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Fertility Dynamics in Ethiopia: A Multi-faceted Analysis

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ABSTRACT

The study of fertility dynamics is both difficult and intriguing. Difficult because it does not follow a universal theoretical framework and intriguing because there are always surprises in the findings. This study was aimed at attempting to provide partial answers to pre-set research questions. In particular, the study was intended to look at the status of the fertility transition in the 'Rest' of Ethiopia in comparison with the much touted transition to below-replacement fertility level in Addis Ababa.

In the quest to answer these and other similar questions, the study of prerequisites such as marriage and fertility preference were also carried out. Beginning with a trend analysis, the study employed various modelling techniques that included design-based, event history/survival, decomposition, multivariate and multilevel modelling as well as principal components analysis. The Ethiopian Demographic and Health Survey (ETDHS 2000) was the main source of data. However, data from the 1984 and 1994 Censuses and the 1990 Family and Fertility Survey (FFS 1990) were systematically used despite the difficulty in comparison due to the change in the sample frame since early 1990s.

Besides attempting to identify a number of factors influencing marriage, fertility preference and eventually actual period fertility of the 'Rest' of Ethiopia in comparison with that of Addis Ababa, this study also found some surprises. Among the important findings, education, household wealth status and housing status are identified as the most important factors influencing 'time to marriage', 'desire for additional children' and 'actual fertility'.

Education was identified as the single most important factor with a strong positive/delaying effect on marriage, depressing/negative effect on fertility intentions and actual fertility. The reason why it has such strong effect in Addis Ababa and less so in the 'Rest' is attributed to the contextual nature in which it operates, interplay with modernization in the capital city and with culture in the 'Rest'.

Like education, there have been conflicting views on the association between poverty and fertility some declaring positive relationship and others introducing the innovative ideational/diffusion approach. One of the main findings of this study is that some of the poverty indicators such as lower household assets index and not having own house were consistently related to shorter time to first marriage, less desire for additional children and fewer number of children born in Addis Ababa. As they stand, these findings suggest that the fertility decline in Addis Ababa has likely been poverty induced while cultural forces have likely constricted the transition in the 'Rest' of Ethiopia.

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ABBREVIATIONS AND ACRONYMS

AIDS	-	Acquired Immune Deficiency Syndrome
ASFR	-	Age Specific Fertility Rates
BL1Y	-	Births in the Last One Year
BL5Y	-	Births in the Last Five Years
CSA	-	Central Statistical Authority
CDC	-	Centre for Disease Control
DEFF	-	Design Effect
FFS	-	Fertility and Family Survey
ETDHS	-	Ethiopian Demographic and Health survey
FGAE	-	Family Guidance Association of Ethiopia
FPP	-	Family Planning programme/s
HIV	-	Human Immunodeficiency Virus
IEC	-	Information, Education and Communication
IGLS	-	Iterative Generalised Least Squares
KAP	-	Knowledge, Attitude and Practice
NHE	-	New Household Economics
NCPD	-	National Council for Population and Development, Kenya
ORC Macro	-	Opinion Research Corporation Macro International
PQL	-	Predictive Quasi Likelihood
RIGLS	-	Restricted Iterative Generalised Least Squares
SSA	-	Sub-Saharan Africa
SNNP	-	Southern Nations and Nationalities Peoples
SMAM	-	Singulate Mean age at Marriage
TDHS	-	Tanzania Demographic and Health Survey
TFR	-	Total Fertility Rates
TKAPS	-	Tanzania Knowledge, Attitude and Practice Survey
UNDP	-	United Nations Development Program
UNECA	-	United Nations Economic Commission for Africa
PRB	-	Population Reference Bureau

CHAPTER ONE
RESEARCH PROBLEM STATMENT AND BACKGROUND INFORMATION

1.1 Identifying the Research Problem

Reproductive health, food security, sustainable development, environmental conservation, global warming etc, all have connection in one way or another with the population problem which is considered to be a major threat next to nuclear and cold war. However, now, the cold war and nuclear threat are minimized, but the population problem remains unsolved and continues to be a challenge for researchers, planners and policy makers. Solving the 'population problem' does not only mean reducing population growth rate through the regulation of fertility but also reducing the risk of environmental degradation, reducing reproductive health risk, maintaining food security for the family and maintaining sustainable development with an optimum population (RS and NAS, 1992; Ehrlich *et al*, 1993).

Although the population problem is a global burden, developing countries especially sub-Saharan African countries are among the most affected. Ethiopia is one of the sub-Saharan African countries with challenging population problems caught in a vicious cycle of poverty and ever growing numbers of people needing basic services (see Table 1.1).

Table 1.1: Recent estimates of basic indicators (Ethiopia)

Indicator	Year2000
Population (est. in millions)	70
Per capita income ($)	100
Population Living Below US$1 per Day (%)	31
Life expectancy (yrs)	50
Life expectancy lost due to HIV/AIDS (yrs)	3.9
Crude birth rate (per 1,000 live births)	41
Infant mortality rate (per 1,000 live births)	100
Forest Area, Change in 1990-2000 (per 1000 hectares)	-403

Source: ETDHS 2000, UNDP, CDC, PRB

Due to this reality, researchers and policy makers have long been engaged in trying to understand and establish the socioeconomic, cultural and ecological forces that underlie the population dynamics (fertility, mortality, migration). The study of fertility dynamics has been the focus since the 1974 world population conference, where demography enlarged its scope to include relevant social, cultural, and particularly economic factors and population policy had been reemphasized (Mauldin et al, 1974). Between the early 1960s and the late 1990s the largest fertility declines occurred in Asia and Latin

America (Bongaarts, 2002). In contrast, the fertility transition in sub-Saharan Africa had not shown any sign of beginning until the late 1980s (Lesthaeghe, 1989, Caldwell *et al*, 1992).

So, most of the studies in the developing countries have since focused on fertility transition and the context of social and economic developments in which they take place in different countries. For instance, one of the typical examples of fertility transition that took place surpassing the stages of the demographic transition theory is that of Bangladesh fertility decline. Despite the fact that Bangladesh was among the economically poor with acute population crowding, environmental deterioration, massive migration from rural areas to unplanned urban settings, it was identified that the increase in the use of family planning was the sole force behind the country's fertility transition (Cleland et al, 1992, 1994). The authors further also emphasized that the Bangladesh family planning program helped couples to bring ideational changes towards small families and to change their attitude about the use of modern contraceptives.

Yet an example of another context of fertility transition in Latin America is that which took place in Argentina, Chile, and Uruguay, which reached to a TFR as low as 3 - 3.3 in 1970 and the onset of the transition began as early as 1960 under fluctuating economic conditions and development Pantelides (2001). Conversely, Brazil (5.33 in 1970 to 2.46 in 1995) and Mexico (6.73 in 1970 to just under 3 in 1995) underwent a rapid fertility transition during the last forty years with all sorts of economic difficulties such as inflation, income inequality and high unemployment (Mason, 1997; Goldani, 2001).

Turning to sub-Saharan Africa, fertility transition has taken place in a number of countries in a different way. Why different? Because the transition from high to low fertility occurred in all age groups disparate form the fertility transition in Europe, where the fertility decline began mainly by dwindling fertility in the older age groups (Moultrie, and Timaeus, 2002).

Despite the fact that no demographer outside the country was aware due to the apartheid policy, South Africa was the first sub Saharan African country to have gone through a sustained fertility transition (Caldwell and Caldwell 2002). This was followed by the onset of fertility transitions observed in the mid to late 1980s in Botswana, Kenya and Zimbabwe. Caldwell et al (1992) declaring "a new type of transition" for Africa argue that Botswana, Zimbabwe and Kenya which entered the onset of the fertility transition had common characteristics such as infant mortality rate unusually less than 70 and high level of female education. In addition, Kenya and Zimbabwe's fertility transition was attributed to the high level of contraceptive use and delayed marriage (Robinson, 1992; Guilkey and Jayne, 1997).

Regarding Botswana's fertility decline observed in the 1980s, Diamond and Rutenberg (1995) mention some of the attributes for the decline as: "a response to harsh economic conditions resulting from sustained drought, which in turn contributed to greater separation of spouses due to migration to urban areas accompanied with housing shortages and a large number of female heads of families' choosing to adopt contraception due to limited resource for supporting children".

Having seen some contexts of the fertility transitions and main attributes for the decline, it is time to turn to the focus of this study ask the question: Where does Ethiopia feature or stand in the fertility transition? This is one of the research questions that this study will attempt to answer, but before embarking on to this it is worth noting an important piece of literature that prompted this study – the unique fertility decline that was declared by Kinfu (2001) and later officially confirmed by the 2000 ETDHS.

In his study, Kinfu (2001) by using the several sources of data (Note that Addis Ababa was rich in demographic data as it was the hub of most of the small scale surveys, in contrast to scarcity/lack of complete national level data) and employing various techniques including Bongaarts model, found out as he called it "quite revolution" that Addis Ababa's fertility has reached below replacement level – a stage even some countries in the developed world have not yet reached. After ascertaining the fertility transition in the capital city, the same author proceeded to examine the factors attributable to this dramatic decline. However, he examines only Addis Ababa and simply caressed the big picture perhaps leaving it for future research – and that is what this study picked: what unique mechanisms does Addis Ababa go through that the 'Rest' of Ethiopia has not?

Despite the fact that Kinfu's study was preoccupied in ascertaining the fertility decline in Addis Ababa, he also carried out some statistical analysis and concluded that decline was "driven by changes in the marriage pattern supplemented by increased propensity of fertility control". Although he did not include data on 'housing status' in the analysis, he also forwarded the idea that housing problem might have played an important role. So this study also picks this issue and intends to answer the question: Is housing status an important criterion in fertility decision making? Whether to have a child?

Another study is that conducted by Sibanda *et al* (2003). Using the first ever Demographic and health Survey of 2000 and also using Bongaarts proximate determinants model the authors found "a decrease in the age-specific proportions of women who are married followed by an increase in contraceptive use" as "the most important mechanisms by which fertility has declined in Addis Ababa". However, the authors did not go further than identifying the most important factors in the decline and did not attempt to examine the factors influencing at least the leading factor - marriage. This study was prompted to pick the question: if marriage was the leading factor in the fertility decline in Addis Ababa, then what factors influence marriage itself? In particular what would the picture be compared to the factors that influence marriage in the 'Rest' of Ethiopia?

1.1.1 Research problem statement

The research problems identified above can be summarized in the form of research questions that this study will attempt to answer:

1. Where does Ethiopia feature or stand in the fertility transition? Has fertility transition only begun in the capital city? Or is the onset of fertility transition begun in Ethiopia?
2. If marriage was the leading factor in the fertility decline in Addis Ababa, then what factors influence marriage itself?
3. Are the mechanisms that influence 'family size' and 'fertility intention' different for Addis Ababa and the 'Rest' of Ethiopia?
4. What factors influence birth interval/spacing in Addis Ababa and the 'Rest' of Ethiopia?
5. How much are the gaps in non-marriage, childbearing rate and fertility intents between Addis Ababa and the 'Rest' of Ethiopia? And what factors account for such gaps?

1.2 Significance of the study

Why is this study necessary? What is its envisaged contribution to the on going fertility transition in the country? The following arguments are expected to partially answer these questions.

It was unclear in which direction fertility level has been moving in Ethiopia until the mid-1980s due to lack of national level censuses or surveys. However, the 1984 census and the 1990 Family and Fertility Survey (FFS) indicated that the fertility level of Ethiopia was among the highest by Sub-Saharan African standard. But lack of completeness as data were collected from a few provinces due to insecurity, together with the recent regional restructuring of the sample frame made the resulting data incomparable thereby leading to inadequate demographic literature at least at national level. Despite this picture at national level, small scale surveys, especially on the capital city and a few other regions have been conducted and several vital studies have been conducted on pockets of the country. Among these, a recent scholarly work was carried out by Kinfu (2001) using the rich demographic data bank collected on the capital city to establish the fertility decline of Addis Ababa.

In the early 1990s, a new regional restructuring and country map was in place following the secession of Eritrea from Ethiopia and the 1994 census revealed a completely new demographic picture of the country. Following this, the 2000 Demographic and Health Survey - the first of its kind in Ethiopia - was conducted in collaboration with an internationally renowned institution - Macro International. To carry out such demographic studies with data on population dynamics updated from time to time is essential.

Secondly, this study is useful in determining whether the observed differential in the transition and level of fertility between the capital city and the 'Rest of Ethiopia' is a result of differences in individual characteristics among women in these major regions, or as a result of the influence of spatial differences intertwined with community norms and other cultural factors. Moreover, it is hoped that this study will identify factors that influence demographic outcomes such as the timing of marriage, the number and the timing of births and future fertility preference as these are key in determining future programs and policy setting for sustainable basic services to cope with growing population.

Finally, the fertility transition that begun in many developing countries before 2-3 decades, has not been clearly detected in Ethiopia until recently, and even the recent revelation of the decline in its capital city (Addis Ababa) is underway with a relatively weak economy and low prevalence of family planning in the entire country. Therefore, it is appropriate to identify the underlying factors responsible for the Addis Ababa fertility decline in comparison with what is missing in the 'Rest' of Ethiopia by using recent data and refined methodology.

1.3 Research aim

The general objective of this study is to document recent trends in the fertility transition and to examine the determinants of marriage and fertility in order to understand the underlying factors that can contribute to the effort of sound policy designing aimed at promoting sustainable population and development program in Ethiopia.

1.3.1 Specific objectives

1. to examine recent fertility levels and trends using time series and other analytical techniques.

2. to search for possible explanations regarding the fertility transition in Ethiopia with particular emphasis on the disparity between fertility transition in the capital city and the 'Rest' of Ethiopia.
3. to identify the demographic, socio-economic and cultural characteristics that are associated with births in the last 5 years and fertility intention of Ethiopian women, particularly Addis Ababa vs the 'Rest'.
4. to identify socio-economic and cultural factors influencing time to marriage.
5. to quantify the gap in non-marriage, family size and fertility preference between Addis Ababa and the 'Rest' of Ethiopia.
6. to identify individual and community/group effects on births in the last 5 years, and fertility preference using a multilevel approach.
7. to examine factors associated with timing of births and duration of birth intervals.
8. to suggest recommendations for policy making and further study.

1.4 Background information about Ethiopia

Ethiopia is a Sub-Saharan African country with a large and rapidly growing population. Ethiopia is about 5 times the size of the United Kingdom or 2 times the size of Texas in the USA with a population density of about 152 persons per square mile. Ethiopia occupies most of the Horn of Africa and shares borders with Sudan, Kenya, Somalia, Djibouti and (since 1993) with Eritrea.

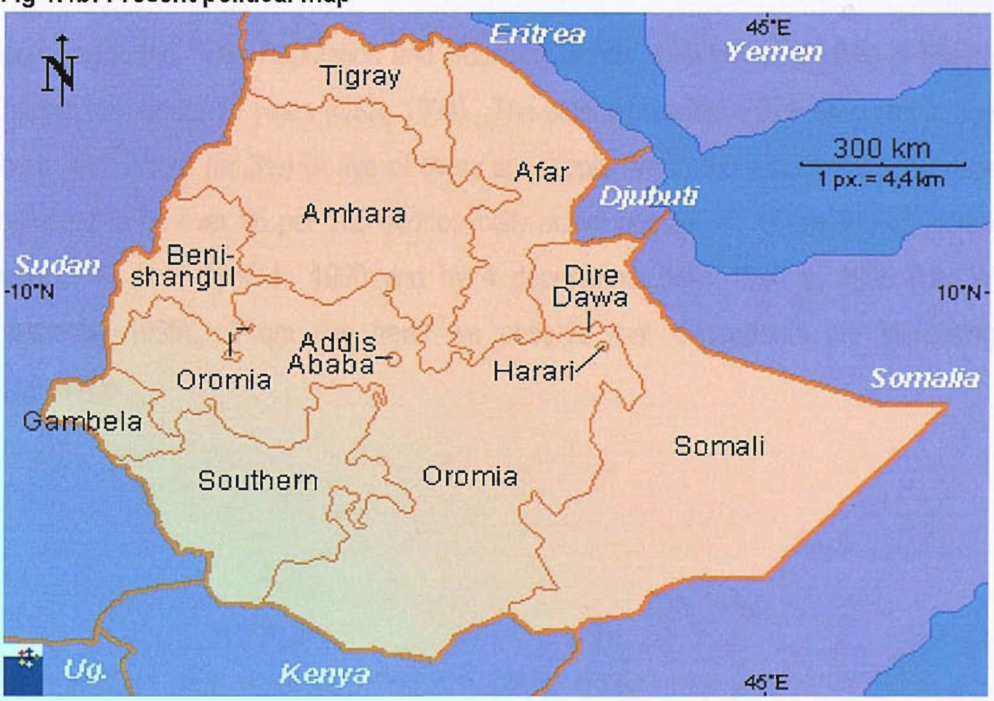
The major landscape features include a massive highland complex of mountains and plateaus (2 km above sea level) divided by the Great Rift Valley and surrounded by lowlands along the periphery. Most of Ethiopia's borders have been delimited by treaty. However, the Ethio-Somalia boundary and recently the Ethio-Eritrea borders have been sources of disputes that resulted in wars.

