lambda_i = \exp(x_i'\beta) \quad , i = 1, ...N$$

$$V[y_i / x_i] = \exp(x_i'\beta)$$

Since we assume equi-dispersion in Poisson distribution in the Poisson regression, the Poisson regression is intrinsically hetroskedastic. Given the Poisson distribution of the mean and variance, the appropriate estimator for the Poisson model is maximum likelihood, where the log likelihood function is given by:

$$\ln\ L(\beta) = \sum_{i=1}^{N} \left\{ y_i x_i'\beta - \exp(x_i'\beta) - \ln y_i ! \right\}$$

The Poisson Maximum Likelihood Estimator denoted $\hat{\beta}_p$ is the solution to K non-linear equations with the first order condition for maximum likelihood given as:

$$\sum_{i=1}^{N} (y_i - \exp(x_i'\beta)) x_i = 0$$

If x_i includes a constant term then the residuals $y_i - \exp(x_i'\beta)$ sum to zero. The log likelihood function is globally concave; hence solving these equations by Gauss-Newton or Newton-Raphson iterative algorithm yields unique parameters estimates (Cameron and Trivedi, 2002).

However, the Poisson regression measure is usually too restrictive for count data. One apparent deficiency of the Poisson model is that for count data the variance usually exceeds the mean, a feature called over-dispersion, while the Poisson model instead implies equality of the variance and the mean, a property called equi-dispersion. Whether the equi-dispersion assumption holds or not has important implications on how the statistical inference is carried out. While the Poisson variance assumption requires the mean to be equal to the variance a weaker assumption allows the variance-mean ratio to be any positive constant:

$$Var(y/x) = \sigma^2 E(y/x)$$

The case where $\sigma^2 > 1$ implies the variance is greater than the mean. This situation is called over-dispersion while if $\sigma^2 < 1$ is it is a clear case of under-dispersion.

Over-dispersion in such models has qualitatively similar consequences as the failure of the assumption of homoskedasticity in the linear regression model. According to Cameron and Trivedi (2005), large over-dispersion leads to grossly deflated standard errors and hence inflated t-statistics in the usual Maximum Likelihood output. A statistical test of over-dispersion is significantly relevant after running Poisson regression.

Most count models with over-dispersion specify dispersion with the form:

$$V[y_i / x_i] = \lambda_i + \alpha g(\lambda_i)$$

Where α is an unknown parameter and $g(.)$ is a known function, most commonly $g(\lambda) = \lambda^2$ or $g(\lambda) = \lambda$. It is assumed that under the null hypothesis of $\alpha = 0$, the variance is given by $V[y_i / x_i] = \lambda_i$, generating the usual Poisson regression (ibid).

One cause of over-dispersion in count data may be unobserved heterogeneity. In this case, counts are considered as being generated by a Poisson process but the rate parameter of the process cannot be correctly specified. The rate parameter itself is a random variable. In such cases where there is an over-dispersion a better suited analysis is the full maximum likelihood having a particular parameterization of the negative binomial distribution taking the density function of the form:-

$$pr(Y = y / \lambda, \alpha) = \frac{\Gamma(\alpha^{-1} + y)}{\Gamma(\alpha^{-1}) y!} \left(\frac{\alpha^{-1}}{\alpha^{-1} + \lambda} \right)^{\alpha^{-1}} \left(\frac{\lambda}{\lambda + \alpha^{-1}} \right)^{y}$$

Where λ is the mean or the expected value of the distribution and α is the over-dispersion parameter. The likelihood function for the negative binomial model is, therefore, defined as:

$$L(\beta / y, \mathrm{X}) = \prod_{i=1}^{N} \mathrm{pr}(y_i / \mathrm{x}_i) = \exp \prod_{i=1}^{N} \frac{\Gamma(y + \alpha^{-1})}{y! \Gamma(\alpha^{-1})} \left[\frac{\alpha^{-1}}{\alpha^{-1} + \lambda_i} \right]^{\alpha^{-1}} \left[\frac{\lambda_i}{\alpha^{-1} + \lambda_i} \right]^{y_i}$$

$$\text{where } \lambda_{\mathrm{i}} = E[y_i / \mathrm{x}_{\mathrm{i}}] = \exp(\mathrm{x}_{\mathrm{i}} \beta)$$

In the panel data framework, to be employed for the EUSES data, the best suited count data model is the non linear Poisson random effects model. As in the case of the linear random effects model, the count data panel random effects models explicitly contain an unobserved effect. Whether the unobserved heterogeneity, c_i, will be treated as a random effect or a fixed effect depends on whether c_i is viewed as a random variable or as a parameter to be estimated. According to Wooldgridge (2002), with a large number of random draws from a cross section it makes strong sense to treat the unobserved effect, along with the dependent and explanatory variables, as random draws from neglected heterogeneity perspective.

In cases where few observations are available for different individuals over a period of time, it is important to make efficient use of all the available data (Hsiao, 1986). The fixed effect model is more fit in such cases where the researcher makes inferences conditional on the effects that are in the sample. On the other hand, the random effects model is viewed as one where the researcher makes unconditional inferences with respect to the population of all effects. According to Hsiao (1986), if a certain research involves hundreds of individuals selected as a random sample from a large population then random effect is more appropriate. Moreover, the random effects model also helps retain variables that do not vary over time but are considered to be crucial for explaining a variable of interest.

The main consideration in choosing between the random effects and fixed effects approach is whether the unobserved effects c_i is correlated with the explanatory variables, it is imperative to test if this correlation exists. To test this, disparity between the random effects and fixed effects estimates is checked using the Hausman test. According to this test, since the fixed effects estimates are assumed to be consistent even when c_i and x_i are correlated, while the random effects estimator is not, a statistically significant difference is interpreted as evidence against the random effects assumption. Letting $\hat{\delta}_{RE}$ be the vector of random effects estimates without the coefficients on time-constant variables and $\hat{\delta}_{FE}$ be the corresponding fixed effect estimates then the Hausman test specification given by

$$H = \left(\hat{\delta}_{FE} - \hat{\delta}_{FE}\right)' \left[\hat{\text{Avar}}(\hat{\delta}_{FE}) - \hat{\text{Avar}}(\hat{\delta}_{RE})\right]^{-1} \left(\hat{\delta}_{FE} - \hat{\delta}_{RE}\right)$$

is distributed asymptotically as χ^2_M under the random effects assumptions

With count data panel models, the issues that are present with the unobserved effects are similar to those of the linear panel data models and the conditional joint distribution for a Poisson-based random-effects model is given by:

$$pr(y_{i1},....,y_{iT} / c_i, x_i) = \left[\prod_{t=1}^{T_i} \frac{\lambda_{it}}{y_{it}!}\right] \exp\left(-c_i \sum_{t=1}^{T_i} \lambda_{it}\right) c_i^{\sum_{t=1}^{T_i} y_{it}}$$

Where c_i represents the random-effects applicable to each group i and $\lambda_{it} = \exp(x_{it}^{'}\beta)$ ensures the non- negativity and where $c_i \square\ gamma(\theta,\theta)$ with $E[c_i] = 1$ and $V[c_i] = 1/\theta$. Integrating out the gamma distributed c_i results in the following unconditional distribution.

$$pr(y_{i1},....y_{iT} / x_i) = \left[\prod_{t=1}^{T_i} \frac{\lambda_{it}^{y_{it}}}{y_{it}!}\right] . \frac{\Gamma(\theta + \sum_{t=1}^{T_i} y_{it})}{\Gamma(\theta)} \left(\frac{\theta}{\theta + \sum_{t=1}^{T_i} \lambda_{it}}\right) \left(\frac{1}{\theta + \sum_{t=1}^{T_i} \lambda_{it}}\right)^{\sum_{t=1}^{T_i} y_{it}}$$

For the fixed effects version of the Poisson panel model the fixed effects, c_i , can take on any value. The fixed effects disappear from the log-likelihood function and the parameters β become estimable with the following density function:

$$pr(y_{i1},...,y_{iT_i} / \sum_{t=1}^{T_i} y_{it}, x_i) = \frac{\left(\sum_{t=1}^{T_i} y_{it}\right)!}{\prod_{t=1}^{T_i} y_{it}!} . \prod_{t=1}^{T_i} \left[\frac{\lambda_{it}}{\sum_{s=1}^{T_i} \lambda_{is}}\right]^{y_{it}}$$

In a panel analysis of negative binomial models, the individual effects do not apply to the mean value but to the distribution of the dispersion parameter (α). Random-effects models are appropriate when dispersion varies randomly across groups due to unidentified factors which are specific to groups. In the standard random effects case the, the dispersion varies randomly across

groups according to a *beta* distribution with parameters *r* and *s*. A random-effects negative binomial model allows the dispersion parameter to vary such that $1/(1+\delta_i)$ □ $beta(r,s)$ which yields the following joint probability for the i^{th} group.

$$pr(y_{i1},...y_{iT_i}) = \frac{\Gamma(r+s)\Gamma\left(r+\sum_{t=1}^{T_i}\lambda_{it}\right)\Gamma\left(s+\sum_{t=1}^{T_i}y_{it}\right)}{\Gamma(r)\Gamma(s)\Gamma\left(r+s+\sum_{t=1}^{T_i}\lambda_{it}+\sum_{t=1}^{T_i}y_{it}\right)}\prod_{t=1}^{T_i}\frac{\Gamma(\lambda_{it}+y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it}+1)}$$

For a fixed-effects negative binomial model, like the Poisson fixed-effects model, the dispersion parameter drops and the β parameters can be estimated with a fixed-effects joint probability for group *i*, expressed as follows:

$$pr\left(y_{i1},....,y_{iT_i}/\sum_{t=1}^{T_i}y_{it}\right) = \frac{\Gamma\left(\sum_{t=1}^{T_i}\lambda_{it}\right)\Gamma\left(\sum_{t=1}^{T_i}y_{it}+1\right)}{\Gamma\left(\sum_{t=1}^{T_i}\lambda_{it}+\sum_{t=1}^{T_i}y_{it}\right)}\prod_{t=1}^{T_i}\frac{\Gamma(\lambda_{it}+y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it}+1)}$$

3.3 Model Specification for EUSES

This model is going to be estimated using data from the Ethiopian Urban Socio-Economic Surveys (EUSES) under a panel count data setting. The equation of interest is given by:

$$Nofchld_{it} = \beta_0 + \beta_1 weduc_{it} + \beta_2 age_{it} + \beta_3 age_{it}^2 + \beta_4 \ln pce\,\mathrm{xp}_{it} + \beta_5 region_{it} + \beta_6 marstat_{it} + \beta_7 incgenwom_{it} + \beta_8 religion_{it} + \nu_{it}$$

Where the variables are defined as

Nofchld= Number of children

weduc = Educational level of the woman

age = age of the woman

age^2 = age of the woman in quadratic form

lnpcexp= log of per capita consumption expenditure of the household

region = a dummy included to indicate the region of the household

marstat= marital status of the woman

incgenwom = a dummy to capture if the woman is engaged in income generating activity

religion = religion dummy

According to Becker (1960) and Becker and Lewis (1973), as income of the household increases households tend to substitute quality for quantity resulting in lesser number of children. This theory, the exposition of which is given in the literature review part, is the most widely applied micro economic fertility theory. However, in many empirical works the measurement of income is an often challenging task due to related measurement errors that may arise during data collection.

According to Deaton and Zaidi (1999), consumption is a theoretically more satisfactory measure of living standard especially in developing countries framework. In developed industrial economies where self employment is relatively not common and annual income variation is low, income can be taken as a measure of welfare. However, in less developed economies where self employment may be common, income data cannot be considered to be reliable as it is prone to measurement error. It is also common for most households to understate their earning during such surveys for fear of possible implication on taxation. On the other hand, consumption is

considered to be a better measure than income in that it is not closely tied to short-term fluctuations in income, and that it is smoother and less-variable than income (ibid). Hence, the logarizm of per capita consumption expenditure (total consumption expenditure divided by the household size) of each household is taken as a measure of living standard of households.

The other crucial variable incorporated in the model is a dummy to indicate whether the mother is engaged in an income generating activity or not. If the mother participates in the labor force or is engaged in any income generating activity, assuming that children are normal goods, the final effect on decision concerning fertility is ambiguous depending on which of the effects, whether the income effect or substitution effect in terms of allocating time between work in the household, is the most dominant one. The neoclassical framework explains the increase in female labor supply and decrease in fertility in terms of the increase in women's market wage opportunities or the opportunity cost of women's time in household production activities (Schultz, 1990).

As indicated in the literature review section, some argue that income generation of women also affects their fertility decisions as child bearing activities constrain the woman from participating in the labor force. However, this simultaneity issue is not going to be handled in the model as it is assumed that the feedback effect from fertility to women's labor force participation is not expected to be significant in a country like Ethiopia where the extended family system is very strong and the cost associated with child care is not that high as the case is in most developed countries.

Another important variable is education of women. Most researchers agree that education of women has a negative effect on their fertility though the route through which it affects fertility may differ. Others, on the other hand, argue that a small amount of education in least literate societies might initially increase fertility at the early stage of development the effect of education on fertility could be positive due to a possible income effect (Jain, 1981). Hence, it is imperative to include the education of women into the model to see its significance and how it affects the fertility decision of women in urban Ethiopia. The educational level of the husband is also to be incorporated in the model since it directly or indirectly affects the fertility decision in the household.

The region dummy is included in the model to capture if there are peculiar traits in each region that affect fertility decisions other than the individual characteristics of individuals and their households. The inclusion of the region dummy indicating the region the household is located will be helpful to understand if the fertility decision of households is significantly affected by the particular situations of the region they are in, in addition to their peculiar individual household traits.

Moreover, since marriage pattern is an important determinant of fertility levels in a population, marital status of the women in the sample are incorporated to see its impact on fertility. Other variables included in the model are age of the woman and religion of the household head to see the possible impact of these variables on the fertility decision of households.

3.4 Model Specification for EDHS

The second data set to be used for the analysis is the Ethiopian Demographic Health Survey (EDHS), 2005. The equation to be estimated takes the form:

$$chldevb = \beta_0 + \beta_1 educ + \beta_2 age + \beta_3 age^2 + \beta_4 chdmor + \beta_5 marstat + \beta_6 incgenwom + \beta_7 religion + \beta_8 ageatfirmar + \beta_9 region + u_i$$

where $u_i \sim iid(0, \delta^2)$

Where the variables are defined as

Chldevb= Children ever born by the woman

Educ = Educational level of the woman

age = age of the woman

chdmor = the number of children that were born alive but died before the age of 5

marstat= a dummy indicating the marital status of the woman

incgenwom = a dummy to capture whether the woman is engaged in any income generating activity (measured by whether the woman has performed any income generating work in the last 12 months)

religion = a dummy capturing the religion of the woman

ageatfirmar= age at first marriage

region= a dummy to indicate where the woman lives

The EDHS does not incorporate a direct measure of income or consumption of the women in the sample. On the other hand, it uses an economic index that indicates the level of wealth of the household. This economic index is constructed using household asset data which includes ownership of different consumer items and dwelling characteristics, such as source of drinking

water, sanitation facilities and others. In constructing the wealth index each asset was given a weight that was generated through principal component analysis and each household was then assigned a score for each asset. A single asset index was developed for the whole sample and the sample was accordingly divided into five quintiles from the lowest to the highest scores. However, this wealth index could not be included in the model as a measure of living standard because almost 96% of the women in the urban sample were categorized to be 'rich' and, hence, no variation is observed between the different individuals in the sample.