Out of the estimated 1.1-1.2 sq km Ethiopia's total land area, it is estimated about 66 percent is potentially suitable for agriculture. Ethiopia's remaining forest land is estimated at less than 3 percent. Under the current land tenure system, the government owns all land and provides long-term leases to the tenants. Most farming communities live on the highlands, mainly at elevations of 1,500 to 3,000 meters. The population in the lowland peripheries (below l,500 meters) is nomadic, engaged mainly in livestock raising. The Ethiopian highlands are the centre of the economic activity of the country with over 85 percent of the country's population and 75 percent of livestock and they are the source of many of the country's major rivers (including the Blue Nile).

Fig 1.1: Ethiopia's physical and political map – past and present

Fig 1.1a: Past political map

Fig 1.1b: Present political map



1.4.1 Ethiopia's population

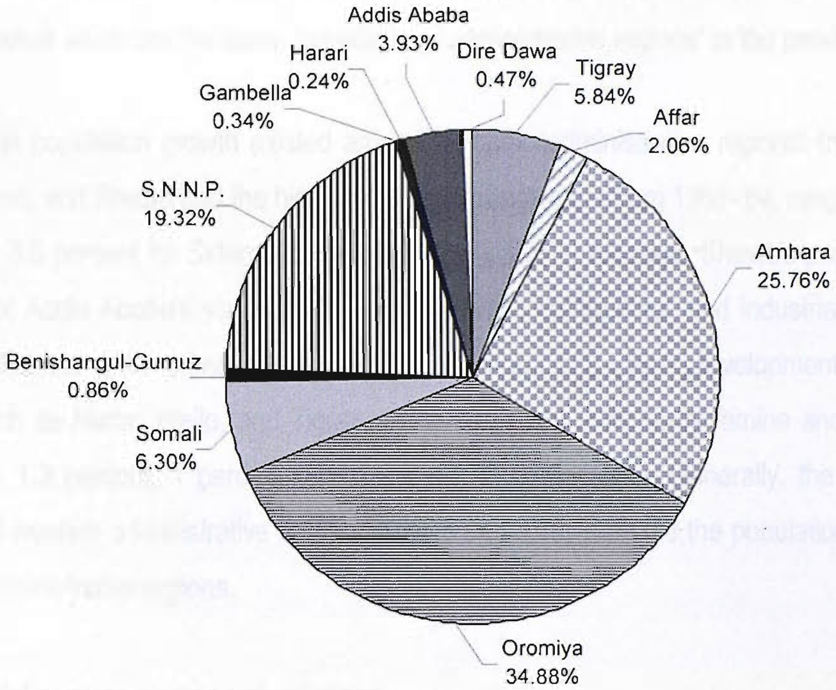
According to facts documented by the Population Council of the country, the population of Ethiopia was about 11.8 million in 1900, which doubled to about 23.6 million in 1960 and to 47.3 million in 1988. It took 60 years for the population to double between 1900 and 1960, while it took only 28 years to double between 1960 and 1988. The growth rate between 1980 and 1989 was 2.9 but it was projected that if the then prevailing fertility schedule continued, the population of Ethiopia would grow at the rate of 3.1% up to the year 2000 (Government of Ethiopia, 1993).

The first national census was conducted in 1984, which revealed that Ethiopia's population was about 42 million. But the census was not comprehensive since it did not include rural areas of the then Eritrea and Tigray provinces, which were excluded due to insecurity. Since Eritrea is not part of Ethiopia now and Tigray is less than 5% of the entire population, most of the 1984 census data set can still be used as a useful source of demographic information for relative comparison with recent developments. The 1984 census also revealed that Ethiopia's population was about 89 percent rural.

The mid-2001 estimated population is about 65.4 million (3rd most populated African country next to Nigeria and Egypt) with estimated total fertility rate (TFR) of about 6 births per woman (ETDHS, 2000). The total fertility rate was estimated to be 6.4 births per woman in the 1990 Family and Fertility Survey (CSA, 1993).

According to the '1994 Population and Housing Census', nearly half (45.4%) of the total population of Ethiopia falls under 15 years (CSA, 1994). The elderly population over 60 years of age is estimated at about 3%. About (86.3%) or five of every six people live in the rural area. The dependency ratio is estimated to be over 96 per 100 economically active population. These figures increased by about 2 dependants from 1985 to 1990 and by 4 dependants from 1990 to 1995 (UN World Population Prospects, 1995). From this trend we observe that dependants are increasing in Geometric progression.

Fig. 1.2: Population distribution in Ethiopia by Federal Region (1994 Census)



The Ethiopian population has always been predominantly rural, engaging in agricultural activities such as the cultivation of crops and livestock-raising in the highlands. In the lowlands, the main activities traditionally have been subsistence farming by semi-nomadic groups and seasonal grazing of livestock by nomadic people.

The distribution of Ethiopia's population is generally related to altitude, climate, and soil. These physical factors explain the concentration of population in the highlands due to their moderate temperature, rich soil, and adequate rainfall. About 14 percent of the population lives in areas above 2,400 meters (cool climatic zone), about 75 percent between 1,500 and 2,400 meters (temperate zone), and only 11 percent below 1,500 meters (hot climatic zone), although the hot zone encompasses more than half of Ethiopia's territory (Woldemariam, 1970). Localities with elevations above 3,000 meters and below 1,500 meters are sparsely populated, the first because of cold temperatures and rugged terrain, which limit agricultural activity, and the second because of high temperatures and low rainfall, except in the West and South-west.

Prior to 1991, Ethiopia was divided into 14 provinces until 1987 (see Fig 1.1a) and briefly between 1987 and 1991 into 30 regions (24 'administrative regions' and 6 'autonomous regions' including the capital city). However, in 1991 Ethiopia adopted the 'Federal system' of administration decentralising state power to ethnic based regional units and currently the country is divided into 11 'federal regions' including the chartered capital city – Addis Ababa (see Fig 1.1b). Each federal region consists of "Zones" most of which are the same "provinces or administrative regions" in the previous regime.

Variations in population growth existed among the then 'administrative regions' (now called "Zones"). Kefa, Sidamo, and Shewa had the highest average growth rates from 1967- 84, ranging from 4.2 percent for Kefa to 3.5 percent for Sidamo and Shewa (CSA, 1991). Whereas Shewa's population growth was the result of Addis Ababa's status as the administrative, commercial, and industrial capital of Ethiopia, Kefa and Sidamo grew primarily because of agricultural and urban development. The population in regions such as Harar, Wello, and Tigray, which had been hard hit by famine and insecurity, grew at slow rates: 1.3 percent, 1 percent, and 0.2 percent, respectively. Generally, the population of most central and western administrative regions grew more rapidly than did the population of the eastern and northern administrative regions.

1.4.2 Social system and social relations

Ethiopia has a multi-ethnic and multi-cultural society with about seventy-seven ethnic groups, speaking about eighty languages and over two hundred local dialects. Each group has its own customs and traditions. Family structure typically includes the extended family with strong ties.

However, Ethiopia's ethnic and cultural diversity has affected social relations. Most lowland people are geographically and socially isolated from the highland population. Moreover, in most of the rural areas exposure to other ethnic groups usually occurs by means of relatively limited contact with administrators, tax collectors, and retail merchants. By contrast, the towns display high social and ethnic diversity with greater communication and cultural integration. In Addis Ababa, it is common for families and groups from various social and economic classes to live side by side. However, in recent years (especially after the 'cold war'), upper-income residential zones have emerged.

The existence of more than seventy languages has been another barrier to social communication and national integration. Ethiopia's successive kings in the past, recognizing the importance of a national language, adopted 'Amharic' as the official language (Levine, 1974). The use of Amharic became mandatory in government, education, radiobroadcasts, and newspapers. Language policy changed under the subsequent governments, which attempted to reverse the trend recognizing several languages widely spoken in specific areas - such as 'Oromiffa', 'Tigrinya', 'Afar', 'Somali' etc. for use in schools at the lower levels and also authorized the use of these languages in radiobroadcasts and literacy campaigns. Since 1994, when the country was re-mapped along major ethnic boundaries, the predominant languages spoken in each of the federal states became working languages. Nevertheless, Amharic remains the official national and working language.

1.4.3 Economy

The country is endowed with arable land and natural resources. However, much of its potential is not yet exploited. For instance, out of the sixty per cent of its landmass, which is known to have a potential for agricultural development, only 15 per cent is estimated to have been developed (MIDAC, 1998).

The Ethiopian economy is dominated by peasant agriculture, with the agricultural sector contributing about 60 per cent to the total GDP and accounting for 80 per cent of total employment. Coffee is Ethiopia's largest export and generates about 60% of all its export earnings. It is worth noting here that many historians believe that the word 'coffee' came from the Ethiopian word "Kafa" – one of the provinces of Ethiopia where coffee was first discovered in the 10th century (Donnelly, 1996, Fact book, 1996). Although its contribution to the national economy is very limited, the country's livestock wealth is the largest in Africa. There is also rich potential of mineral resources that include gold, platinum, marble, tantalite, copper, potash, soda-ash, zinc, nickel, iron and natural gas. However, much of this is yet to be exploited (MIDAC, 1998). In 2001, Ethiopia qualified for debt relief from the Highly Indebted Poor Countries (HIPC) initiative, and in 2005 the International Monetary Fund (IMF) voted to write-off the Ethiopia's debt (World Bank, 2001).

The environmental concern is land degradation manifested in soil erosion, deforestation, recurrent drought and rapidly growing population pressure. The level of development of the manufacturing sector in Ethiopia is at its infancy; and the country's industrial base is very low. The share of intermediate and capital goods industry is very insignificant. The industrial sector is heavily dependent on imports of semi-processed goods, raw materials, spare-parts and fuel. In addition to imported inputs, the factories depend upon backward and subsistence agriculture for their raw material demand. The manufacturing industry, including small-scale and handicrafts, contributes about 11% to GDP and 15% of the total export (MIDAC, 1998). Furthermore, about 3% of total employment is engaged in manufacturing industry. Out of the country's limited number of manufacturing industries, consumer goods producing industries contribute more than half of the sector's output.

1.4.4 Urbanization

Unlike many other African cities, the founding, growth and development of cities in Ethiopia are not rooted in colonization but rather indigenous due to the fact that Ethiopia was never colonized (Akpan, 1985). For instance, Addis Ababa - the current capital city, founded in 1896 by Emperor Menelik II, is the last in a succession of capitals next to 'Axum' and 'Gondar' and accounts for about 30% of the total urban population in the entire country (Pankhurst, 1985; Census, 1991, 1994).

Although Ethiopia is considered as one of the oldest independent African States, urbanization is low (about 15%) compared with many other African countries. The urban growth was more rapid between 1966 and 1970 (6.6%) then slowed down to 4.23% in 1970-1984. The slow urbanization might be due to the fact that city and town life had not been a feature of Ethiopian society and trade was not a full-time occupation for Ethiopians in the past (Pankhurst, 1985). There is highly uneven regional distribution of urbanization with the core urban region accommodating close to half the urban population (Tesfaghiorghis, 1986). Urban areas are divided into 'Kebeles' (an Amharic term used to describe a neighbourhood area. 'Kebeles' are the basic units of urban administration.

1.4.5 Religion

The Ethiopian Orthodox Church, founded in the 4th century A.D., was the established church of the monarchical era until 1974 and the church was the guardian of the state and the monarchy (Ullendorff, 1968, 1976). By contrast, Islam spread among ethnically diverse and geographically dispersed groups along the peripheries at different times and therefore failed to provide the same degree of political unity to its adherents (Trimingham, 1952). However, Islam has spread tremendously in the eastern, southern and western low lands including thousands of followers in Addis Ababa after the Marxist government took power by deposing the monarchy in 1974.

Traditional (indigenous) belief systems exist in the lowland regions, but diminishing due to the widespread of the popular religions. Successive governments in the last 2-3 decades have introduced major changes in the official status of the Ethiopian Orthodox Church and other religions declaring that all religions were equal, and a number of Muslim holidays became official in addition to the Christian holidays already honoured. Although, statistical data on religious affiliation fluctuates, when members of the predominantly Christian ethnic groups (Amharas and Tigriyans) are combined with others who have accepted Christianity, the total Christian population might be about 50 percent of all Ethiopians while the Muslim population in Ethiopia has been estimated to be about 30-40 percent of the population. Among believers of traditional or indigenous religions are most of those speaking Nilo-Saharan languages and many of those speaking Omotic and Cushitic, including sections of the Oromo, such as the pastoral Borana (Caraman, 1985; Zewde, 1991).

1.4.6 Internal situation and the research environment

Since the Second World War, there has been a general expectation that social and economic development in the 3rd World would bring peace (Smith, 1994). However, experience has shown that these hopes have not been fully realized because war appears to be more widespread today than at the start of the development era in the late 1940s and most of these conflicts take place in the 3rd world – Africa taking the highest proportion (Smith, 1994). Smith further argues that "poverty may cause war yet war may also cause poverty" but identifying the causes of conflict is complicated. However, some causes of conflict may be concealed within other factors. For instance 'border conflicts' are usually loaded with other historical, economic, environmental or resources and ethnic or civil and even market control factors (Smith, 1994).

Ethiopia has been frequently detracted from development track in the last 3-4 decades due to continued internal conflict. This has affected development research that includes demographic research, which requires a peaceful environment in order to reach each household at any location in the country. For instance, the 1984 Ethiopian Census, and the 1990 Family and Fertility Survey (FFS), although designed to be national, did not include some parts of the country due to security problems. Even the 1994 census, which was conducted during a relatively peaceful period, has not covered some parts of the country for the same reason (CSA, 1994). The other problem is that relative peace in Ethiopia is short-lived and might affect ongoing research before covering the designated areas.

1.5 Presentation of the thesis

The thesis begins with a general introduction to the research problem statement and background information of the study area in chapter one. In chapter two, literature on theoretical approaches and existing knowledge are reviewed.

Chapter three presents detailed description of all methodology used in the study with an assessment of the quality of data. In chapter four, preliminary analyses such as trends in fertility are presented.

In chapter five, we have two analyses – a survival analysis of 'time to marriage' and design-based negative binomial and Poisson modelling of recent fertility (births in the last five years).

Chapter six presents a design-based multinomial logistic analysis of 'fertility intention'. In chapter seven the study revisits non-marriage, childbearing rate and fertility intention, but this time quantifying the gap between Addis Ababa and the 'Rest' of Ethiopia.

Chapter eight is dedicated to multilevel modelling of fertility. Chapter nine presents the survival analysis of birth intervals. The last chapter of the thesis, chapter ten, summarises the work presented so far.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The literature review documents earlier studies carried out as far as the topic at hand is concerned. There are two parts in the literature review. Part one reviews well-known theories of fertility transition such as economic theories, improved survival theories, ideational theories, diffusion and cultural theories. The second part presents reviews on the fertility transition in Africa in reference with the rest of the world.