As is the case with the first model the educational level of the women, their working status, age, religion and region of residence are included in this model. In addition to these variables, child morality and age at first marriage are also included.

Child mortality is integrated in the fertility equation as actual experience or expectation of infant mortality affect fertility decision positively. According to Ben-Porath (1976), the two types of reaction to child mortality: 'hoarding' and 'replacement' as responses to expected and experienced child mortality respectively affect fertility decision of households. Hence, number of children that were born alive but died eventually before the age of five is incorporated into the model to see its impact on fertility decisions.

Age at first marriage is another variable included in the model. Women who marry at their early ages are less likely to be well educated and have good knowledge concerning family planning. Moreover, women who marry early are more likely to be exposed to higher fertility for a longer period of their reproductive time.

CHAPTER FOUR

DESCRIPTIVE STATISTICS AND ESTIMATION RESULTS

4.1 Results for EUSES

4.1.1 Descriptive Statistics

About 70% of the households in the sample are male headed. The distribution of household heads by religious affiliation shows that 79 percent are Orthodox Christians and nearly 14 percent are Muslims. Those household heads that are protestant and Catholic account for 4% and 1% of the sample while the rest 2% have other beliefs. From the total pooled observation 72% of the women in the sample are married while 25 % were divorced or separated and 3% are single. The average age of women in the sample is 35.74 in 1994 and 45.84 in 2004.

The main limitation of this study is the fact that the number of children indicated at the first wave do not account for those children that are deceased or have moved out of the household mainly because the survey does not incorporate such information. However, the information on the childbearing behavior of the households for the 10 year period between the waves is a precise measure of fertility outcomes. Accordingly, the average number of children in each household has increased from 3.75 in 1994 to 4.17 in year 2004. The average number of children taken from all the observations is 3.93.

Table 4.1 Summary Statistics on Age, Household Size and Number of Children (Means and Standard Deviations)

Variable	1994	1995	1997	2000	2004	Pooled
Age of woman	35.74	36.79	38.82	41.69	45.84	39.23
	(7.11)	(7.12)	(7.10)	(7.1)	(7.1)	(7.9)
Household size	6.55	6.45	6.35	7.62	7.28	6.78
	(2.63)	(2.68)	(2.58)	(2.75)	(2.77)	(2.72)
Number of children	3.75	3.85	3.93	4.08	4.17	3.93
	(2.38)	(2.40)	(2.37)	(2.35)	(2.33)	(2.37)

Source: EUSES and own computation

Education, being one of the major socioeconomic factors influencing a person's behavior and attitude, is believed to have an impact on the fertility decision of households. The classification of educational level is done according to the current system of formal education which is based on a three-tier system: eight years of primary education, followed by four years of secondary school and tertiary education. Accordingly, as is the case with most developing countries, majority of the women in the sample, 57%, have only primary level education while 19% are without education and only 17% and 7% of the women have attained secondary and tertiary level education, respectively. Only 25% of the women under analysis have performed some kind of income generating, whether in their own business or being employed.

Table 4.2 Educational Level from EUSES

Variable	Percentage from Sample (1994)	Percentage from Sample (2000)
Educational level of women		
No education	19%	13%
Primary level	57%	68%
Secondary Level	17%	13%
Tertiary level	7%	5%

Source: EUSES and own computation

The consumption expenditure of the household is taken as a proxy for the income of the households. The annual total expenditure of the households for all periods is given in real 1995 Ethiopian Birr using the Consumer Price Index from CSA and the amount is converted to per capita expenditure after dividing the total expenditure by the total household size.

Table 4.3 Summary of Per Capita Consumption Expenditure

Year	Median	Mean
1994	733.47	975.96
1995	740.87	1,442.63
1997	851.76	1,782.52
2000	865.72	1,189.62
2004	818.70	1,124.59

Source: EUSES and own computation

Though information about contraceptive use of the households in the sample is not available for all years of the survey except for year 2004, a descriptive statistics of this information using the year 2004 data may shed light to the general awareness and contraceptive use of the households incorporated in the survey. According to the data, 94% of the households have heard about contraceptives through mass media, friends, health professionals or community events. Of these informed households, 66% use both modern and traditional contraceptive methods to delay or limit pregnancy while the rest 34% do not use contraceptive methods for religious reasons, fear of side effects and health concerns, opposition from their husbands, their need to have as many children as possible or because they are not sexually active.

4.1.2 Regression Results

A panel data may be assumed to be balanced only when data is available for every individual in every year. However, in the EUSES, the fact that the number of observations in each wave varies among the surveys conducted at the different times indicates that the panel data is unbalanced. This is usually the case with most panel surveys of individuals where there usually is a drop off or attrition over time in the proportion of individuals still answering the survey. In such cases, where the panel data is unbalanced, according to Cameron and Trivedi (2005), the fixed estimator is going to be consistent if the strong exogeneity assumption becomes:

$$E[u_{it} / \alpha_i, x_{i1},..., x_{iT}, d_{i1},...d_{iT}] = 0$$

and the random effects estimator is consistent if additionally the unobserved heterogeneity, α_i ,is independent of the other conditioning variables. If these hold true, then both the fixed effects and random effects estimators can be applied to unbalanced data with little adjustment. Moreover, to

proceed with the estimation of the unbalanced panel data, the fixed effects model requires that an individual observation be observed at least twice in the sample.

Special methods need to be applied to unbalanced panels only if the reason for individuals dropping out of the sample is correlated with the error term. If the reason for attrition is related to the dependent variable it may result in unrepresentative panel that leads to attrition bias (Cameron and Trivedi, 2005). It is, however, assumed that the attrition is random and is less likely to be correlated with the number of children in a household which is the dependent variable in the model. In constructing the sample for the study, 965 households that have women between the age of 15 and 49 (women in their reproductive age at least in the first round) are selected from the 1994 survey and these households are followed up until the final round. Assuming there is no attrition bias, econometric packages such as STATA, which is to be used in this paper, have the advantage of handling unbalanced panels by undertaking the required adjustments (ibid).

Given the option of using more than one possible model specification for the estimation, i.e. Poisson or negative binomial, fixed effect or random effects, the first estimation was made using the random effects Poisson model. However, the likelihood ratio test of the over dispersion parameter was found to be significant indicating a possible over dispersion in the model. Hence, the negative binomial fixed effects and random effects panel specifications were estimated and compared.

Since the negative binomial panel model to be estimated uses exponential transformation to ensure the non negativity of the dependent variable, the interpolation of the model coefficients

are not as obvious as in the case of the simple linear models. In an exponential case, $E[y_i / x_i] = \exp(x_i^{'}\beta)$ the marginal effect of each variable is expressed as:

$$\partial E[y_i / x_i] = \exp(x_i^{'}\beta) \times \beta_j = E(y_i / x_i) \times \beta_j$$

$$\frac{\partial E(y_i / x_i) / E(y_i / x_i)}{\partial x_{ij}} = \beta_j$$

This implies that a unit change in the j^{th} variable leads to a multiplicative change in $E(y_i / x_i)$ of β_j. In other words, if β_j =1.2, a unit change in x_j will increase the mean by 120%.

According to Cameron and Trivedi (2005), the main weakness of panel commands in most econometric packages is that they compute the standard errors based on restrictive distributional assumptions such as identically and independently errors in the fixed effects models, in individual effect and in the random effects models. Hence, to compute a more robust standard error estimates, they suggest panel estimation with a panel bootstrap. Hence, all standard errors presented in the regression results are bootstrapped.

The regression result for the negative binomial panel random effects and fixed effects are presented in Table 4.4. The marginal effects of the regression results are reported in appendix 1. To check for possible multicollinearity between the variables, a pooled OLS regression was performed and the VIF (Variance-Inflation Factor) was checked for all variables (Refer Appendix 2).A common rule of thumb is that if VIF(β_i) is greater than 5, then multicollinearity is high. However, since all the reported VIFs are less than 5, there is no sign of serious multicollinearity.

Possible problem of hetroskedasticity is handled through the bootstrapping procedure that does not rely on restrictive distributional assumptions. The chi-distributed *Wald* statistic which is similar to the *F* statistic in the linear case is significant, rejecting the null hypothesis that at least one of the variables has a zero value. Similar regression result is also obtained from the pooled negative binomial regression which is reported in Appendix 3.

Table 4.3 Regression Result for Random Effects and Fixed Effects Negative Binomial Models

Variables	Random effects negative binomial	Fixed effects negative binomial
Age	0.0887*	0.0530*
	(0.0087)	(0.0050)
Age^2	-0.0009*	-0.0053*
	(0.0001)	(0.0006)
Married	0.1017*	0.0302*
	(0.0255)	(0.0113)
Muslim	0.1397*	-
	(0.0414)	
Other religion	-0.1087	-
	(0.2100)	
Primary education	-0.0078	-0.0230*
	(0.0284)	(0.0115)
Secondary education	-0.1818*	-0.0097
	(0.0447)	(0.0224)
Higher education	-0.2303*	-0.0028
	(0.0593)	(0.0351)
Awassa	0.2368*	-
	(0.0826)	
Bahirdar	0.0310	-
	(0.0592)	
Dessie	0.0085	-
	(0.0737)	
Dire Dawa	-0.0845	-
	(0.0839)	
Jimma	-0.0796	-
	(0.0707)	
Mekelle	0.0177	-
	(0.0569)	
Income generating women	-0.1017	-0.0076
	(0.0276)	(0.0045)
Log Per capita consumption expenditure	-0.0332*	-0.0062*
	(0.0037)	(0.0113)
Number of observations	4073	3843
Log likelihood	-7516.61	-4086.55
likelihood Ratio **	173.11*	NA
Wald Statistics	190.94*	245.86*
P> chi^2	0.0000	0.0000

*Significant at 5%

**Likelihood Ratio statistics is given by $LR = 2(L_{ur} - L_r)$ where L_{ur} is the log likelihood for the full model and L_r is the log likelihood from the model containing constant only and $LR \sim \chi^2_q$

The Hausman specification test was conducted to compare the fixed effects and random effects results. The result from the Hausman test rejected the random-effects model. Such rejection suggests a possible correlation between random effects and explanatory variables. Hence, the fixed effect model was found to be more plausible. Those variables that are not likely to vary with time are dropped out from the fixed effects regression result.

According to the result from the fixed effect, it is obviously the case that fertility is positively related with age but the negative sign pertaining to the variable age squared implies a quadratic relationship between age and fertility behavior to reflect the biological factors that may limit the fertility of women as they grow older. This finding is consistent with the CSA (2005) report which indicates that fertility is low among adolescents and increases to a peak of 241 births per 1,000 among women of age 25-29 and declines thereafter.

Education has entered the model in level form, rather than by year of schooling. The reference category for analyzing the results is the variable ‘no education’. Accordingly, women’s education is found to affect fertility negatively. This is specially found to be significant in the case of primary education of women while the impact of secondary and higher education was not found to be significant in the fixed effects model. The result implies that women with primary education are less likely to have an additional child than those with no education. This is mainly due to the low level of variation with regards to educational status with in the different waves especially for these two groups. It can therefore be generalized that women that have acquired formal education are likely to have lower number of children than those women with no education, other variables remaining constant.

This finding is inline with the argument of Bledsoe and Cohen (1993) which indicate that throughout the world, formal schooling for women is the single most consistent variable correlated with their low fertility. Education also affects fertility negatively because education imprints women in ways that make them substantially alter their lifetime reproductive behavior.

Women who currently participate in income generating work are more likely to have lower number of children than those who do not. However, this variable is found to be insignificant in explaining the fertility behavior. This may be due to the fact that the percentage of women in the sample that participate in income generating activity is low.

One other variable that significantly explains the fertility decision of households is the consumption expenditure which is taken as a proxy for income. The sign of the coefficient of this variable takes a negative value indicating a negative relationship between income and fertility. The result implies that households with higher level of income are more likely to have ore number of children that those with low income level.

The marital status dummy takes a value of one if the woman is currently married and zero otherwise. According to the regression result, currently married women have a higher probability of having higher number of children that those who are not married, other things remaining constant. This is also inline with the findings of Sibanda et al (2003) who, in their attempt to explain the low fertility rate in Addis Ababa, find that the single most important factor that is responsible for the low fertility is the increased proportion of unmarried women.

4.2 Results for EDHS

4.2.1 Descriptive Statistics

Women in this sample are comprised from 11 regions and the sample size is allocated to each region depending on its contribution to the total population. These women have an average age of 33 years. 70% of these women are currently married. 23% and 36% of these women have completed secondary level education while about 34% have no education. A small percentage (7%) has completed higher level education. About 48% of the women in the sample have performed an income generating activity in the past 12 months of the survey.

Table 4.4 Educational Level from EDHS

Variable	Percentage from Sample
Educational level of women	
No education	34%
Primary level	23%
Secondary Level	36%
Tertiary level	7%

Source: EDHS (2005) and own computation

The number of children recorded in the survey is the actual number of children ever born by the woman, including those that are deceased or those that do not live with their mothers. Accordingly, the average number of children a woman has is 3.1. The mean value of the number of children varies among regions the lowest being 2.8 in Afar and the highest 4.7 in SNNPRS. To understand the reason for the surprisingly low number of children recorded in Afar, the ethnicity

of the sampled women were verified. Accordingly, it was found out that about 64% of the women in the sample are Amharas while 22% are either Oromo, Gurage or Tigray and only the rest 14% are Afars or Somalis. Hence the low number of children per household could be due to the fact that if these women have moved from other region for work or other reasons and are not permanent residents of the region, they may not be likely to have higher number of children.

The average age at first marriage among the women in the sample is 17 years: the minimum being 8 years while the maximum is 38 years. The highest average age at marriage is in Addis, which is 18 years, while the minimum is in Amhara region with 15 years. 48% of the women in the sample have performed an income generating activity during the 12 months before the survey was conducted. The regional distribution of this variable also differs among the different regions (Refer appendix 4). Moreover, 37% of the women in the sample use contraceptives to delay or prevent pregnancy. The highest rate of contraceptive use is found in Addis (41%) while the lowest is in Somali region (7.8%)

4.2.2 Regression Results

The result is estimated using Poisson because the dependent variable was not found to have an over dispersion. This was confirmed from the test for the over dispersion parameter α. From the negative binomial regression, the log likelihood test could not reject the null hypothesis that this over dispersion parameter was zero ($\alpha = 0$) (refer Appendix 5). This shows that the equi-dispersion assumption holds and the Poisson regression can be applied. Accordingly, the result of the Poisson regression is presented in the following table (table 4.5). The marginal effects of the

regression are given in Appendix 6. After performing a simple OLS regression test for multicollinearity was conducted using VIF and the result showed that there is no serious multicollinearity problem between the variables (refer Appendix 7 for the result). Breusch-Pagan test for hetroskedasticity rejected the null hypothesis of constant variance and hence, robust standard errors are computed to correct for the hetroskedasticity. The Likelihood ratio conducted proved that the unrestricted model is better in explaining fertility than the restricted model with constant only.