2.1 Overview of various theories of fertility transition

2.1.1 Economic theories

The demographic transition was first described by Frank Notestein (1953). In his transition theory, the main argument was that as a society increases its modernization (industrialization, urbanization, increased education), this first leads to a decline in mortality and subsequently to a decline in fertility. Moreover, Notestein posited that the economic value of children would decline and hence families would opt to have fewer children.

Although classical demographic transition theory has been mainly focused on the promotion of all-round economic growth in order to generate the kinds of institutions, which would transform traditional patterns of behaviour, specific economic models eventually emerged.

The economic theories related to fertility can be generalized into the two main models – Becker's (1960, 1991) 'household economics' and Easterlin's (1978, 1983) "Relative income" theories. Both were developed to explain how fertility might respond to economic factors and both are based on the common assumption of a positive relationship between income and fertility and differ only in the determination of the main player: the 'price of time' in Becker's model and 'relative income' in Easterlin's model as described briefly below.

The New Household Economics, proposed by Becker (1960, 1991) seeks to extend the basic classical economics to the analysis of fertility behaviour on the assumption that the decision to have children is analogous to other economic choices in essential ways: children contribute to utility and they involve the use of scarce resources. Households are portrayed as choosing to consume a package of commodities (utility-bearing goods and services), subject to their budget constraints. This package may either be purchased in the marketplace or produced at home; within a model of fertility behaviour, children or rather 'child services' are included among the possible utility-bearing commodities that households can choose to acquire. As with any commodity, an increase in income is associated with an increase in the demand for children while an increase in the 'price' of children is associated with a decrease. The decision to have children is therefore made directly analogous to the decision to purchase any other consumer durable such as a car: costly to acquire and maintain initially, but with maintenance costs declining over the life of the child relative to the flow of utility derived from the child.

Other modifications to the theory occurred in the course of empirical testing. Initially, the theory had predicted a positive relationship between family size and income, once knowledge and use of birth control was held constant. However, studies revealed both an inverse relationship over time between family size and income (suggesting that in conventional economic terms, children were an 'inferior' good). These apparently anomalous results were dealt with in two ways. First of all, the 'price' of children was reformulated to include the value of the time spent in child care by parents, typically the mother, along with more conventional elements of child costs such as food, clothing and housing. Thus the cost of time in childcare, which is measured by the value foregone (opportunity cost) in other alternative activities, is generally equated with the shadow price of women's time.

Some studies pointed out shortcomings to this due to the fact that as women's incomes rise they might be able to pay for replacements of their own services in the home such as taking children to nursery school, hiring housekeepers which will in turn make it more likely that they will combine motherhood and a career:

The second modification, the question of 'quantity-quality' exchange refers to resource investments per child. Fertility choices may be constrained due to the fact that 'an increase in the quality is more expensive if there are more children because the increase has to apply to more units'; similarly, an increase in quantity is more expensive if the children are of higher quality, because higher quality children cost more (Becker et al, 1973). Thus, parents face the choice, for a given set of resources, of either investing in many children (quantity) with low resource investments per child, or investing in fewer children but with higher resource investments per child (quality).

Again some argue that parents are not free to choose any level of quality – for example, to choose six "low quality" children rather than three "high quality" children. Instead, they are constrained by their own education and standard of living to a given level, or at least range, of quality.

Easterlin (1978, 1983) and Easterlin and Crimmins (1982) have attempted to provide an integrated theory of economic and sociological approaches to fertility change in the model of the demand and supply of children, including the cost of fertility regulation. In its original formulation, Easterlin's theory hypothesized that demand for children is affected by three proximate factors; price, income and tastes. This offered a reasonable solution to the tricky relation between income and fertility.

In Easterlin's model income in relation to material aspirations is used to indicate shifts in preferences over time. With economic growth, each generation supposedly experiences increasing income and higher standard of living, yet temporary reversals occur due to economic as well as demographic fluctuations. Young individuals belonging to a large cohort will meet an unfavourable future with tough labour market conditions, high unemployment and relatively low age-specific wages. So, individuals belonging to a large cohort tend to react to the gap between income and material aspirations and distinguish themselves and tend to adjust by postponing marriage and by postponing and reducing childbearing.

A shortcoming of the relative income theory is the different measure of relative income and the difficult distinction between what are the 'true' relative income effects and what are effects of social and normative change over time (Westoff, 1986).

To sum up the economic theories, have their limitations as well as sound aspects and each of them provide significant insight into the relationship of fertility and its determinants. However, a combination of both could be helpful.

2.1.2 Improved survival theories

Kingsley Davis (1963), through his "Theory of change and response in modern demographic history" or "The Theory of Multiphasic Response" and in an attempt to provide an "overall analysis of the demographic change in industrialized countries", mentioned the contribution of decline in mortality (improved survival) as a "stimulus" among the multiphase responses (contraception, postponement of marriage and poverty) to the demographic change that took place particularly in Japan. Davis argued, using Japanese data, that decline in mortality and sustained natural increase was the stimulus that gave rise to postponement of marriage, increase in contraception use and sterilization as well as abortion bringing down the gross reproduction rate.

But Davis gives emphasis on the main focus of his "multiphasic" demographic change theory - to show the complex nature of the process of demographic change. He claimed that demographic change is "reflexive in that a change in one component is altered by the change it has induced in other components" and "behavioural in that the process involves human decisions". Furthermore, Davis's theory and similar researches that were carried out during that time were perhaps aimed at counter balancing the negative attitude toward improved standards of health that blamed the latter for accelerating population growth (Preston, 1975).

However, the improved survival theory was grounded, with sufficient evidence and by including the context of developing countries, by Cleland (2001). He underpins his argument on the fact that:

> "mortality decline is the common underlying cause – both necessary and sufficient - of the fertility declines that have swept across most of the developing world in the past 40 years."

This claim is supported by evidence from Asian counties like India and Indonesia and Latin American Countries such as Mexico, Colombia and Chile with the exception of Africa (perhaps due to lack of data), where life expectancy improved by a minimum of 19 years in India and maximum of 46 years in Indonesia. This was followed by an initial rising and then declining NRR (Net Reproductive Rate) with changing childbearing patterns. While in Asia the mortality-fertility trade off was brought about by increased use of modern contraception and age at marriage, in Latin America use of modern contraception is alluded.

In sub Saharan Africa, a promising application based on this theory is being carried out in Ghana using the 'Navrongo Demographic Surveillance System'. Preliminary results of the experiment have given the improved survival theory further ground by revealing that "the death of a child has no effect on the odds of subsequent parity progression" (Binka et al, 2004)

2.1.3 Ideational, cultural or diffusion theories

Classic transition theory was undermined by the 'European Fertility Project' carried out at Princeton University, which did not find any consistent relationship between the timing of the onset of fertility decline and the different measures of social and economic development associated with transition (Knodel and van de Walle, 1979). Instead, what did appear significant were a series of variables, which were classified under the structure of 'culture' (language, ethnicity, religion, geographical region), which Greenhalgh (1995) terms as 'the seeds of the cultural or diffusion interpretation of fertility decline'.

These ideas have been picked up by researchers of contemporary fertility transitions and a version of the cultural concept is vigorously argued in Cleland and Wilson's (1987) "iconoclastic view". Drawing both on data on European fertility transition as well as from 24 developing countries covered by the 1979 World Fertility Survey, they single out "ideational change" as the main explanation for the shift to smaller family sizes. They define "ideational change" as a "psychological shift from fatalism to a sense of control of destiny, from passivity to the pursuit of achievement, from a religious, tradition-bound and parochial view of the world to a more secular, rational and cosmopolitan one" (Cleland and Wilson, 1987). They further argue that "the implications of such general shifts in outlook for attitudes towards and propensity to use birth control are obvious". They adapt the diffusionist tradition within early modernization theory with its focus on media, communications and influential "change agents" as critical to the transmission of modern values from external sources to explain the process of ideational change in the field of contraceptive technology.

Those subscribing to the 'ideational' model of change argue that the fact that different economic variables do not have the same impact in all contexts - and may have no impact at all in some contexts - is sufficient grounds for rejecting economic explanations for fertility behaviour; instead they advocate some combination of cultural variables and family planning programmes as a more viable alternative explanation (Cleland et al, 1987).

McNicoll (1992) argues that what distinguishes the interpretation given to "ideational change" by Cleland and Wilson (1987) from earlier formulations in modernization theory is the central role ascribed to ideas concerning the acceptability and feasibility of birth control rather than ideas about the economics of family size as the motivating force for fertility decline. Thus, there has been a shift away from the broader version of transition theory with its emphasis on structural change to the diffusion of new knowledge, ideas and attitudes related to contraception.

However, in traditional, rural and agricultural countries like those of the Sub-Saharan African (SSA), Asian and Latin American societies, where the transition has stagnated or moving at a very slow pace, it was imminent that the challenge would continue for some time. High value placed on sustaining the lineage, marriage coupled with polygamy, which sometimes promotes competition for childbearing among co-wives are among the factors that contributed to the observed high fertility in SSA. In spite of this, there is a rich demographic literature which describes some emerging evidence revealing that some of the traditional values placed on children gradually eroded and that the fertility transition eventually began in some Sub-Saharan African countries (Boserup 1985; Lesthaeghe 1989; Caldwell et. al. 1992, Cleland, 1985, Cleland and Wilson 1987).

However, the fact that fertility transition has started in some countries does not mean that 'a broad regional transition is imminent' (Caldwell et al, 1992). Therefore, there is a

To sum up, McDonald (2001) notes to "keeping in mind Hirschman's skeptical view", by quoting what Hirschman (1994) argued:

> "The standard social science model is that society works pretty much like a regression equation: the task is to find the right set of predictors, solve the equation, and discover what factors are most important in predicting social outcomes (Hirschman 1994: 226)."

Caldwell's (1976b) "wealth flows theory" is among those that can be classified under the 'Ideational-cultural-diffusion' group. Caldwell in his theory proposes a direct link between family structure and fertility. According to the theory, there are only two major forms of family structure, differing principally in the direction of wealth flows among generations. In 'primitive' and 'traditional' societies, net wealth flows are primarily upward from younger to older generations, and individual interests are subjugated to corporate interests. In developed nations, family structure is organized in terms of downward wealth flows where parents are expected to provide for children's economic well-being.

According to wealth flows theory, cultural transmission of new family values is the principal driving force in fertility transition. The theory proposes that fertility decisions in all societies are economically rational responses to familial wealth flows. In societies with net upward wealth flows, the economically rational decision is to have as many surviving children as possible (within the constraints imposed by biology), because each additional child adds positively to a parent's wealth, security in old age, and social wellbeing. In societies with net downward wealth flows, the economically rational decision is to have no children or the minimum number allowed by a psychological disposition that derives pleasure from children and parenting. The worldwide transition from high to low fertility is the result of a change in family structures from upward to downward wealth flows.

This change in family structure was due to the spread of new values that placed a premium on individual satisfaction and achievement (Caldwell, 1980). Those values emanated from the educated, middle-class in the west and are now being exported to the developing world through mass formal education. Implicit in the educational materials and expectations of schools is the individualistic value system that produces downward wealth flows.

However, like the other theories, the wealth flows theory has also been challenged especially by evolutionary biologists, who argue that net wealth flows should only be downward in all organisms, including humans (Turke 1989). Moreover, there is little empirical evidence that supports one side of the theory regarding 'two fertility regimes to be associated with upward and downward wealth flows'.

Finally, the 'diffusion' approach of fertility transition, which was perhaps first coined by Carlsson (1966) when he used the terms 'innovation' and 'diffusion' in his analysis of the decline of fertility.
This approach focuses on what is being transmitted (the innovation) and on how it is being transmitted (the diffusion of innovation among individuals and families).

However, after Cleland and Wilson's (1987) 'ideational theory', the innovation-diffusion' approach is considered as falling under it. Cleland (2001) describes it in a more emphatic way by saying: "'the engine of demographic change is the structural transformation of societies, and diffusion is the lubricant". The diffusion theory (also known as innovation-diffusion theory) centres around the argument that fertility decline is the consequence of the increased prevalence of attitudes and behaviors that were previously very rare or absent in the population, that is, they are innovative (Cleland, 2001; Casterline, 2001). One of the concerns that draws attention on innovation-diffusion theory is the concern with the diffusion process, that is, with the question "How does diffusion occur?" (Casterline, 2001).

2.1.4 Overview of conceptual approaches on fertility preference

Research in fertility preference in developing countries has received considerable attention in recent years because parental attitudes are key to household fertility decision-making and to the future course of fertility in a society. The focus has been on intention to have additional children and the desired or preferred family size (Coombs, 1974, Pullum, 1980, McClelland, 1983, Lightbourne, and MacDonald, 1982).

When a woman's fertility preferences are related in some way to her actual fertility, then information on fertility preference can be used as an important determinant in forecasting the future course of fertility. Studies on fertility preferences conducted in most developed and some developing countries have confirmed this fact but it has not yet been well established whether this is also true for countries like Ethiopia where fertility regulation is not widespread.

A wide range of approaches have been used in the measurement of fertility preferences and surveys have varied widely in the wording of questions used to measure these. For instance, questions like: 'how many more', 'ideal family size', 'desired family size', 'intended family size' and 'expected family size' have been used in surveys (Lightbourne, and MacDonald, 1982). Ideal family size, which is measured in several ways as a generalised ideal size, that is, for a woman in the society or as a personal ideal size, that is, for her own family size, creates another conceptual issue (Pullum, 1980).

The following questions are often used in Demographic and Health Surveys (DHS) to gather information on desired family size: Currently married women are asked: 'would you like to have (a/another) child or would you prefer not to have any (more) children?' Women with children are asked: 'if you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?' Childless women are asked: 'If you could choose exactly the number of children to have in your whole life, how many would that be?'

The reliability of these questions and the validity of measures based on them have received tremendous attention and criticism (Rasul, 1993, Bushan and Hill, 1995; Ascadi and Ascadi, 1990; Van de Walle, 1992; Bongaarts 1992). The main criticisms against the measurement of desired family size relate to questions of bias and to the ability of respondents to give numeric responses to questions, especially in settings where fertility decision making is beyond the control of the individual women. Ascadi et al. (1990) argued that the ability to respond to such queries is questionable in societies where fertility is controlled by lineage or ancestors who do not recognise individual desires in fertility decision making, and where fertility control is not widespread. It is also often unclear as to what constraints the respondents have in mind while answering questions on family size preferences and to what extent their responses reflect personal ideals in contrast to societal norms (Pullum, 1980).

Mhloyi (1994) argued that the conventional approach which measures fertility preference at a fixed point in time, assumes that a woman adopts the same fertility behaviour, and has the same views about the social and economic value of children throughout her reproductive life, whereas fertility preferences are constantly reviewed over the life course. Similarly, Rasul (1993) argued that the conventional measure of fertility preference is weighed in terms of costs and benefits of making choices to satisfy personally defined objectives. He further argued that overlapping cultural, socio-economic and physical realities define the relative power of women and men in decision-making and, therefore, that changes in the circumstances affecting women could cause them to revise their fertility preferences over the life course irrespective of market considerations.

Bushan and Hill (1995) argued that responses to questions on fertility preference are characterised by uncertainty because individuals are not sure of what might happen in the future and that is why individuals give answers such as number of children to have is up to God. They argued that this uncertainty accounts for the high incidence of non-numeric answers to questions on fertility preference.

Despite the above criticisms, data on fertility preference has several advantages in fertility analysis. Primarily, it measures fertility desire and there is no measure that provides an equally effective index of the potential for change in family size in the developing countries (Ware, 1974, Fapohunda et al, 1997). Secondly, it reflects the norms and culture and the value of children associated to a place of the respondent's residence (Westoff and Bankole, 1995). Thirdly, in an analysis of DHS data from 18 developing countries considerable agreement between stated preferences and demographic behaviour among women was revealed, where it was found that 85% of the respondents whose actual fertility exceeded their desired family size wanted no more children with 15% inconsistencies attributed to unachieved sex composition (Bongaarts, 1991).