Table 4.5 Poisson Regression Result for EDHS

Variables	Coefficients and Robust Standard Errors
Age	0.1451* (0.0102)
Age^2	-0.0013* (0.0002)
Married	0.3112* (0.0260)
Age at first marriage	-0.0395* (0.0030)
Muslim	0.2027* (0.0.0290)
Other religion	-0.2519 ((0.3031)
Primary education	-0.0977* (0.0301)
Secondary education	-0.2015* (0.0285)
Higher education	-0.2703* (0.0469)
Child mortality	0.0128 (0.0093)
Income generating women	-0.0512* (0.0223)
Afar	-0.1245 (0.0697)
Amhara	-0.0370 (0.0529)
Benshangul Gumuz	0.0172 (0.0800)
Dire Dawa	-0.0159 (0.0340)
Gambella	0.0933 (0.0534)
Harrari	-0.0333 (0.0365)
Oromia	0.1397* (0.0392)
SNNPRS	0.3564* (0.0361)

Variables	Coefficients and Robust Standard Errors
Somali	0.0296* (0.0503)
Tigray	0.1034 (0.0441)
Number of observations	2129
Log likelihood	-3653.07
Pseudo R^2	0.2029
Wald Statistics P>chi^2	3581.80* 0.0000
Likelihood Ration** P>chi^2	1868.52* 0.0000

* Significant at 5%

**Likelihood Ratio statistics is given by $LR = 2(L_{ur} - L_r)$ where L_{ur} is the log likelihood for the full model and L_r is the log likelihood from the model containing constant only and $LR \sim \chi^2_q$

As was the case with the first model, education, age and age^2 were all found to be significant in affecting fertility. The fact that education was found to be negatively related to fertility, further sheds light on the possible negative relationship between income and fertility since higher education level also means higher level of income in most cases. Hence, though income variable is not directly incorporated into the analysis a possible negative relationship between income and fertility can be indirectly inferred. Out of the two new variables introduced to this model (age at first marriage and child mortality) age at first marriage is found to affect fertility significantly.

The sign of the variable age at first marriage is negative as expected. Early female marriage is associated with a number of poor social and physical outcomes for young women and their children. On average, girls who marry as adolescents attain lower schooling, have lower social status in their husbands' families and report less reproductive control (Field and Ambrus, 2006). These factors, in addition to the fact that early marriage implies a longer exposure to fertility in

the reproductive time of a woman, in turn have a high potential to increase the number of children a woman would have in her reproductive period. These individual outcomes suggest a number of larger social consequences of early marriage which includes higher population growth.

The variable that captures the participation of women in income generating activities was found to be significant in this case. A significant relationship could not be observed in the EUSES case possibly due to a low level of participation of women in the sample in income generating activities (25%) as opposed to the 48% participation rate in the EDHS. The direction of relationship was also found to be negative as expected. This supports the economic household model which argues that working women, or those women who generate income for their households, are less likely to have more number of children as the opportunity cost of childbearing and childrearing are expected to be high for these women.

With regards to the regional dummies incorporated in the model, the regions that were found to be significantly different from the reference region, Addis Ababa, are Oromia, SNNPRS and Somali. According to the result, a person living in these regions has a higher probability of having an additional child than those living in Addis Ababa, other things remaining constant. The fact that women living in Addis have better information and access to family planning methods could have contributed to this significant difference in fertility. The lower fertility in Addis could also be a result of high cost of living that is witnessed in the city than the other urban towns forcing families to limit their number of children. Higher level of awareness concerning the possible negative impact of having many children on welfare could also make households living in the city more cautious on their fertility decisions.

4.3 Main Findings of the Study

The main findings from the two data are similar with regards to the common variables that were incorporated in both models. The variables age and marital status are both found to significantly affect fertility positively as expected. Education of women is also found to affect fertility negatively and significantly in both cases as hypothesized. Educated women are more likely to have more exposure and awareness concerning family planning and its implications on welfare. The way these women value children is also expected to be different from women with no education. Those women with no education, in addition to the expected lack of awareness concerning family planning, may view children as investment goods. For part of the uneducated society with no sustainable income and social security system for the future, having children could be the only old age security system known to them.

Women with no formal education are also less empowered to make their own decisions in their households. Fertility decisions may not always necessarily be the choice of the woman and could be imposed by the husband or other family members. Though the woman may not want to have additional number of children, the fact that she is dependent on her husband and other family members for her welfare forces her to adhere to their fertility choices. Hence, education, by increasing the status of women in a society, empowers women to make their own choices and decisions regarding their lives and also matters in their households including fertility. Those women with education and their own source of income tend to be independent in making their own choices and are less likely to be influenced by others with regards to their fertility choices.

The other mechanism through which higher level of education leads to lower fertility is through the increased opportunity of women to participate in the labor force. Women with education are likely to have their own means of income other than being completely swallowed up with the daily household chores, which mainly includes child rearing. The fact that these women are engaged in income generating activities makes the opportunity cost of childrearing activities very high. Allocating majority of time at the household could be viewed as a costly activity to the mother leading to a decision to limit her fertility. This is supported by the finding from the EDHS that women who engage in income generating activity are likely to have lower number of children than those who do not, inline with the hypothesis presented initially.

The hypothesis that income is inversely related to fertility was tested using the EUSES as the EDHS does not incorporate an objective measure of income Hence, according to the EUSES, consumption expenditure, taken as a proxy for income, is found to affect fertility negatively as expected. Those households with higher income are found to be more likely to reduce their fertility than those households with lower income proving that children cannot be considered as normal goods. This finding is inline with fertility theories that speculate this negative relationship arguing that families with high income tend to substitute quantity of children with quality (Becker and Lewis, 1973). Families with higher income would want to educate their children in private schools that demand higher payments and the cost per child with regards to expenditures like clothing, food and others tend to be higher. This shift in focus from having many children to increased consciousness about their quality could be one way to explain the inverse relationship between income and fertility.

Using the data from EDHS, age at first marriage is found to significantly affect fertility negatively. As age of a woman at her first marriage increases she is more likely to have lower number of children. Those women who marry at an early age are less likely to pursue their education, have their own source of income and are, therefore, more likely to be dependent on their husbands and other family members. Their low level of education could result in lack of awareness about advantages of family planning and the various ways one can control fertility. Even if these women may have awareness about family planning, their status as decision makers of their households could be undermined due to their high dependence on their husbands for welfare.

Religion and region, the time invariant variables that were dropped out from the first fixed effects model, were found to be significant in explaining fertility in the EDHS. The religious beliefs of people, almost always, affect their decisions in various matters. People who accept children as 'gifts from God' are less likely to exercise control over their fertility behaviors. Hence, different religious teachings and beliefs have a significant influence on the decision of households regarding their fertility. In this study it was found that Muslim women are more likely to have more number of children than Christians. This could be a reflection of beliefs on the use of contraceptives, education of women and other particular doctrinal values that could affect fertility decisions directly or indirectly.

With regards to region, women living in Oromia, SNNPRS and Somali are likely to have more number of children than those living in Addis Ababa, other things remaining constant. Addis Ababa, being a metropolitan, is characterized by a relatively higher cost of living. This could reflect on the fertility decision of households as the problem of housing and higher cost of rearing

children makes parents more cautious on their fertility decisions. The relatively higher contraceptive use prevalence rate witnessed in Addis can also explain the lower probability of women in Addis to have additional children

On the other hand, child mortality was not found to significantly affect fertility decisions. This finding is against the initial hypothesis that it is likely to affect fertility decisions positively. The way child mortality was expected to affect fertility was through the replacement and hoarding theories. It was predicted that if families have an experience or expectation of child mortality they would increase their fertility to arrive at their desired surviving number of children. However, this was not found to hold true in the Ethiopian urban context. The possible explanation is the reduced experience or expectation of child mortality due to the spread of health facilities in major urban towns.