2.1.5 Overview of studies on fertility transitions in developing countries

Although, the universality of the above transition theories has been challenged in the light of changing fertility behaviour in developing countries, it can be argued that except for differences in 'context', the fertility transitions in some developing countries follow the fundamental mechanisms as indicated in the theories. With this view and still keeping in mind Hirschman's suggestion that the main 'task is to find the right set of predictors, solve the equation, and discover what factors are most important in predicting social outcomes' (Hirschman, 1994), the following brief reviews are made on fertility transition in sub Saharan Africa and other developing countries. Some of the studies carried out have been mentioned above along with the theories.

Just as in Asia and Latin America, high levels of infant and child mortality, early and universal marriage followed by early child bearing, high social values placed on child bearing and low contraceptive use are among the factors that have contributed to persistent high levels of fertility in Sub-Saharan Africa (SSA). However, the changes that took place in Sub-Saharan Africa have been different from that in Asia and Latin America. For instance, various UN estimates and projections have revealed that fertility and mortality rates declined concurrently in Latin America and Asia, while only mortality fell in Africa.

In most sub Saharan African societies, where high value is placed on sustaining the lineage, marriage coupled with polygamy, which sometimes promotes competition for childbearing among co-wives are among the factors that contributed to the observed high fertility in SSA. In spite of this, there is a rich demographic literature which describes some emerging evidence revealing that some of the traditional values placed on children gradually eroded and that the fertility transition eventually began in some Sub-Saharan African countries (Boserup 1985; Lesthaeghe 1989; Caldwell et. al. 1992, Cleland, 1985, Cleland and Wilson 1987).

In some countries (e.g. Indonesia, Bangladesh and China) fertility declines were caused by integrating family planning programs with development plans. In others (e.g. Sri Lanka, Viet Nam and India) fertility rates have declined due to other contexts long before such programmes became widely available (Kabeer, 1996). In many parts of Sub-Saharan Africa, average years of school per child appears to be positively related to family size, contradicting the prediction that quantity has to be traded off against quality of children (Kabeer, 1996; Caldwell, 1982; Cochrane and Farid, 1989).

Cleland et al. (1994) analyzed fertility using surveys undertaken in Africa between the late 1980s and early 1990s. They used the parity-fertility (P/F) ratio technique, and found out that only data from Botswana DHS-1988, Kenya DHS-1989, and N. Sudan DHS-1989-90 display the classic pattern of upward P/F ratios usually associated with declining marital fertility. They further found that data from six other surveys - Zimbabwe DHS-1984 and DHS-1988, Senegal DHS-1986, Togo DHS-1988, Nigeria DHS-1990, Cameroon DHS-1990 and Swaziland census -1986 display a pattern consistent with a recent fertility decline that has affected all age groups with the exception of Nigeria data that mask large regional differentials.

Recently, data from Cote d'Ivoire DHS-1994, Ghana DHS-1993, Lesotho DHS-1986, Namibia DHS-1992, Rwanda DHS-1992, Senegal DHS-1992-93, Tanzania DHS-1994 and Zambia DHS- 1992 indicate that they have experienced a recent decline in marital fertility. The list is increasing with the release of new surveys.

Latin American countries experienced the highest rate of population growth in 1950-60 with an average annual rate of about 2.8%, which some Sub-Saharan African countries only began experiencing in the 1990s. Chackiel and Schkolnik (1996) classified the fertility decline in Latin America into four categories: (1) Very advanced transition (countries with TFR<3), (2) Advanced transition (3<TFR<4.5), (3) Intermediate transition (4.5<TFR<5.5) and (4) Beginning transition (TFR>5.5). It was also found that while a decline in the level of fertility was accompanied by a rise in age at marriage, there also appeared to be a concern accompanying increased age at marriage such as increased unwanted pregnancies and higher incidences of abortion (Chackiel et al, 1996).

Rodriguez (1996) also affirms the fertility transition in Latin America from a different approach. He examined the spacing and limiting components of the fertility transition by modelling period marital fertility of individual women using a loglinear Poisson regression using WFS and DHS data sets for six Latin American countries. He confirmed that total marital fertility had declined in all the six countries ranging from 0.4 births in Trinidad to 2.2 births per woman in Mexico (Rodriguez, 1996).

Among the intermediate and socio-economic factors that contributed to the fertility transition in Latin America, contraceptive use had the greatest influence (Pullum et al, 1985; Moreno et al, 1996). Among the socio-economic and background factors, women's educational level has been found to explain changes in fertility (Rodriguez & Cleland, 1984). However, higher education did not affect fertility uniformly across countries. For instance, Brazil exhibited a rapid decline in fertility and at the same time was not the country with the highest educational level in the region (Juarez et al, 1996). It was further argued that Columbia, the country with lower education than Peru and Ecuador, showed advanced signs of fertility decline. Juarez et al (1996) conclude that according to their findings, contraceptive use is increasingly becoming independent of women's educational level.

In terms of fertility intents, Westoff et al (1996) found that there has been a significant decline in the mean desired family size in five out of eight Latin American countries for which data on ideal number of children was analyzed. In another study on the predictive validity of reproductive intentions, Westoff (1990) concluded that "the measurement of reproductive intentions has a high level of aggregate validity", and a good predictor of TFR several years later. He further argues that this evidence makes preferences/intentions an important outcome variable.

Freedman (1995) concludes that the most pronounced fertility decline in Asia took place between the late 1960s and 1980s. He assessed fertility trends of 24 Asian countries that account for 56 percent of the world's population and found out three factors (mortality decline, broad social and economic development, and effective national family planning programs) that are likely to explain the rapid fertility decline in most of these countries. He also discovered that by 1990, nearly two-thirds of Asian countries had experienced declines in fertility by at least 25 percent. Six of these countries (Bangladesh, China, India, Indonesia, Sri Lanka, and Vietnam), that account for 76 percent of Asia's population, have established strong national family planning programs and collectively have a contraceptive use rate of 64 percent and total fertility rates (TFR) ranging from 4.5 to 2.1 (Freedman, 1995).

In addition to the strong family planning programmes, two other factors - low mortality and high adult female literacy were found to have significant role in fertility transition in China, Indonesia, Sri Lanka, and Vietnam, which had the largest fertility declines in the region (Freedman, 1995).. Bangladesh's fertility decline is an exception due to the fact that in spite of high mortality and low female literacy levels, it has experienced a significant fertility decline.

On the other hand, six countries in East and Southeast Asia (Hong Kong, Japan, South Korea, Singapore, Taiwan, and Thailand) have already approached/crossed below-replacement fertility. This may be explained by the fact that Hong Kong and Japan have experienced social and economic development combined with private family planning services, while the fertility decline in South Korea, Singapore, Taiwan, and Thailand has likely been brought about through broadly based development combined with strong family planning programs (Freedman, 1995). Other possible explanations for the downward trend toward below replacement fertility are the rise in age at marriage entailing delayed marriage and links to women's improved status.

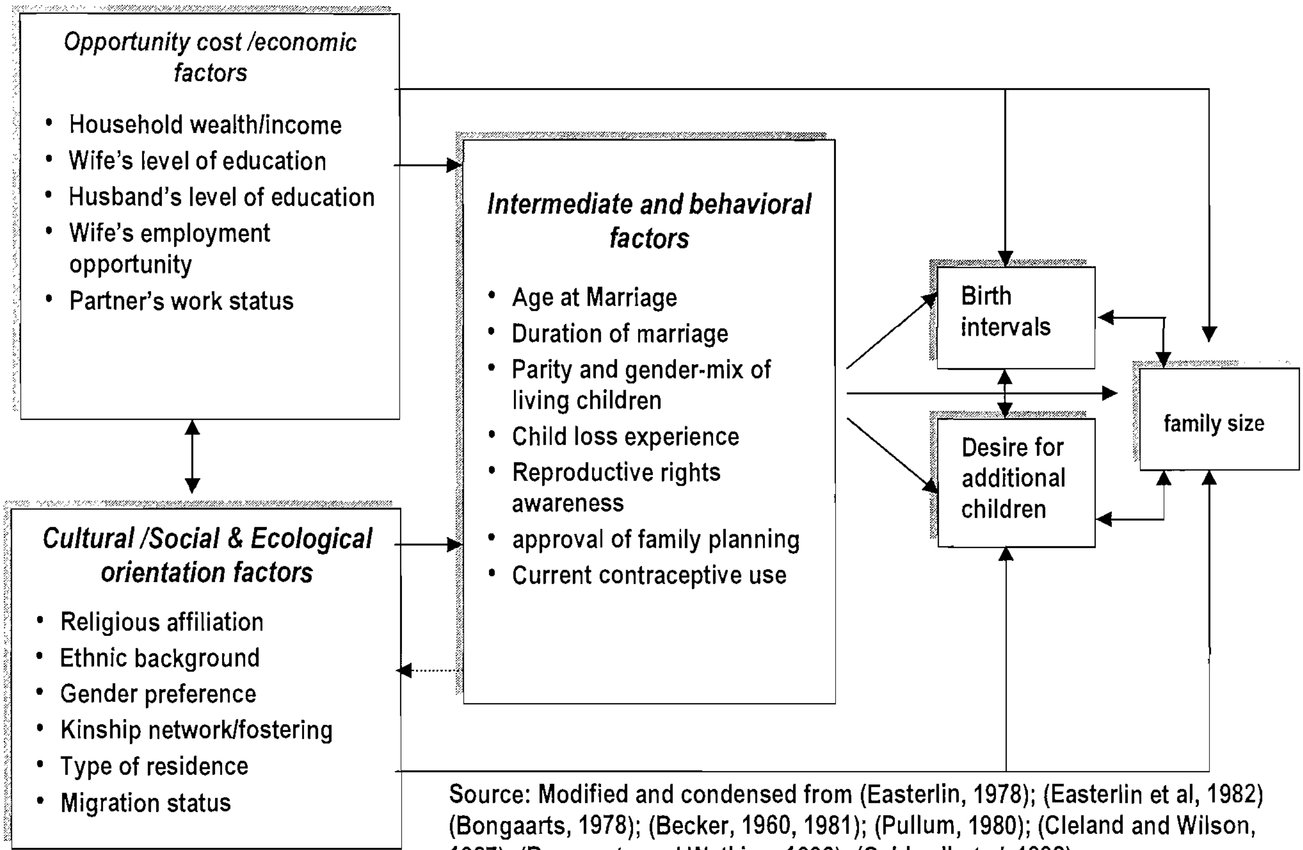
2.2 Proposed framework for this study

As mentioned earlier, researchers have not still converged to a common explanation for the most basic questions of demographic change. Demographers agree that no single theory of fertility has so far provided a comprehensive answer as to why fertility rates have fallen in many societies and not in others, and why fertility transitions have been fast in some, and slow in others. Several theories of fertility have been put forward to explain these differences, but each providing only partial explanation (Davis and Blake (1956); Rogers and Shoemaker (1971); Easterlin, (1978, 1982); Pullum (1980); Cleland and Wilson (1987); Becker (1960, 1981 & 1986) and Bongaarts and Watkins (1996). It was also indicated in the literature that the high value for children observed in developing countries has been linked to lack of economic development (Mhloyi, 1992). However, the fertility transition experienced in Bangladesh, Botswana, Zimbabwe and Kenya began with little signs of economic development but as a result of the interplay of several factors. In view of this argument, this study attempts to combine individual decision making with society's cultural values and norms, ideational change, socio-economic level and ecological factors using theoretical and conceptual frameworks put forward by the above mentioned social scientists.

Therefore the main assumption underlying the framework in this study (Fig 2.1) is that the economic, diffusion, ideational and cultural theories and concepts can be integrated into a single framework incorporating operational factors associated with the individual. In other words, a woman makes fertility decisions under the restrictions of economic forces, deeply ingrained cultural values, and personal attributes influenced by ideational change (Easterlin, 1978; Pullum, 1980; Easterlin and Crimmis, 1982; Caldwell, 1982; Cleland and Wilson, 1987; Bongaarts and Watkins, 1996).

Hirschman (1994) on the challenge of identifying a suitable theory noted: "The standard social science model is that society works pretty much like a regression equation: the task is to find the right set of predictors, solve the equation, and discover what factors are most important in predicting social outcomes (Hirschman 1994: 226)." Therefore, it is worth noting here that the proposed framework is modified in an ambitious attempt to capture the Ethiopian scenario and may not fully address several factors including some behavioural and physiological elements involved in fertility dynamics.

Fig. 2.1: Conceptual framework for Fertility correlates



Source: Modified and condensed from (Easterlin, 1978); (Easterlin et al, 1982) (Bongaarts, 1978); (Becker, 1960, 1981); (Pullum, 1980); (Cleland and Wilson, 1987); (Bongaarts and Watkins, 1996); (Caldwell *et al*, 1992)

2.3 Overview of literature on operational variables

Attempt is made to apply the above theories in the context of sub Saharan Africa. Several individual and societal factors can be considered as proxies when analysing fertility. Earlier studies using these factors are briefly reviewed below.

2.3.1 Education

Although there is no scientific consensus about the exact mechanism by which education affects fertility, it has been established that education is associated with characteristics such as literacy skills, greater personal autonomy, and exposure to new values, ideas, and role models that might enable a woman to choose fewer children (Diamond et al., 1999; Lloyd et al., 1999; UN, 1997; Jejeebhoy, 1997; Glewwe, 1999, Bledsoe et al., 1993). The following are a summary of the channels provided by these and other researchers why women's education may operate to influence fertility.

(i) high opportunity costs of childbearing involved in some types of work that may be offered to the better-educated women,

(ii) children's reduced contribution to domestic and agricultural work as a result of children's schooling, which tends to be encouraged by educated mothers,

(iii) reduced need for children as old age security, or to support the woman even as a relatively young widow, when the family's wealth allows other kinds of savings, or when the woman is able to earn a living on her own and even set something of that aside for the future,

(iv) lower infant and child mortality, influencing desires through replacement and insurance effects.

(v) a possibly stimulating impact of a higher purchasing power resulting from educated women's own work or their marriage into a relatively rich family.

(vi) higher age at marriage among the better educated

(vii) knowledge about and acceptance for modern contraception, and their ability to use it efficiently, as well as their more efficient use of traditional methods because of better knowledge about their own body,

(viii) erosion of traditional norms about postpartum sexual abstinence and breastfeeding that is supposed to go hand in hand with education,

Despite the fact that education increases the opportunity costs of caring for children; expands women's aspirations and choices; delays their age of marriage; and modifies their preferences so that they have fewer and healthier children (Summers, 1993), in the light of existing empirical evidence, there exist differences in the fertility effects of education across societies. For instance, of the 24 countries covered by the World Fertility Survey, education is significant in explaining fertility differentials in 13 countries; but had little or no effect in 11 (Thomas, 1991). Moreover, Jeffery and Basu (1996) argue that even within a single region, the relevance of either women's education or strong family planning programmes for fertility transition is by no means clear-cut. Therefore the basic argument here is that education does not always measure the opportunity costs of women's time in childcare. Female education can sometimes be taken as a proxy for the opportunity costs of child care, as suggested by economists; in other situations, it acts as a measure of attitudes, knowledge and ability to use family planning, as suggested by Cleland and Wilson (1987). Or education may operate by improving women's capacity to care for children, thereby lowering child mortality rates and, as a consequence, birth rates (Jeffery & Basu, 1996). In Ethiopia, female education is not evenly spread across the country, and added to this there is deep cultural bonding within each ethnic community, making it complex to identify the contribution of literacy/education on fertility.

2.3.2 Marriage and age at first birth

Childbearing outside unions greatly affects the level of fertility. It has been argued that the 'most significant change in Sub-Saharan Africa is not a rise in rates of adolescent fertility but in childbearing among unmarried women' (Bledsoe et al., 1993). But also as observed in Botswana, the increasing proportion of young unmarried mothers and the relatively high contraceptive prevalence rates among them can account for a considerable part of fertility decline (Botswana DHS, 1988). This change of reproductive behaviour is a new dimension of the major determinants of fertility decline and a good example of effective control of fertility outside marriage.

Although, births out of marriage have increased from time to time in Sub-Saharan Africa, fertility takes place within marriage and the average woman gets married at her early 20s (Westoff *et al.*, 1994). It has been established that age at marriage can be used to explain changes in fertility (Bongaarts and Potter, 1983; Casterline *et al*, 1984; Moreno, 1991). However, attention should be given to the argument that age at marriage can not be taken as a good index of exposure to the risk of childbearing as it does not reflect the beginning of exposure in the society under study. But the degree of exposure and frequency of sexual intercourse are crucial factors in fertility differentials among various marital groups.

Until recently, age at marriage has long been regarded as one of the proximate determinants of fertility (Davis and Blake, 1956; Bongaarts 1982). However, recent studies have revealed that this is not always true and that the effect of age at marriage on fertility is inconsistent (McDonald, Ruzicka & Caldwell 1980; Coale 1992). Some argue that age at marriage has a major impact on fertility, because the female reproductive duration in a lifetime is determined by age at marriage while others refute this approach that the contribution of age at marriage to fertility may be minimal or negligible because those who marry late usually attempt to compensate by reducing the birth interval. While the former may be true when age-specific fecundability is consistent for changes in age at marriage, the latter effect is also likely to be true when age and duration of marriage interact to influence fecundability.

It is obvious, that if fertility is controlled within marriage by using contraceptives or other means, age at marriage may not have much effect on fertility because couples may decide how many children they would like to have regardless of the age at marriage. However, in Ethiopia, where marriage for men and women is almost universal, and contraceptive use is very low (FFS, 1990), it is likely that high fertility is encouraged by other factors including age at marriage and has to be re-examined.

The age of a woman at first birth is a similar but an important factor influencing fertility. Demographically, early childbearing leads to large completed families and significantly shortens the time period between generations (Bogue et al., 1977). According to the 1990 Family and Fertility Survey, childbearing begins early in Ethiopia. One in three women aged 15-19 begins childbearing in her teens (either gives birth or is pregnant with her first child). Moreover, by the time these teenage women reach age 19, over 50 percent of them have begun childbearing. Elsewhere, results of Demographic and Health Survey data from 25 countries in Africa, Asia, Latin America and Caribbean indicated that the median age at first birth among women aged 40-44 ranged from 18.3 years in Uganda to 23.1 years in Sri Lanka. In general, women in Sub-Saharan Africa were about two years younger than women in other regions when they had their first child (Althaus, 1991).

However, it has also been argued that the effect of age at marriage on fertility is contextual (Chowdhury et al, 1996). These authors argue that in some circumstances, age at marriage may have minimal effect on fertility partly due to the following reasons.

- First, if women start having children no matter when they married, then the effect of age at marriage on fertility may be limited. In other words, a woman who marries late will have the same fertility experience as a woman who married early because the loss in reproductive life owing to late marriage may be compensated by increased fecundability.
- Second, if fertility is controlled within marriage by using contraceptives or other means, age at marriage may not have much effect on fertility because couples may decide how many children they would like to have regardless of the age at marriage.

In Ethiopia, marriage for both men and women is relatively early and contraceptive use among young women is almost absent (FFS, 1990; ETDHS, 2000).

2.3.3 Family planning

It has become common to associate fertility decline with the widespread use of modern contraception. It is difficult to deny that national Family Planning Programs played an instrumental role in fertility decline, at least initially (Casterline, 1991). However, the causes of recent fertility declines, particularly in developing countries remains under debate and probably will be for the foreseeable future. In broad terms, the dispute relates to the relative importance of changes in social and economic factors as compared to the role of family planning programs in inducing fertility transition.

In earlier studies, Bongaarts (1987) Bongaarts and Potter (1983) argue that contraceptive prevalence is not the only proximate determinant of fertility rates but the principal proximate determinants of natural fertility are marriage pattern and duration and intensity of breastfeeding. According to the 1990 Ethiopian Family and Fertility Survey (FFS), 'breastfeeding is a universal practice in Ethiopia' (FFS, 1993). In view of this and the long-standing fact that traditional fertility regulations such as breastfeeding and abstinence play a 'depressant and dampening' role on pregnancy (Frank, et al., 1987), make the need for intended fertility control considerably low.

For many years, the understanding and prediction of fertility and family planning behaviour has been a major objective of demographic research. Between 1960 and mid-70's, numerous household surveys were undertaken in developing countries to ascertain the contraceptive knowledge, attitudes and practices (KAP) of couples of reproductive age. From these surveys, the KAP-gap (the difference between the potential use and actual use of contraception) would be estimated.

However, these KAP surveys were criticised as lacking scientific vigour and professional expertise. Since the implementation of the World Fertility Survey (WFS) and Contraceptive Prevalence Surveys (CPS) in the mid 70's, the standards of research design, execution and analysis have been sufficiently developed to warrant confidence in policy prescriptions based on recent surveys. The literature on 'unmet need' (a term that replaced KAP-gap) has since continued to expand with more documentation of research in this field accompanied by better methods of estimating the unmet need for contraception.

Findings of the surveys carried out indicate that in almost all countries outside Africa, the level of unmet need decreases with the level of education (Westoff, 1989). North Africa also shows a similar pattern. In other regions of Africa, the relationship between education and unmet need is not consistent (Westoff, 1981). The relationship between age and the level of unmet need is quite inconsistent in most regions. In Africa, the level of unmet need seems to increase with age reaching a climax among those of middle age and then declining among those of older ages.

It would be expected that social influence plays an extremely important role in deciding people's reproductive behaviour, since there are fairly well-defined social norms about the desirable number, sex, and timing of children. Similarly, social norms and cultural beliefs influence the type of contraceptives a couple should or should not use. Reproductive decisions are influenced by the attitudes about fertility and contraception of those with whom a person interacts most often (Rogers and Kincaid, 1981). Survey and focus-group research find that social disapproval of contraception plays a major role in creating unmet need (Tuoane, 1999).

Casterline (1999) stresses the importance of family planning in the transition to lower fertility saying: 'There is much excitement in the field of population as evidence accumulates that fertility transition is underway, and in many cases well-advanced, in all regions of the world. In this excitement, there is a danger that family planning and reproductive health programs in countries with slower transitions will be neglected just when they most need support. We should be careful to avoid complacency'.

Although influencing social norms and cultural beliefs through fertility control such as family planning programs is difficult to achieve in a short time interval, it has also been shown that it is not impossible. For instance, in Bangladesh discussion groups called 'Jiggasha' consisting of, among others, opinion leaders, village women, the community-based depot-holder of contraceptives, and the Family Welfare worker had been formed in several villages to create a supportive social environment for contraceptive use (Kincaid et al. 1993). This process empowers women to take family planning decisions that previously would have to have been made without social support. Moreover, these discussion groups have marked effects even in the absence of household visits by the Family Welfare Assistant, demonstrating that such programs can provide social support to users that do not arise from services and communication approaches that assume a passive role on the part of clients (Cleland, 1994).

Wives who believed that their husbands approved of family planning were significantly more likely to be practising contraception than those who felt their husband disapproved or those who said they did not know their husband's attitude. Although this divergence may to some extent be due to the questioning procedure, the small proportion of spouses who had discussed family planning suggests that many women may not know their husband's attitude. This lack of knowledge may have important implications for contraceptive use.

According to Bongaarts and Judith (1995), the principal causes of unmet need in developing countries are lack of information, fear of side effects, and social and familial disapproval. Consequently, though a family planning program may provide services even in remote areas, this will not translate to a correspondingly high level of contraception if the providers do not engage the clients in dialogue about health fears, misinformation and facilitating couples to have communication about their fertility and fertility control behaviour.

2.3.4 Child loss experience

There is adequate literature on the study of the relationship between child loss experience and fertility. The most common are those relating to the 'replacement effect' and 'insurance effect' hypotheses (Preston, 1978; UN, 1987, 1988). These hypotheses state that 'experience with or fear of child loss may lead parents to have additional births either to 'replace' those who have actually died or as an 'insurance' against expected deaths'. In the Ethiopian case, in addition to the above hypotheses and given the fact that frequent clashes among ethnic groups and with neighbouring countries take place, it could be hypothesised that there is likely a higher demand for male children to replace those who die in these clashes. However, this hypothesis can only be tested in a qualitative research as there are no explicit questions included in demographic and health surveys.

It is generally expected that women who have experienced child loss in their reproductive career are more likely to desire to continue child bearing than their counterparts who have had no experience of child loss at all due to the fact that the former tend to ensure their family survival by having as many children as possible (Chanaka, 1988). A high level of child mortality almost certainly keeps fertility at a high level through both biological and behavioural mechanisms. The biological effect of child mortality on fertility is well established whereby the mother's infertile period following a birth is shortened because of truncated breastfeeding after the death of the child.

2.3.5 Culture

As in some parts of Sub-Saharan Africa, becoming a parent is some how 'prestigious' in Ethiopia, at least, in terms of changing one's status from childlessness to being a parent. In most of the regions of Ethiopia - cities, towns and rural areas alike - there is a tradition of addressing parents. For instance, when a person addresses a parent, he/she uses special phrases instead of calling by the natural names. It is a common practice to address either of the parents by the name of their first-born child irrespective of the sex of the child, for instance, 'mother/father of Mary' or 'mother/father of David'. This way of addressing a parent may seem only for respect, but it also carries a hidden motivation or incentive for prospective parents. On the other hand, childlessness or remaining single beyond a certain age results in social isolation or stigma in some communities. This leads to the argument that children are sources of social prestige and as a result Ethiopian women, men or couples are likely to be motivated to start a family and have a child, which will then be influenced by other factors such as gender preference.

Religion has a significant relevance in the demographic study of socio-economic groups. Religion prescribes a code of life, refers to a system of beliefs, attitudes and practices which individuals share in groups, and through this orientation towards life and death, religion is supposed to affect one's fertility behaviour (Chaudhary,1982). According to Westoff, 'the religious affiliation of the couple connotes a system of values which can affect family via several routes: (a) directly, by imposing sanctions on the practice of birth control or legitimising the practice of less effective methods only, or (b) indirectly, by indoctrinating its members with a moral and social philosophy of marriage and family which emphasises the virtues of reproduction' (Westoff, 1995).

The study of demography of religious communities is important and intriguing because of their heterogeneity and the fact that followers of different religions often live side by side. Religious opposition to contraceptive use is not a major reason for unmet need in most countries. Casterline and colleagues (1995) reached this conclusion in their in-depth study in the Philippines. However, in some countries like Bangladesh, Nigeria, Pakistan and Kenya (Catholic), perceived religious opposition discourages some women from adopting contraception.

2.3.6 Ethnicity

Ethnicity refers to groups that use either or any combination of linguistic, tribal, regional, or religious marker-criteria (Bishaw, 1995). Social interaction within and among ethnic groups plays a vital role in every aspect of societal issues. Information flows from individual to individual, families and communities within the same area and from one region to the other. Some scholars believe that this flow of information or what is known as the "diffusion approach" is an important mechanism of fertility change (Cleland and Wilson, 1987; Montgomery and Casterline, 1993; Rosero-Bixby and Casterline, 1993). The diffusion approach refers to the process by which innovation spreads among regions, social groups or individuals independently of social and economic circumstances (Bongaarts and Watkins, 1996).

Ethiopia is one of those African states that are currently undergoing a change of administrative system after the cold war, but in a unique way because Ethiopia chose the ethno-federal model of state structure. According to Abbink (1995), 'the primacy of politics above economics is still a dominant principle in Ethiopia and the ethno-political reform policy may also have retarded effects on national and regional economic development'. This might have also influenced the reproductive behaviour of the ethno-federal regions if this 'ethnic-based democracy' is erroneously perceived to mean `to govern is to populate', which in turn induces a pro-natalist view and ethnic supremacy at least in terms of voter and population size. The relationship between ethnicity and political or military power, which has been practised since ancient times, is known to be in favour of high fertility to ensure a continuous supply for military size without considering the economic and environmental consequences.

2.3.7 Kinship network

The importance of kinship network in fertility behaviour, particularly why a particular form of social organization, (e.g. the patrilineal/matrilineal lineage), has supported high fertility in Sub-Saharan Africa has been the focus of previous studies (Caldwell, 1977a, b, 1982). Having many children provides prestige and a sense of security in that one's lineage will continue in time. Many children provide domestic labour and potential financial assistance in old age and play a role by linking kin groups from whom social and economic support can be expected. Caldwell further argues that fertility will decline when the mutual kinship claims and obligations are restricted (Caldwell 1977b).

2.3.8 Gender preference

Although the degree of son preference is not intense in Africa as in Asia, it has been established that the demographic impact of son preference appears to be closely associated with family size and contraceptive use (Abeykoon, 1995). In Africa too, particularly in rural settings, couples continue childbearing until there are enough number of sons in the family because they are regarded as economic assets and old-age security (Khan and Serageldin, 1977; Ali, 1989). Consistent with this view is that of Rahman, et al. (1992) who argue that 'although findings are not entirely consistent across social settings, all interpretations of son preference as an influence on fertility implicitly assume that couples regulate their fertility in response to their gender preferences.

2.3.9 Reproductive rights

Reproductive rights were not initially a part of the first comprehensive statement of human rights, the Universal Declaration of Human Rights, adopted by the United Nations General Assembly in 1948. Human reproduction was first brought up as a subject of international legal concern at the international human rights conference held in Teheran in 1968, where the 'Final Act' included a provision stating that 'parents have a basic human right to decide freely and responsibly on the number and spacing of their children and a right to adequate education and information in this respect' (UN, 1968). However, the advent of the international women's movement on the development stage has been accompanied by a very different interpretation of reproductive rights, one linking it specifically to women's human rights.

Freedman and Isaacs (1993) identify two vital dimensions of the question of reproductive rights. First, 'free and responsible choice' has to be seen in conjunction with the right not to be alienated from their sexual or reproductive capacity and bodily integrity through coerced sex or marriage, denial of access to birth control, sterilization without informed consent, freedom from unsafe contraceptive methods, from unwanted pregnancies or coerced child bearing, from unwanted medical attention.

Secondly, reproductive rights need to be grounded in their relationships with men, in particular on gender equity and in the distribution of rights and responsibilities for women and men in deciding on the number and spacing of children. Given that women bear the main costs of child bearing, this requires entrusting to them both the ability to make decisions about reproduction and the ability to make those decisions based on access to the necessary information and services (Freedman and Isaacs, 1993). The ICPD Programme of Action reaffirmed once again the principles of 'free and responsible' decision-making about the number and spacing of children (UNFPA, 1995:9). In view of this, in Ethiopia where men have been historically and culturally dominating decision making in the household and successive governments have failed to recognise these rights, it is hypothesised that better awareness of reproductive rights will be observed only in places where there is some impact of modernization (e.g. education and urbanization) on society.

2.4 Summary of the literature review

As mentioned earlier, the purpose of the foregoing literature review was to learn from other researchers who have tackled a similar problem and to identify possible gaps. The purpose was also to learn from distinguished research undertakings in terms of the conceptual frameworks and techniques of analysis used.

The conceptual task of explaining modern fertility transitions was first put into a formal theory by Notestein (1953) as 'the demographic transition theory' with its three stages: first, the pre-transition societies with high fertility and mortality; second, transitional stage with declining mortality and, after a short delay, declining fertility, and final stage of post-transitional societies, which have low mortality and fertility. Due to lack of universality, economists came up with specific economic theories of fertility transition.

While Becker (1960, 1991) proposed the 'household economics' theory, Easterlin (1978, 1983) attempted to provide an integrated theory of economic and sociological approaches to fertility change in the "Relative income" theory. Both were developed to explain how fertility might respond to economic factors and both are based on the common assumption of a positive relationship between income and fertility and differ only in the determination of the main player: the 'price of time' in Becker's model and 'relative income' in Easterlin's model.

Subsequent researches challenged the applicability of these theories with the first challenge coming from the result of the Princeton European Fertility Project (Coale and Watkins, 1986), which found that the pace of fertility decline across regions in the European countries included in the project was only moderately correlated with the socioeconomic variables that are given utmost emphasis in the demographic transition theory and instead, the patterns and speed of fertility decline emerged to be more associated with regions that shared common languages and culture than common socioeconomic features.