The above findings, except for the insignificance of child mortality in explaining fertility, are in line with the initial hypothesis presented in the study. The fact that the above discussed socio-economic variables affect the fertility of women shows that a sustainable reduction of fertility rate can only be achieved through tackling major development issues related to education, income, urbanization and other development indicators that can bring about an overall improvement in the status of the society as a whole.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main objective of this research has been to understand the major socio-economic determinants of fertility in urban Ethiopia. The socio-economic determinants that were expected to have an effect on fertility decisions were education, income, age at first marriage, participation of women in income generating activity and child mortality. The direction of relationship of these variables with fertility was expected to be positive in the case of child mortality while negative relationship was expected for the rest of the variables. Accordingly, count data models using two data sets (EUSES and EDHS) have been employed to understand the significance of these variables in understanding fertility decisions and also their direction of impact.

The analysis of the study has shown that the major socio-economic determinants of fertility that were found to affect fertility significantly are age, education, income, age at first marriage, participation of women in an income generating activity, martial status, religion and region of residence. The effects of education, income, age at first marriage and participation of women in income generating activity was found to be negative and significant as expected while age and marital status were found to affect fertility positively. However, child mortality is not found to have a significant impact on fertility.

The findings of the study indicate that fertility is not only a factor of biological variables but socio-economic variables also play a significant role in determining fertility decisions at a household level. The fact that many socio-economic factors like education, income, participation of women in income generating activity, age at first marriage, region of residence affect fertility has an important implication that a policy that is directed to reducing population growth through reduced fertility should not only directly focus on family planning campaigns but should be all rounded in addressing all these socio-economic variables that are significant in determining fertility decisions of households. It further sheds light on the fact that population reduction is an outcome of an overall development process of a nation with improved services on education, health and an increase in the income and general status of its people. However, since achieving these development objectives takes a longer period of time and can be considered as a long term objective, until the development process brings the required socio-economic dynamics needed to result in lower fertility, interventions on promoting contraceptive use and creating different incentive schemes to reduce fertility should be developed and implemented.

Though this study mainly emphasized on those variables that affect fertility and considers a one way relationship between these variables and fertility, the possibility of feedback effect from fertility to the variables, especially income and participation of women in income generating activity, cannot be altogether ruled out. Hence, there is a room for further investigation of the possible causal relationship between these variables by employing simultaneous equation frameworks. Similar studies can also be extended to the rural settings to get an overall countrywide understanding of the issues pertaining to fertility.

5.2 Recommendations

The main long term objective the country needs to meet is closing the gap between high population growth and low economic development through consistent endeavor to bring about economic development while maintaining a check on the population growth. Owing to the fact that achieving a sustainable development of the country requires controlling the population growth rate, developing an all rounded effective policy measure to tackle the problem of increasing population is of significant value. Though this study mainly focused on households and women in the urban parts of the country, the implications of the variables that were found to affect fertility decisions can be further extended to the rural areas as well. Hence, from the discussion of the main findings of the study, the identification of education, income, age at first marriage, participation of women in income generating activity and marital status of women as important variables in explaining fertility, can give indications to clear policy measures to achieve the goal of reduced fertility. Accordingly, the following policy measures are recommended.

1. Provision of education services to women should also be given due importance in both the urban and rural parts of the country. Female students should be provided with all necessary encouragements to ensure that they are able to pursue their education without interruption.

2. To discourage early marriage with in the society, in addition to strengthening the law enforcement mechanism against early marriage and abduction, incentive mechanisms could be planned for families that engage in investing on the education of their children.

For example, Bangladesh introduced a secondary school scholarship program for girls provided that they are not married before age 18 while Mexico had similar incentive scheme that made transfers to poor mothers in rural areas if their children enroll in school (Schultz, 2007a). Similar incentive schemes that take the specific situation of the different societal settings into considerations can be adopted in both the urban and rural areas.

3. Creation of increased employment opportunities for women should also be another policy objective to improve their status among the society and make them better empowered in making their own choices regarding fertility decisions. Concrete measures, specific to the different cultures and settings, should be adopted to abolish all discriminatory customs and practices that discourage women from participating in the labor force. Affirmative action programs should be developed to promote the status of women in all spheres of society and provide them with equal employment opportunity. Micro-financing schemes targeted towards women should also be widely spread to allow them to be self employed and thereby increase their income generating capacity.

4. Those regions and cultures that may have special traits that encourage higher fertility should be clearly identified and policy measures that are specific to those setups should be developed. In other words, rather than a ‘one size fits all’ kind of policy direction, region focused policies could be more effective in delivering the required target of lower fertility rate.

5. Since income of households was found to significantly affect fertility decisions of households, policies that are geared towards bringing about pro-poor economic growth should be considered side by side with population control objectives to bring about a sustainable lower population growth in the long run.

6. Polices should be geared towards subsidizing sex education and information dissemination regarding birth control methods. Creating awareness concerning the negative welfare implication of having high level of fertility should also be given due importance to improve the receptivity of households to modern contraceptive methods. Development of infrastructures that could facilitate an improved access to birth control methods should also be given due consideration especially in the rural towns.

Subsidies could also be directly used to reduce the cost of birth controls. However, practical considerations need to be taken into account concerning when, for whom and by how much family planning programs should be subsidized. Such subsidies should also be backed up by a continuous awareness creation programs to ensure the proper and continuous use of contraceptives.

BIBLIOGRAPHY

Aase, A & Ageyei-Mensah, S. (1998). "Patterns of Fertility Change in Ghana: A Time and Space Perspective." *Human Geography* 80(4):203-213

Ainsworth M., D. Filmer and I. Semali (1996). The impact of AIDS mortality on individual fertility: evidence from Tanzania. Paper presented at a workshop on: *The links between infant and child mortality and fertility*, organized by the Committee on Population, National Research Council, Washington, D.C., November 6-7,1996.

Ainsworth, M. (1996). Introduction: Fertility in Sub Saharan Africa. *World Bank Economic review*, 10(1), 81-84

Axinn, W.G. (1993). The Effects of Children's Schooling on Fertility Limitation.*Population Studies*. 47(3): 481-493

Baylies C. (2000). The impact of HIV on family size preference in Zambia. *Reproductive Health Matters*. 8 (15): 77-86

Becker, G. S. and Lewis H.G., (1973), On the Interaction between the Quantity and Quality of Children, *Journal of Political Economy*, **81**(2), Part 2, S279-S288.

Becker, G.S. & Barro R.J. (1988). A Reformulation of the Economic Theory of Fertility. *The Quarterly Journal of Economics*, 103(1), 1-25

Becker, G.S. (1960). *An Economic Analysis of Fertility*. Bureau of Economic Research. Demographic and Economic Changes in Developed Countries. Princeton, N.J.: Princeton University Press

Behrman, J.R. (1997). *Women's Schooling and Child Education: A Survey*. Mimeo, University of Pennsylvania.

Behrman, J.R. and Mark R. Rosenzweig (2002). Does increasing Women's Schooling Raise the Schooling of the Next Generation? *The American Economic Review*. 92(1):323-334

Ben-Porath, Y. (1976) Fertility Response to child Mortality: Micro Data from Israel. *The Journal of Political Economy*. 84(4): S163-S178

Benefot, K. and P. Shultz (1996). Fertility and child Mortality in Cote D'Ivoire and Ghana. *World Bank Economic Review*. 1(1):123-158

Bigsten et al. (2003). Growth and Poverty Reduction in Ethiopia: Evidence for Household Panel Surveys. *World Development*, 31(1), 87-106.