Moreover, the results of the World Fertility Survey, which found that although in general, fertility was correlated with female education, urban residence, and other socioeconomic variables, the relationships were modest (Cleland *et al*, 1985, 1987). Based on these results, Cleland and Wilson (1987) questioned the empirical validity of demographic transition theory and suggested an alternative approach – the 'ideational theory', arguing that cultural values have long term consequences on human fertility than changes brought about by socioeconomic factors. They also advocate family planning programmes as more viable alternative explanations.

Another alternative explanation of the fertility transition in developing countries is that of Caldwell's 'intergenerational wealth flows theory' (Caldwell, 1982), which hypothesizes that mass education and Western culture have popularized the idea of 'child-centred' or 'nucleated' families that reduce the flow of wealth and services from child to parent. Since these changes have made children less valuable, there are fewer incentives to have large families.

The improved survival theory, which was first proposed within the "multi-phasic demographic transition" theory proposed by Davis (1963), with the argument that the decline in mortality will eventually be followed by a decline in fertility due to survival of children has picked momentum after a recent study with convincing evidence (Cleland, 2001).

The importance of assessing fertility intentions has also attracted social scientists who argue that if instruments and measures are properly devised and implemented, data on fertility preference can effectively be used to forecast as well as to determe fertility behaviour (Pullum, 1980; Lee, 1980; Bulatao, 1981, Bongaarts 1992.

To sum up, although there are many new ideas explaining variations in the timing of the onset and the pace of fertility transitions and their determinants, the various theoretical approaches are not necessarily contrasting but rather complementary to each other to produce an integrated theory of the dynamics of fertility. Therefore it is with this persuasion that this study adopts the economic, sociological, cultural and diffusion approaches on fertility transition put forward among others by Easterlin (1978), Becker (1960, 1991), Bongaarts and Watkins (1996), Cleland and Wilson (1987), Pullum (1980) as organizational frameworks.

CHAPTER THREE
SOURCE, DESIGN AND QUALITY OF DATA AND METHODOLOGY OF ANALYSIS

3.1 Introduction

Data are the foundation for every scientific research and the quality of data plays a vital role in the understanding of research problems. The main data set used in the analyses of fertility and contraceptive dynamics is the 2000 Ethiopian Demographic and Health Survey. In addition, the 1990 Family and Fertility Survey as well as the 1984 and 1994 national Censuses are utilized where necessary.

As the topic indicates, in the first part of this chapter, the history of demographic data collection in Ethiopia and the data sets to be used are briefly examined after which the design and quality of the data sets used in the analyses are examined. In the second part of the chapter, detailed description of various types of analytical methodologies are presented.

3.1.1 Overview of Ethiopia's Demographic Data

Historically, demographic data collection began in Ethiopia soon after the Central Statistical Office was established in 1960 whose first task was to conduct population and housing 'counts' of Addis Ababa and Asmara in 1961 and 1963 respectively (CSA, 1993). A national level census was not conducted until 1984 when Ethiopia carried out the 1984 Population and Housing Census, which was followed by the second census in 1994. Several sample surveys covering agriculture, livestock, land tenure and some demographic characteristics have been conducted, though not completely covering the entire country.

According to the Central Statistical Authority (CSA) of Ethiopia, the '1990 Family and Fertility Survey' (FFS) was the first national survey of its kind ever conducted in the country (CSA, 1993). It collected data on fertility, nuptiality mortality and family planning from 8757 interviewed women between May 1990 and august, 1991 with financial assistance from UNFPA.

At the time of the 1990 FFS survey, Ethiopia was divided into 30 regions (24 administrative regions and 65 autonomous regions including the capital Addis Ababa), but the survey was not conducted based on these regions. Instead the survey was conducted after transforming the regions into 'domains' (dividing the country into 8 domains - 2 urban and 6 rural domains). The main reasons provided for creating these domains were similarities of socio-economic, demographic and ecological characteristics (CSA, 1993).

However, the 'domain design' for the 1990 FFS makes comparative studies difficult on the following grounds. First, the reason that necessitated the grouping of 30 administrative regions into 8 domains - 'taking into account heterogeneity of the population, socio-economic, demographic and ecological characteristics' are not satisfactory and, in fact, are self-contradictory. For instance, looking at the rural domains, Dire Dawa – in Eastern Ethiopia is grouped with areas in the North-west (Metekel) and extreme Western Ethiopia (Assosa and Gambela) only on the basis of ecological similarity but these regions are heterogeneous in terms of socio-economic, cultural and demographic setting. Secondly, the fact that the survey was conducted in a format different from the standard DHS format (sample and questionnaire design) adopted by many developing countries, makes it difficult to construct regional differentials with the current ETDHS results and generalisations across cultural settings as well as cross-national comparisons resulting from 'different question formulations' compared to that of the standard DHS questions (Frank et al., 1987). However, since the country had never had a DHS survey, the FFS survey results could be used at national level and for some areas like Addis Ababa. The first ever Demographic and Health Survey (ETDHS) was conducted around mid-2000.

3.2 Sources of Data

The data sets utilised in this study are drawn mainly from the first Ethiopian Demographic and Health Survey (ETDHS 2000) and where necessary from the 1990 National Family and Fertility Survey (FFS 1990), Ethiopia's Censuses 1984 and 1994. The ETDHS 2000 is part of the 4th generation of the Demographic and Health Surveys that was conducted by the Central Statistical Authority (CSA) in collaboration with ORC Macro, a US based international organization specialising in technical assistance for demographic data collection and processing. The principal aim of the 2000 ETDHS was to provide up-to-date information on fertility, childhood mortality, nuptiality, awareness and use of family planning methods, use of maternal and child health services, and knowledge related to HIV/AIDS.

3.3 Sample design

The 2000 ETDHS could be considered as the first nationally representative survey as most of the previous surveys, although national in design failed to accomplish their targets due to several circumstances such as insecurity. The survey targeted women and men of reproductive age 15-49 and 15-59 respectively.

The sample was designed to provide estimates of key variables for the regions: Tigray, Affar, Amhara, Oromia, Somali, Benshangul-Gumuz, Southern Nations, Nationalities and Peoples (SNNP), Gambela, Harari, Dire Dawa and Addis Ababa. It should be noted, however, that in Affar region only 3 of 5 zones(zones 1, 3 &5) were covered, while in Somali region only 3 of the 9 zones (Jijiga, Shinile and Liben) were covered. Therefore, there may be some bias in the representativeness of the regional estimates for the two regions.

The sampling frame that was used in the ETDHS is the same frame used for census enumeration areas with population and household information from the 1994 Census. It is worth noting here that in the process of the sample design, 'proportional sample allocation' was discarded because the procedure yielded a distribution in which 80% of the sample came from only three regions, 16% from four regions and 4% from five regions (CSA and ORC Macro, 2001). In stead, the sample was allocated by region proportional to the square root of the respective region's population size.

The sample selection is based on a two-stage, stratified sample, consisting of 540 enumeration areas – 139 from urban and 401 from rural areas. The hierarchy of data, for instance, women's data in the 2000 ETDHS is as follows: 15,367 individual respondents nested within 540 enumeration areas (PSUs/clusters) nested within 11 regions nested within one domain (national).

3.4 Quality of data

Demographic data are vital components of any social science research undertaking. For this reason, the correctness and accuracy of the demographic data is crucial for the quality of the event rates and their trends over time. Demographic data on various characteristics of population such as age, marital status, duration of marriage and birth intervals are subject to a variety of errors and he reasons for such errors vary from low level of literacy to systematic shifting and unconscious digit preference. Therefore, it is important to assess the quality of data, particularly with respect to age, births and duration data reported by women of reproductive ages before carrying out estimates of various indicators such as fertility etc.

Quality may be defined as the degree of excellence in a product, service or performance. Redman (1992) argues that data quality is a desirable goal achieved through management and statistical quality control. He further claims that the concern for data quality stems out of:

- increased use of data for planning and decision support, such that the implications of using low-quality data are becoming more widespread.
- Increased reliance on secondary data sources, due to the growth of the internet, data translators and data transfer standards. Thus, poor-quality data is ever easier to obtain.

The data producer usually carries out primary data quality assessment. It is based on compliance testing strategies to identify databases that meet a pre-defined quality limit. However, this technique assumes that errors don't occur beyond the pre-defined quality (Ibid). The second and most common technique of checking quality of data is to assume that error is inevitable at any stage of data handling. So, instead of imposing a minimum quality standard, it gives the user the responsibility for assessing suitability for use. The producer's responsibility in this case is only documentation. This approach is flexible, but there is still no feedback from the user and thus the producer cannot correct mistakes.

In this section, an effort is made to assess the quality of the ETDHS 2000 data that are used for the estimation and subsequent analyses. A number of numerical quality indicators are also computed from the actual demographic data to identify possible errors in the data not detected by routine checking.

3.4.1 Routine data checking

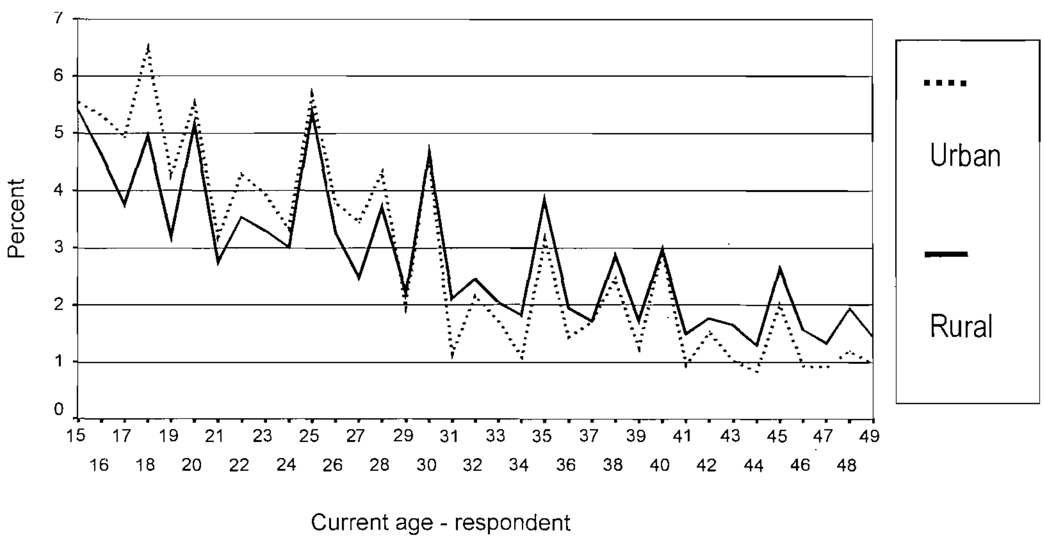
This is the primary and basic form of checking the quality of data. DHS data are usually collected on paper forms and then keyed into a database. Routine checks take place for consistency with the row and column totals of the forms. Furthermore, the age and sex distribution are visually checked for any peculiarities. Whenever inconsistencies or something unexpected is found, the problems are communicated to the field supervisors and corrections or explanations are sought. Such routine checking procedures minimise coding errors in completing the data collection forms and keying the data in to the computer.

3.4.2 Age distribution

Age is one of the most important variables in demographic analysis. Age is usually stated in completed years or in terms of actual date of birth (day, month, year). The latter is more accurate but has setbacks that it is usually used by literate people. There are several causes of errors in age data. Among these are: ignorance of correct age, carelessness of recording, tendency to over-exaggerate, preference for certain digits, sub-conscious avoidance of numbers (e.g. 13), misstatement arising from economic or political motives and age heaping in certain digits. For instance, an unmarried person (male or female) may systematically understate their age purposely to stay in the marriage market or may overstate their ages to avoid military duty (Srinivasan, 1998).

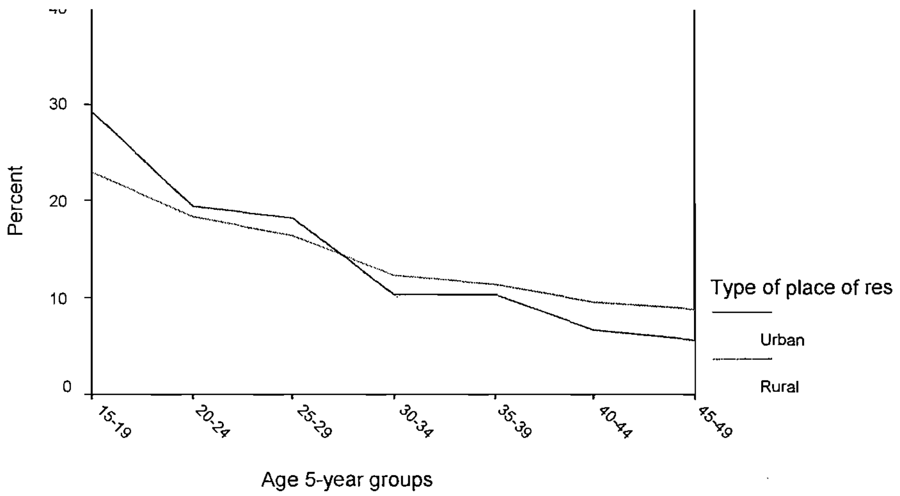
The peaks and troughs in Figure 3.1 below indicate preferences and dislikes for the particular ages. The heaping is reflected in ages ending in multiples of 5 or 2.

Fig. 3.1: Age distribution of women by place of residence



Several techniques are available for smoothing age heaping. The first and simplest technique is to group the single ages usually in five year age groups. Figure 3.2 shows how the heaping has been smoothed when the single ages were grouped into five year age groups because the percentage distribution decreases consistently as we move from age groups 15-19 to 45-49.

Fig 3.2: Distribution of respondents by five year age group and place of residence



It has been suggested that better-trained interviewers, longer interview time and focused supervision considerably lower the degree of age misreporting.

3.4.3 Completeness of age reporting

Completeness refers to the degree of errors as a result of omission in a database. It is assessed relative to the database specification, which defines the desired degree of generalisation. In summary, data quality contains components, including accuracy, consistency and completeness. Each component can be assessed according to a given context. The quality of age data in developing countries like Ethiopia is usually doubtful. Although, maximum care has been taken by both Measure DHS and the Ethiopian Statistical Authority in the collection of age data in the ETDHS 2000, it is very difficult to ensure its quality, particularly in a situation where the majority of the respondents are illiterate. As shown in Table (3.1), very few Ethiopian women could report their exact date of birth (DOB) either in terms of year or month of birth.

Table 3.1: Percent distribution of completeness of information

	Place of residence & percent reporting exact DOB		
	Urban (% of total)	Rural (% of total)	overall
Month and year	11.6	9	20.6
Month and age only	2.3	6.1	8.4
Year and age only	3.9	9	12.9
Age only	11.8	46	58.1

From Table 3.1, it is clear that only about 21% of women aged 15-49 could report the complete year and month in which they were born. More than half (58%) of the respondents could only report their age only. Of this figure, about 46% are rural residents. The proportion of women who could report their month and year of birth is lower in rural areas (9%) than in those urban areas (about 12%). The reporting of exact date of birth marginally improves if women were asked to report their age only rather than in terms of month and year in which they were born.

The accuracy of age reporting is usually doubtful in a situation where most of the respondents couldn't state their exact date of birth. It is generally expected that single year distribution, in the absence of drastic change in mortality and migration, assumes a descending pattern as age increases. The single year age distribution shown in Figure (3.1) gives an evidence for this argument. We observe age heaping on ages 25, 30, 35, 40 and 45 for both urban and rural residents.

3.4.4 Age shifting

Another problem in the quality of data in developing countries is the preference or avoidance of some digits. Myers' Index is a technique developed to assess 'preferences' or 'avoidance' of any of the digits 0 to 9. It is applicable for single years. The method derives a 'blended population', which is essentially a weighted sum of the number of persons reporting ages ending in each of the digits 0-9. The underlying assumption is that if there are no systematic irregularities in the reporting of age, the blended sum at each terminal digit should be approximately equal to 10% of the total blended population. If the sum exceeds 10%, it indicates digit preference ending in that digit and a sum less than 10% indicates digit avoidance.

Table 3.2 displays Myers' index of digit preference by place of residence. The indices were calculated over the age range 20-49 years by blending the population ending at each digit and then taking the percentage of the result out of the total blended population. According to the results shown in Table 3.2, the percent deviations from Myers' theoretical 10% show a tendency for women in 20-49 to over-state their ages ending in 0, 5 and 8 and under-state their ages ending in 1 and 4. The highest age heaping (preference) occurred at ages ending in 5 followed by 0 and 8. The most avoided ages are those ending in 1 followed by 4.

It is also apparent from Table 3.2 that the quality of age reporting is better in rural areas than in urban areas. The theoretical value of Myers' index ranges form 0 to 90, where 0 represents 'no age heaping' while 90 indicates that ages were reported in numbers 'ending in the same digit'. The lower the value of Myers' index, the higher the quality of data. In this regard, the overall Myers' indices for National, urban and rural areas, disregarding signs, are about 27, 26 and 38 respectively indicating that the single age data collected in ETDHS 2000 are subject to digit preference. However, the overall quality is fair as the indices for urban and rural areas are not far from one-third of the maximum (90).

Table 3.2: Myers' blended index of terminal digit preference by place of residence

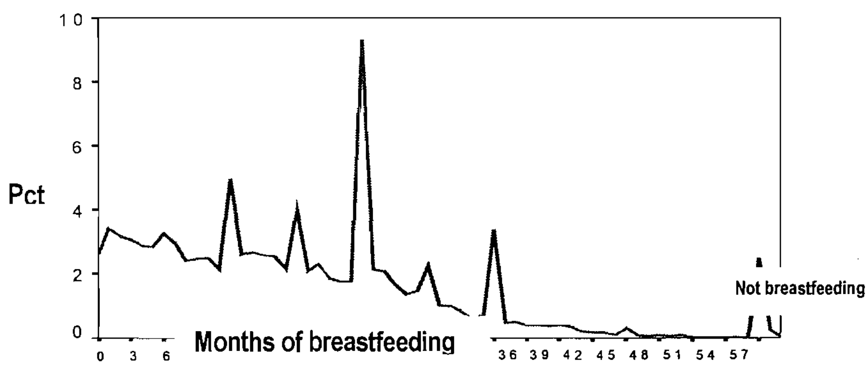
	Percent deviation from 10%		
Digit	National	Urban	Rural
0	5.38	3.61	5.52
1	-4.91	-3.13	-5.05
2	-277	-1.30	-3.14
3	-2.07	-1.80	-3.70
4	-3.47	-2.48	-4.38
5	5.71	5.79	6.24
6	-0.92	-0.62	-1.36
7	0.29	-1.88	0.67
8	3.64	3.13	6.26
9	-2.33	-2.47	-1.82
Total §	27.49	26.21	38.14

Source: Estimated from ETDHS 2000; § Total shows the sum of each columns disregarding sign

3.4.5 Checking quality of duration data

The distribution of months of breastfeeding by respondents of ETDHS 2000 is shown in Fig. 3.3. Breastfeeding in Ethiopia is fairly high with higher proportion of women breastfeeding for 24 months. The average duration of breastfeeding is about 19.4 months. From Figure 3.3, we also observe heaping in reporting of breastfeeding in multiples of 6 (12, 24 and 36 months etc). However, this heaping may not be attributed to preference for a particular length of breastfeeding if a society has strong attitude to the length of breastfeeding.

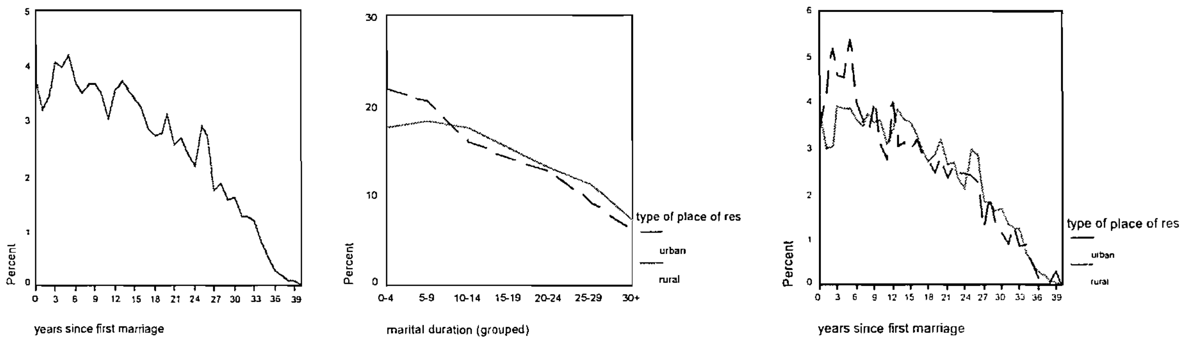
Fig 3.3: Percent distribution of months of breastfeeding (ETDHS 2000)



3.4.6 Duration of marriage data

Despite the fact that in the past two decades, successive governments have introduced stern measures to stop 'child marriage', it is still practiced in some parts of Ethiopia. Women who were married at an early age but had not cohabited with their spouses until reaching age at menarche still report the original date of marriage. This is a possible source of misreporting as there is a delay between marriage and cohabiting date.

Fig 3.4: Distribution of duration of marriage by single age, by five year age group and by residence



(a) (b) (c)

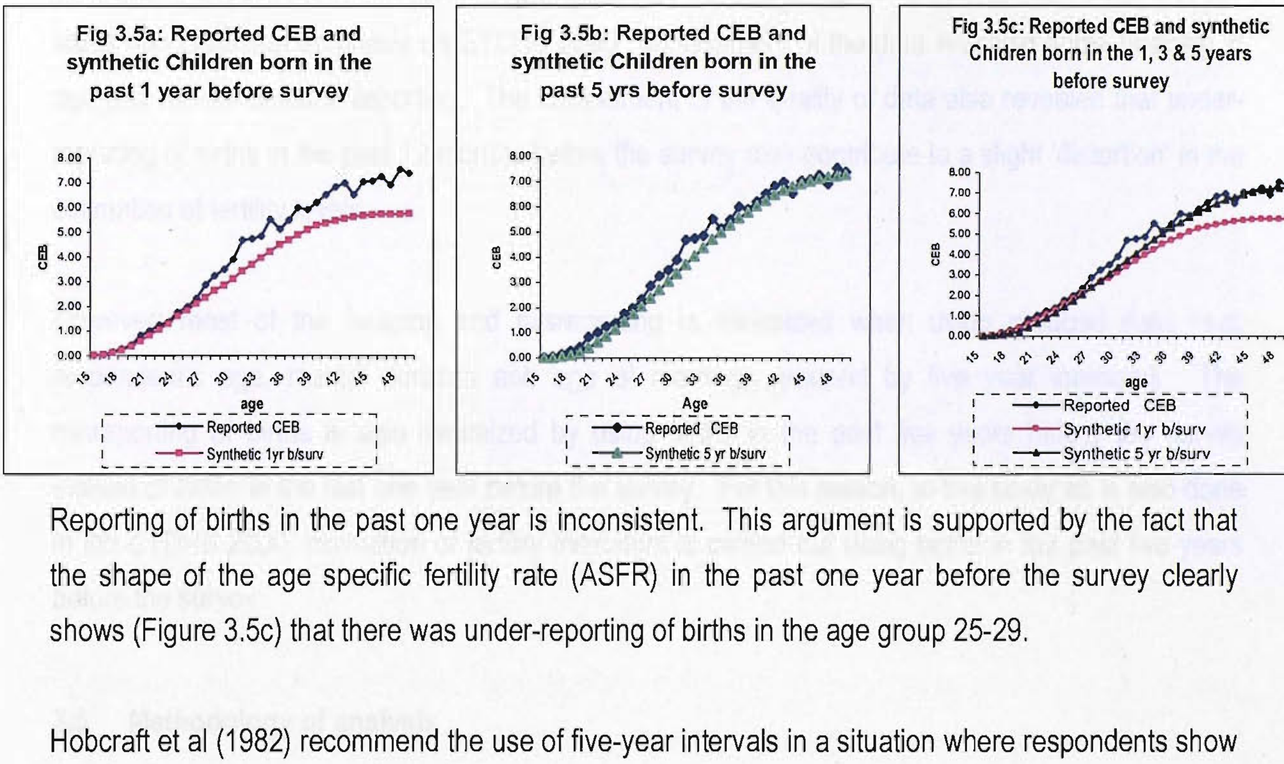
Figure 3.4 shows the distribution of duration of marriage by single years of age, by five year age group and by residence (see graphs (a) to (c)). Graphs (a) and (c) of Figure 3.4 show a similar trend - heaping in multiples of five while graph (c) reveals that the heaping is more pronounced in urban than rural respondents. This may have arisen from the fact that more women cohabit in urban areas than rural areas and they don't consider 'cohabiting' as 'marriage'.

3.4.7 Reporting of births

In the Ethiopian Demographic and Health Survey, data on lifetime and current fertility were collected based on children ever born and on children born one year before the survey respectively. These measures can be compared to assess accuracy (Brass, 1973). The two types of measures can also be used to detect and allow for errors in the data because of the logical relationship between them (Brass, 1973). As a cohort of women moves through life the mean number of children ever born at each exact age equals the cumulative total of age specific fertility rates up to that age. If these two measures don't coincide with each other, then the difference has to be explained in terms of birth reporting. The cumulative fertility based of children ever born usually is biased downwards due to memory lapse of women in the older age groups.

However, in countries like Ethiopia where the majority of the respondents are illiterate, it is expected that substantial omissions occur in the reported number of children ever born (CEB). Information on current fertility may also be erroneous for women of all ages due to misperception of the time of birth (Hobcraft and Goldman, 1982). Fig 3.5a reveals this fact that the children ever born estimated from births one year before the survey are consistently lower than the reported CEB for all ages although the differences are small at adolescent ages 15-19 and increase there after reaching maximum at age 29 and above. The graphs for the synthetic children born are constructed by first cumulating the births in the past 1, 3, or 5 years before the survey up to each exact age group and then plotting them against single years of age.

Fig 3.5a-c: Reported children ever born and synthetic children born in the past 1, 3 & 5 years before survey



Reporting of births in the past one year is inconsistent. This argument is supported by the fact that the shape of the age specific fertility rate (ASFR) in the past one year before the survey clearly shows (Figure 3.5c) that there was under-reporting of births in the age group 25-29.

Hobcraft et al (1982) recommend the use of five-year intervals in a situation where respondents show digit preferences for numbers ending in '0' and '5'. Thus, it is reasonable to use births reported in the past five years as the gap between the reported and synthetic children ever born improves when considering births in the past five years.

The difference between the reported CEB and the synthetic children born obtained from one-year before the survey could be a result of the fact that both data are deficient. Moreover, as Brass et al (1973, 1983) argue, the fertility rate based on responses to a question about births occurring in the year preceding a census or a survey could be inflated (such as two or more births in a calendar year) or under-reported due to cultural conditions. For instance, in some parts of Ethiopia a woman may not report what is known as 'Yeshitelay Lij' (an Amharic term for a child that is born after several futile efforts due to miscarriage or infant death) for fear of losing the baby. In most cases these children are dressed in the opposite sex style to conceal their true gender and this is more prominent when the child is a boy. Wording of questions in a questionnaire and inadequate instructions to interviewers are also among the factors that can cause these errors.

Generally, reporting of births is a major concern in developing country data (Brass, 1973, 1983) and Ethiopia is not an exception.

3.4.8 Summary of the design and quality of data

This section presented the sample design and quality of the demographic data that are utilised in this study with particular emphasis on ETDHS 2000. Assessment of the data revealed some heaping in age and marital duration reporting. The assessment of the quality of data also revealed that under-reporting of births in the past 12 months before the survey may contribute to a slight 'distortion' in the estimation of fertility levels.

However, most of the heaping and misreporting is minimized when using grouped data (e.g. respondent's age, marital duration and age at marriage grouped by five year intervals). The misreporting of births is also minimized by using births in the past five years before the survey instead of births in the last one year before the survey. For this reason, in this study as is also done in the ETDHS 2000, estimation of fertility indicators is carried out using births in the past five years before the survey.

3.5 Methodology of analysis

Most social science research involves the analysis of data using modern statistical theory in order to infer or draw conclusions about specific characteristics. The main purpose of describing and documenting the methodologies of data analyses is to enable the reader have a clear picture of the assumptions and conditions for inference of the statistical procedures employed and what the study is attempting to discover.

3.5.1 Design-based modelling

Design-based modelling also called as 'complex survey analysis' refers to regression modelling taking into account the sampling design of large scale surveys which are drawn using stratified multistage sampling designs (Chambers, 1986; Korn and Graubard 1995). Design-based modelling perhaps developed as a result of the need to correct sample data for the unequal selection probabilities (i.e. sample weight), the need for precision in standard errors (i.e. stratification) and the need to account for homogeneity and independence (i.e. clustering - as individuals in one cluster are more alike than another cluster) (Chambers, 1986; Pfeffermann and La Vange, 1989; Korn and Graubard, 1995).

The sample weight associated with an individual is the inverse of that individual's probability of being included in the sample, adjusted, if necessary, for non-response (Korn and Graubard 1995). The sample weights in a dataset can therefore be thought of as, approximately, the number of individuals in the population that are represented by the sampled individual. Thus the sample weights act to correct sample data for the unequal selection probabilities and failure to include these in the modelling process can lead to estimates that are seriously biased for their corresponding population parameters.

Stratification can produce gains in precision. That is, a stratified design can lead to smaller standard errors than a simple random sampling design if the observations within strata are similar. If the stratification is ignored in the analysis the standard errors will be too large, so that the confidence intervals will be too wide, giving coverage greater than the nominal coverage.

Cluster sampling is often used in national social and demographic surveys, where the clusters are groups of households derived from census enumeration areas or from well-defined communities. Individuals who belong to a particular cluster may be more alike than those of a different cluster so that the assumption of independence that is assumed in techniques such as ordinary least squares is violated. The failure to recognise the clustering of survey data may lead to standard errors that are smaller than the true standard errors, and hence confidence intervals may be too narrow.

Another advantage of survey data analysis technique is that it takes care of the sampling weights and provides relatively unbiased parameter estimators. In short, it is essential to use weights in order to get the point estimates (parameter estimates) right while taking account of clustering and stratification of the survey design enables correct estimation of the standard errors. If clustering is ignored, any analysis is likely to produce smaller standard errors than would have been expected.

Survey design-based modelling is one of the methods employed in modelling fertility in this study. The 2000 Ethiopian Demographic and Health Survey (ETDHS 2000) was designed on the basis of a national representative multi-stage sampling, stratified into clusters that identify the sample point. In The 2000 ETDHS, about 540 clusters or primary sampling units (PSUs) or locally known as 'Kebeles' (The Amharic word for 'neighbourhoods' or 'villages') were sampled. In other words, the 15367 women respondents that were interviewed in the 2000 ETDHS were drawn from 540 clusters using probability weighting proportional to population size stratified into 21 urban/rural areas of the 11 federal regions.

3.5.1.1a Design Effects

Efficient sample size calculations assume simple random samples. However, in most surveys such as the 2000 Ethiopian Demographic and Health Survey (ETDHS 2000) data are collected based on stratified multistage sampling designs. Sample designs other than simple random sampling have an impact called design effect (DEFF) on sampling variability (Henry, 1990). The design effect (DEFF) is the measure of gain or loss of precision in estimating parameters by the use of cluster sampling instead of simple random sampling (SRS).

DEFF is a factor that is introduced to account for the relative efficiency of the sample design actually used, as compared to a simple random sample (SRS). A DEFF of 2, for example, indicates that the variance taking into account the survey design is about twice that of what would have been obtained by ignoring the survey design (STATA Corp., 2001). In other words, the value of DEFF reveals how much worse one's designed sample is from that if it were a simple random sample. In general, the smaller the DEFF the more efficient the survey design is. So, If DEFF<1, this results in smaller standard errors and the design is more efficient.