Bledsoe, C.H. and Barney Cohen (1993). *Social Dynamics of Adolescent Fertility in Sub-Saharan Africa.* Panel on Population Dynamics of Sub- Saharan Africa, committee on Population, National Research Council. Washington, DC: National Academy Press

Bonaarts, J. (1978). A Framework for Analyzing the Proximate Determinants of Fertility. *Population and Development Review*, 4(1), 105-132.

Caldwell, J. C. (1982). *Theory of Fertility Decline.* Academic Press, London.

Caldwell, J. et al (1992). Fertility Decline in Africa: A New Type of Transition? *Population and Development Review*, 18(2), 211-242

Caldwell, J.C. (1983). Direct Economic Costs and Benefits of Children, In R.A. Bulatao and R.D Lee (ed.). *Determinants of fertility in Developing Countries*, New York: Academic Press.

Cameron, A.C. and P.K.Trivedi (2005). *Microeconometrics Methods and application*.. Cambridge University Press. New York.

Chaundhury, R.H. (1986). Reviewed works: The Influence of Female education, LaborForce Participation and Age at Marriage on fertility Behavior in Bangladesh.*Studies in Family Planning*. 17(1): 53

Cramer, J.C. (1980). Fertility and Female Employment: Problems of Causal Direction. *American Sociological Review*. 45(2):167-190

CSA (2005). Ethiopia Demographic and Health Survey 2005. Retrieved on December 30, 2008 from http://www.csa.gov.et/text_files/Demograpiic_and_Health_Survey_2005/survey0/index.html

Deaton, A. and S. Zaidi (1999). *Guidelines for Constructing Consumption Aggregates for Welfare Analysis.* Working papers 217. Princeton University.

Desgrees du Lou, A., et al. (1998). HIV-1 infection and reproductive history: a retrospective study among pregnant women, Abidjan, Cote D'Ivoire, 1995-1996. *Journal of STD & AIDS* vol 9:452-456.

Easterlin, R.A. and E.M Crimmins (1985). *The Fertility Revolution: A Supply-Demand Analysis.* The University of Chicago Press. Chicago and London.

ECA (2002a) *The State of the Demographic Transition in Africa: Executive Summary*. Fourth Meeting of the Follow-up Committee on the implementation of the DND and the ICPD-PA Yaounde, Cameroon(28-31January2002) retrieved from

http://www.uneca.org/eca_resources/major_eca_websites/icpd/fourth/fc4-03.%20doc%20demo%20transit%20summary.htm on January 22, 2008

ECA (2002b). *Impact of HIV/AIDS on Fertility in Sub-Saharan Africa*. Fourth Meeting of the Follow-up Committee on the implementation of the DND and the ICPD-PA Yaounde, Cameroon 28-31 January 2002 retrieved from http://www.uneca.org/eca_resources/major_eca_websites/icpd/fourth/fc4-03.%20doc%20demo%20transit%20summary.htm on January 22, 2008

Engelhardt, H. et al. (2004). Fertility and Women's Employment Reconsidered: A Macro-Level Time-Series: Analysis for Developed Countries, 1960-2000. Retrieved from https://dspace.lboro.ac.uk/dspace/bitstream/2134/271/1/Engelhardt%20et%20al._PopSt_2004_final%20draft.pdf on January 15, 2008

Field,E.and A. Ambrus (2006). Early Marriage and Female Schooling in Bangladesh. Unpublished Paper Harvard. retrieved from efield@latte.harvard.edu on January 2, 2008

Freedman, D.S. & Thornton, A. (1982). Income and Fertility: The Elusive Relationship. *Demography*, 19(1), 65-78

Gregson,S. (1994). Will HIV become a major determinant of fertility in Sub-Saharan Africa? *The Journal of Development Studies*. 30 (3): 650-679.

Hayami, Y. (1997). *Development Economics: From the poverty to the Wealth of Nations*. Clarendon Press. Oxford.

Hsiao, H. (1986). *Analysis of Panel data*. Cambridge University Press. Cambridge

Jain, A.K. (1981): The Effect of Female Education on Fertility: A Simple Explanation. *Demography*. 18(4): 577-595

Jejeebhoy, S.J. (1991) Women's Status and Fertility: Successive Cross-Sectional Evidence from Tamil

Nadu, India, 1970-80. *Studies in Family Planning*, 22(4), 217-230

Johnson, D.G. (1999). Population and Development. *China Economic Review*. 10(1): 1- 16

Kogel, T. (2006) An explanation of the positive correlation between fertility and female employment across Western European countries. Retrieved from <http://www.lboro.ac.uk/departments/ec/RePEc/lbo/lbowps/Fertility_puzzle.pdf> on January 31, 2008

Leibenstein, H. (1975). The Economic Theory of Fertility Decline. *The Quarterly Journal of Economics*, 89(1), 1-31

Li, H. et al (2005). The Quantity-Quality Tradeoff of Children in a Developing Country: Identification Using Chinese Twins retrieved from http://reap.stanford.edu/research/publications/hongbin-quantity-quality-twins.pdf on February 29, 2008

Malthus, T.T. (1798). *Essay on the principle of Population*, ed. A. Flew. Harmondsworth: Penguin, 1970.

McNown, R. (2003). A Cointegration Model of Age- Specific Fertility and Female Labor Supply in the United States. *Southern Economic Journal*. 70(2): 344-358

Rosenzweig, M.R. and K.Wolpin (1980). Testing the Quantity-Quality Fertility Model. *Econometrica*. 48(1): 227-240

Schultz, T.P. (1990). Testing the Neoclassical Model of Faily Lavor Supply and Fertility. *The Journal of Human resources* 25(4): 559-634

Schultz, T. P. (2007a). Population Policies, Fertility, Women's Human capital, and Child Quality. Discussion paper Series: IZA DP No. 2815

Schultz, T.P. (2007b). *Fertility in Developing Countries*. Center Discussion Paper No.953

Sinbanda, A. et al (2003). The proximate determinants of the decline to below-replacement fertility in Addis Ababa, Ethiopia. *Studies in Family Planning*, 34(1), 1 – 7.

Smith, A. 1976. *The Wealth of Nations*, ed. E. Cannan. London: Methuen, 1961

Smith-Lovin, L. and A.R. Tickamyer (1982). Models of Fertility and Women's Work. *American Sociological Review* 47(4): 561-566

Todaro, M.P. & Smith S.C. (2003). *Economic Development*. Pearson Education Limited. England

UNFPA (2007). *Unleashing the potential of Urban Growth.* UNFPA State of world Population 2007. New York. USA

Whittington, L.A & Stapleton, D.C. (1995). Agricultural Growth, the Status of Women, and Fertility. *American Journal of Agricultural Economics*, 77(3), 706-711

Willis, R.J., (1973). A New Approach to the Economic Theory of Fertility Behavior, *Journal of Political Economy*, **81**(2), part 2, S14-S64.

Wooldgridge, J.M. (2002). *Econometric Analysis of Cross Section and Panel Dat*a. MIT Press. London

Zaba B and S. Gregson (1998). Measuring the impact of HIV on fertility in Africa. *AIDS* Vol 12 supplement 1: S41-S50

_____ (1993). National Population Policy of Ethiopia. The Transitional Government of Ethiopia, Office of the Prime Minister. Addis Ababa.

_____(2005). Plan for Accelerated and Sustained Development to End Poverty (PASDEP) Retrieved on December 30, 2008 from http://www.itacaddis.org/italy/index.cfm?fuseaction=basic_pages.basic_page&page_name=7

APPENDICES

APPENDIX 1

Marginal Effects of Fixed Effects Negative Binomial Regression for EUSES

```
Marginal effects after bootstrap:xtnbreg
      y  = linear prediction (predict)
         =  1.1912717
------------------------------------------------------------------
          variable |      dy/dx    Std. Err.     z    P>|z|
---------+--------------------------------------------------------
               age |    .052978       .0044   12.04   0.000
        incgenwomen|   .0075914      .00488    1.56   0.120
              age2 |  -.0005369      .00005  -11.08   0.000
       primary educ|  -.0229836      .01137   -2.02   0.043
     Secondary educ|   .0097016      .02136    0.45   0.650
        higher educ|  -.0027731      .02306   -0.12   0.904
            married|   .0301744      .01234    2.45   0.014
lnrealpercapitaexp |  -.0062984      .00146   -4.30   0.000
------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

APPENDEX 2

Test for Multicollinearity (EUSES)

Variable	VIF	1/VIF
Age	1.12	0.8935
Married	1.07	0.9387
Muslim	1.09	0.9210
Other religion	1.01	0.9900
Primary education	1.77	0.5635
Secondary education	1.85	0.5398
Higher education	1.47	0.6811
Awassa	1.05	0.9517
Bahirdar	1.05	0.9430
Dessie	1.05	0.9521
Dire Dawa	1.05	0.9516
Jimma	1.09	0.9157
Mekelle	1.05	0.9556
Working women	1.15	0.8726
Mean VIF	1.20	

APPENDIX 3

Pooled Negative Binomial Regression Result for EUSES

Variables	Coefficient and Standard errors
Age	0.1174*
	(0.0095)
Age^2	-0.0012*
	(0.0001)
Married	0.3600*
	(0.0207)
Muslim	0.1058*
	(0.0240)
Other religion	-0.05670
	(0.0957)
Primary education	0.0496*
	(0.0317)
Secondary education	-0.1357*
	(0.0321)
Higher education	-0.2333*
	(0.0439)
Awassa	0.2623*
	(0.0345)
Bahirdar	0.0360
	(0.0334)
Dessie	-0.0141
	(0.0419)
Dire Dawa	-0.0833*
	(0.0334)
Jimma	-0.0996*
	(0.0332)
Mekelle	0.0181
	(0.0345)
Working women	-0.0249
	(0.0215)
Log Per capita consumption expenditure	-0.0996*
	(0.0096)
Number of observations	4073
Log likelihood	-8620.5796
Wald Statistics	1147.58
P> chi^2	0.0000
Pseudo R^2	0.0624

*Significant at 5%

APPENDIX 4

Summary Statistics – For EDHS (Mean Values and Percentage from the Sample

Region	Age at first marriage	Number of children	Working Women	Contraceptive use
Addis Ababa	18.2	2.9	53.9%	41%
Afar	17.5	2.8	24.3%	8.6%
Amhara	14.9	3.0	41.8%	11.9%
Benishangul Gumuz	15.6	3.0	46.3%	7.46%
Dire Dawa	17.15	3.2	47.5%	9.8%
Gambella	15.8	3.3	42.2%	15.6%
Harari	18.19	2.78	50.2%	20.3%
Oromia	16.86	3.56	51.3%	19.6%
SNNPRS	16.55	4.14	51.1%	20.3%
Somali	17.98	4.70	24.4%	24.4%
Tigray	16.23	3.0	52.9%	7.8%

Source: EDHS and own computation

APPENDIX 5

Negative Binomial Regression Result for EDHS

Variables	Coefficient and Standard errors
Age	0.1451*
	(0.0102)
Age^2	-0.0013*
	(0.0002)
Married	0.3112*
	(0.0290)
Muslim	0.2026*
	(0.0290)
Other religion	-0.2519
	(0.3031)
Primary education	-0.0977*
	(0.0301)
Secondary education	-0.2015*
	(0.0285)
Higher education	-0.2703*
	(0.0469)
Child mortality	0.0128
	(0.0093)
Income generating women	-0.0512*
	(0.0223)
Afar	-0.1245
	(0.0697
Amhara	-0.0370
	(0.0590)
Benshangul Gumuz	0.1725
	(0.7990)
Dire Dawa	-0.0159
	(0.0340)
Gambella	0.0933
	(0.0534)
Harrari	-00333
	(0.0365)
Oromia	0.1397*
	(0.0392)
SNNPRS	0.3564*
	(0.0381)
Somali	0.2196*
	(0.0503)
Tigray	0.1034
	(0.0441)

Number of observations	2129
Log likelihood	-3653.07
Wald Statistics	3581.8
P>chi^2	0.0000

* significant at 5%

Likelihood ratio test of alpha=0
Chibar2(01)=0.00
Prob>chibar2=1.00

APPENDIX 6

Marginal Effects of Poisson Regression for EDHS

```
Marginal effects after poisson
      y  = predicted number of events (predict)
         =  2.7509296
------------------------------------------------------------------
             variable |      dy/dx    Std. Err.     z    P>|z|
---------+--------------------------------------------------------
                  age |   .3991697      .02843   14.04   0.000
                 age2 |  -.0037061      .00042   -8.84   0.000
   ageatfirstmarriage|  -.1085434      .00769  -14.11   0.000
         Primary educ|  -.2618429      .07839   -3.34   0.001
       Secondary educ|  -.5409762       .0748   -7.23   0.000
          higher educ|  -.6633352      .10262   -6.46   0.000
       other religion|  -.6128424      .64883   -0.94   0.345
              muslim|   .5895381      .08933    6.60   0.000
             married|   .8081092        .063   12.83   0.000
incomegeneratingwomen|  -.1406682      .06121   -2.30   0.022
     child mortality |   .0353162      .02548    1.39   0.166
                Afar|  -.3234701       .1706   -1.90   0.058
              Amhara|  -.1002252       .1408   -0.71   0.477
     Benshangul Gumuz|   .0478346      .22359    0.21   0.831
            Dire Dawa|  -.0435425      .09262   -0.47   0.638
             Gambella|   .2678476      .16014    1.67   0.094
              Harrari|  -.0904507      .09785   -0.92   0.355
               Oromia|   .4081959       .1215    3.36   0.001
               SNNPRS|   1.151995      .14308    8.05   0.000
               Somali|    .669493      .16919    3.96   0.000
               Tigray|   .2983391      .13323    2.24   0.025
------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

APPENDIX 7

Test for Multicollinearity (EDHS)

Variable	VIF	1/VIF
Age	1.11	0.9003
Married	1.12	0.8962
Age at first marriage	1.20	0.8323
Muslim	1.35	0.7391
Other religion	1.01	0.9905
Primary education	1.45	0.6914
Secondary education	1.70	0.5884
Higher education	1.33	0.7502
Child mortality	1.01	0.9926
Working women	1.12	0.8956
Afar	1.13	0.8841
Amhara	1.15	0.8674
Benshangul Gumuz	1.10	0.9104
Dire Dawa	1.33	0.7502
Gambella	1.12	0.8961
Harrari	1.27	0.7858
Oromia	1.15	0.8692
SNNPRS	1.14	0.8774
Somali	1.27	0.7905
Tigray	1.12	0.8950
Mean VIF	1.21	

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all source of materials used for the thesis have been duly acknowledged.

Declared by

Name: Fanaye Tadesse

Signature: _____

Date: _____

Confirmed by Advisor

Name: Mulat Demeke (PhD)

Signature: _____

Date: _____

June 13, 2008
Addis Ababa