Other characteristics of DEFF include the fact that DEFF is different for each survey variable and thus the sample designer must choose a key variable to design sample. Moreover, the value of DEFF cannot be known in advance of the survey.

3.5.1.1b Binary and multinomial logistic regression models

The analyses carried out in subsequent chapters of this study involve both count and discrete or ordered categorical response variables. Categorical outcome variables with binary values are modelled using the logistic regression model while response variables with more than two unordered categories may are treated using the multinornial logistic regression model. The logistic regression model is employed in chapters seven and nine - dealing with decomposition and birth interval analysis respectively, while the multinomial logistic regression model is used in chapters six and eight dealing with fertility intentions and multilevel modelling.

3.5.1.1c The logistic regression model

The logistic regression model (also known as the logit model) is used when the response variable is dichotomous (coded 0, 1) and can be written as:

$$ln\frac{P(Y_i = 1)}{1 - P(Y_i = 1)} = ln(odds) = \beta_0 + \sum_{k=1}^{k} \beta_k X_{ki} = Z_i \quad (1)$$

The above is referred to as the *log odds* and also as the *logit*. Z_i is used as a convenient shorthand for $\alpha + \Sigma\beta_k X_{ik}$. By taking the antilogs of both sides, the model can also be expressed in odds rather than log odds, i.e.

$$odds_i = \frac{P(Y_i = 1)}{1 \quad P(Y_i = 1)} = exp(\beta_0 + \sum_{k=1}^{k} \beta_k X_{ki}) = exp(Z_i) \quad (2)$$

Note that if we know the odds or the log odds, the probability can easily be obtained as:

$$P_i = \frac{odds_i}{1+odds_i} = \frac{\exp(Z_i)_i}{1+\exp(Z_i)} = \frac{1}{1+\exp(-Z_i)} \quad (3)$$

Interpretation of parameters in a logistic regression analysis is not as straight forward as in linear regression. Since the left hand side of equation (1) stands for the log odds. Hence, a 1 unit increase in X_1 will result in a β_1 increase in the log odds. However, interpreting in terms of log odds is not cornmon. So, we may do slightly better if we express the model in terms of odds:

$$odds_i = \frac{P(Y_i = 1)}{1 - P(Y_i = 1)} = e^{(\beta_0 + \sum_{k=1}^{k} \beta_k X_{ki})} = e^{\beta_0} e^{\beta_1 X_{i1}} \ldots e^{\beta_k X_{ik}} \quad (4)$$

Hence, in equation (4) if X increases by 1 unit, the odds will increase by exp(β).

3.5.1.1d Multinomial logistic regression model

As indicated above, multinomial logistic regression technique may be used when a response variable has more than two unordered categories,. Multinomial logit models are extensions of the binary response or logistic models.

Suppose a response variable has M categories. One value (typically the first or last) of the response variable is designated as the reference category. The probability of membership in other categories is compared to the probability of membership in the reference category.

For a response variable with M categories, this requires the calculation of M-1 equations, one for each category relative to the reference category, to describe the relationship between the response variable and the independent variables.

Hence, if the Mth category is the reference category, then for m = 1, 2,..., M-1,

$$ln\left[\frac{P(Y_i = m)}{P(Y_i = M)}\right] = \alpha_m + \sum_{k=1}^{g} \beta_{mk} X_{ik} = Z_{mi} \qquad (5)$$

Where Z_{mi} = the M-1 predicted log odds, one for each category relative to the reference category.

3.5.1.1e Calculation of probabilities for a multinomial model

After fitting a multinomial regression model, one could simply discuss the effects of a covariate based on the log-odds. However, effects as 'probabilities' may be more easily understood and preferable for interpretation than effects on 'log odds'. In a multinomial model, the probabilities are calculated in a technique suggested by Agresti (1996). The probabilities are calculated by transforming the estimated equations and then setting all other variables other than that of interest at their mean value. In other words, the transformation allows calculating the predicted probability of each of the scores on the dependent (Y) for any given score (scores) on the explanatory (X). For models with many explanatory variables with dummies, one can hold all other dummies constant (usually at their mean values), except the (dummy) for which the probability is calculated, and plot the partial response surfaces.

When there are more than two groups, computing probabilities is a little more complicated than it is in logistic regression. For m = 1, 2,..., M-1,

$$P(Y_i = m) = \frac{exp(Z_{mi})}{1 + \sum_{h=1}^{M-1} exp(Z_{hi})} \qquad (6)$$

Note that when M = 2, the multinomial logit and logistic regression models become the same.

For instance, to calculate the probability in the first category of an outcome with three categories (say Y_1), one has to exponentiate the equation for the selected value of X_1(dummy) for that outcome as a numerator and divide it by 'one plus the sum of the exponentiated equations for each of the other logits in the denominator'. If the dependent variable has three categories, the denominator will have two such terms - one for each logit estimated.

The probability for the reference category is calculated using:

$$P(Y_i = M) = \frac{1}{1 + \sum_{h=1}^{M-1} exp\left(Z_{hi}\right)} \qquad (7)$$

In other words, we take each of the M-1 log odds we computed and exponentiate it. The calculation is performed for the probability of each category of the dependent (Y), except for the reference category. To calculate the probability for the reference category of the dependent variable, one is used in the denominator.

3.5.1.2 Loglinear regression models using Poisson distribution

The loglinear Poisson model is used for the analysis of frequency (count) data where the underlying distribution is assumed to be Poisson (Agresti, 1996). This modelling technique is employed in this study in chapters five, seven and eight dealing with the analysis of births in the last 5 years using various approaches. The Poisson estimation procedure provides a Poisson maximum-likelihood regression of the dependent variable on a set of explanatory variables, where the dependent is a nonnegative count variable. Agresti further elaborates that Poisson regression is usually employed for modelling count or rate data (e.g. births, conceptions, disease incidence etc). The formula for calculating probabilities using the Poisson distribution is given by

$$P(x) = \frac{e^{-\mu} \mu^{x}}{x!} \tag{8}$$

Where x = 0, 1, 2, and μ is the Poisson parameter (mean number of events occurring).

3.5.1.2.1 Poisson regression models

Poisson regression is often used to analyze count data. The distribution of counts is discrete, not continuous, and is limited to non-negative values. It can be used to model the number of occurrences of an event of interest or the rate of occurrence of an event of interest, as a function of some explanatory variables. For example, the occurrence of birth or death, incidence of diseases, crime incidence, can be modelled using Poisson regression.

In many cases the rate of incidence of an event is modelled instead of the number of occurrences. For instance, suppose that we know the number of births per woman and we may be interested to find out if frequency of birth occurrence depends on certain demographic, cultural and socio-economic variables. Since more at risk cases result in more occurrences of the event, we need to adjust for the number of cases at risk. If we denote the expected value μ of variable Y with a Poisson distribution and explanatory variable X, then we can write a Poisson regression model in the following form:

$$log\mu_i = log(N) + \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k \tag{9}$$

Where: N= is the total number of subjects (e.g. by region) and the logarithm of variable N is used as an offset, that is, a regression variable with a constant coefficient of 1 for each observation. The log of the incidence rate, log (μ / N), is modelled now as a linear function of independent variables.

μ_i = expected count or frequency for the response variable when X equals X_i.

β_0 = the expected log frequency when X_i = 0 and

β_1 = the expected change in the log frequency that corresponds to a one unit increase in X_i.

In the analysis of births in the last 5 years, (equation 18) is used. That is, we examine the relationship between the dependent and each independent variable by controlling for all other factors in the model. In other words, we are holding all other factors constant when examining the association of each explanatory variable with the dependent variable (Agresti, 1996; McCullagh and Nelder, 1989).

3.5.1.2.1a Incidence rate

As indicated above, loglinear regression models can also be estimated using the Poisson distribution. In the analysis of count data, the expected frequencies must be nonnegative. To ensure that the predicted values from the linear models fit these constraints, the log link is used to transform the expected value of the response variable. In this case, the statistical package STATA uses the generalised linear model command with Poisson family and log link function to estimate the models. The Poisson regression model can be estimated using maximum-likelihood, with the following likelihood function and log-likelihood function.

$$L = \prod_{i=1}^{M} \Pr(y_i|\lambda_i) = \prod_{i=1}^{M} \frac{e^{-\mu}\mu^{y}}{y} \qquad (10)$$

$$\ln L = \Sigma(y_i \ln(\mu_i)\mu_i) \qquad (11)$$

In the Poisson regression model, the ***incidence rate*** for the j[th] observation is given by:

$$r_j = e^{\beta_0 + \beta_1 X_{1,j} + \ldots\ldots + \beta_K X_{K,j}} \qquad (12)$$

If E_j is the exposure (offset option), the ***expected count*** C_j can be obtained by using:

$$c_j = E_j\left(e^{\beta_o + \beta_1 X_{1+} \ldots\ldots + \beta_k X_k}\right) \qquad (13)$$

$$c_j = e^{\ln(E_j) + \beta_0 + \beta_1 X_{1,j} + \ldots\ldots + \beta_k X_{k,j}} \qquad (14)$$

However, we may be interested in comparing incidence rates such as finding out the relative incidence rate of childbearing among women with different characteristics. This is done using the '*incidence rate ratio (IRR)*'. The incidence rate ratio for a one-unit change in x_i with all other variables in the model held constant is given by:

$$IRR = \frac{e^{\ln(E_j) + \beta_0 + \beta_1 (X+1)_{1,j} + \ldots\ldots + \beta_k X_{k,j}}}{e^{\ln(E_j) + \beta_0 + \beta_1 X_{1,j} + \ldots\ldots + \beta_k X_{k,j}}} = e^{\beta_i} \qquad (15)$$

This means that a one-unit increase in an explanatory variable (e.g. education in single years) has a multiplicative impact on the expected value (mean) of the dependent variable (e.g. completed family size). It also means that we hold all the X's in the model constant except the i^{th} component. Therefore, the incidence rate ratio for a change in X_i is $e^{\beta_i \Delta X_i}$.

3.5.1.2.2 Negative Binomial Models

Negative binomial regression is used to estimate count models when the Poisson estimation is inappropriate due to over-dispersion. In a Poisson distribution the mean and variance are equal. When the variance is greater than the mean the distribution is said to display over-dispersion. The negative binomial regression estimation includes an additional parameter α which is an estimate of the degree of over-dispersion. When α is zero, the negative binomial has the same distribution as Poisson. The larger the value of α the greater the amount of over-dispersion in the data. The negative binomial distribution can be written in several ways and the following is among the common ones:

$$\Pr(y \mid x) = \frac{\Gamma(y+\nu)}{y!\Gamma(\nu)}\left(\frac{\nu}{\nu+\mu}\right)^{\nu}\left(\frac{\mu}{\nu+\mu}\right)^{y}$$

Where, Γ = Gamma function; μ = conditional mean; $\nu = 1/\alpha$ and α = dispersion parameter

The variance is given by: $\operatorname{var}(y \mid x) = \mu\left(1+\frac{\mu}{\alpha}\right)$

In the negative binomial distribution the variance is always larger than the mean As the dispersion parameter α increases, the variance of the negative binomial distribution also increases.

When there is over-dispersion the Poisson estimates are inefficient with standard errors biased downward yielding false large z-values. In count models, the negative binornial distribution can be considered as a Poisson distribution with unobserved heterogeneity which, can also be assumed to be a mixture of two distributions - Poisson and gamma. The negative binomial regression model incorporates observed and unobserved heterogeneity into the conditional mean (Long 1997) and is given by:

$$\mu = e^{(x\beta+\varepsilon)}$$

where $x\beta$ is the linear predictor and ε_i is a random variable for the unobserved informaton. Thus, the conditional variance of y becomes larger than its conditional mean, E(y|x)= μ , which remains unchanged. When Var(y|x) > E(y|x), over-dispersion occurs.

3.5.2 Multilevel Models

The multilevel modelling technique with its various forms (described below such as that for binary, multinomial and count response data, is employed in chapter eight of this study.

3.5.2.1 The basic concept of multilevel modelling

As the name indicates, multilevel modelling is applied to data where observations are nested within different levels of groups. Social, behavioural and even economic data often have a hierarchical structure. However, abundant literature on multilevel structure is often cited in the field of educational and demographic researches. For instance in educational data structures, students are grouped in classes, which are in turn nested in schools, schools in neighbourhoods and so on. We thus have variables describing individuals, but the individuals may be grouped into larger or higher order units. Similarly, in demographic data structure, individuals are grouped within households and households within clusters/neighbourhoods and clusters within districts etc. Yet another example of a multilevel structure is that of repeated measurements, where different measurements of the same individual taken over time form a hierarchical structure.

The main argument for the need of multilevel modelling is that failure to take account of such structures can lead to incorrect inferences in statistical analysis (Goldstein, 1995; Kreft et al, 1998; Goldstein et al, 2000; Rasbash et al, 2000). Moreover, individuals who share similar characteristics related to fertility behaviour, such as living in the same geographical area, are likely to act in a similar manner (Garner and Diamond, 1988). Thus, for example, individuals within a household tend to be more alike in terms of attitudes and behaviours than individuals from different households or individuals from different communities.

Multilevel models enable to understand by explicitly incorporating information about population structures into the model and estimating associated parameters. When considering a data structure where a response and one or more covariates are measured on individual women in a number of villages, the purpose is to model a relationship between the individual response and the explanatory variables, taking into account the possibility that this relationship may vary across the villages. The response variable could either be a continuous such as 'body mass index', count of rare events such as number of children ever born or discrete such as fertility preference or in repeated measures where measurements of one or more characteristics are repeated on the same set of individuals over time.

3.5.2.2 A level-one model

The ordinary regression equation for a level-one relationship between a response y_i and explanatory variable X_i within a single area (e.g. village) can be written as:

$$y_i = \beta_0 + \beta_1 X_i + e_i \quad (16)$$

Where

β_0 and β_1 are level-one coefficients

X_i is level-one predictor for case i

e_i is the level-one random effect or error term with a level-one variance of σ^2 and assuming assume that the random term $e_i \sim N(0, \sigma^2)$.

3.5.2.3 Two level models

3.5.2.3.1 The random intercepts model

A two-level model consists of two sub-models at level 1 and level 2. For example, if the research problem consists of data on women nested within communities, the level-1 model would represent the relationships among the women-level variables and the level-2 model would portray the influence of community-level factors. Formally, there are $i = 1,2....n$ level units nested within $j = 1,2....J$ level-2 units.

In other words, when level-one units are nested within level-two units such as women nested within villages or repeated measures within individual cases then we can describe simultaneously the relationship for several level-two units. This type of two-level model is known as the 'random-intercepts model' (Goldstein, 1995, Rasbash *et al.*, 2000) and can be written as:

$$y_{ij} = \beta_{0j} + \beta_j X_{ij} + e_{ij} \quad (17)$$

Since the intercept is varying, $\beta_{0j} = \beta_0 + u_{0j}$ (18)

where:

y_{ij} is the value of the response variable for individual i and j

X_{ij} is the value of individual level explanatory variable for the i-th woman in the j-th village.

β_{0j} is the random intercept assumed to vary across villages.

β_1 is the slope coefficient and is at this level assumed to be the same in all the villages

u_{0j} is a random variable represents the variation of the j-th village's intercept from the overall population intercept term, β_0.

Combining (27) and (28), the random intercepts model can be written as:

$$y_{ij}=\beta_{0j}+\beta_j X_{ij}+u_{0j+}e_{ij} \quad (19)$$

where:

$\beta_0+\beta_1 X_{ij}$ is the 'fixed part' of the model,

$u_{0j}+e_{ij}$ is the 'random part' of the model.

β_0 and β_1 are the fixed parameters and

and σ_e^2 are the random parameters.

We assume that: $e_{ij} \sim N(0,\sigma_e^2)$, $u_{0j} \sim N(0,\sigma_0^2)$ and $cov(e_{ij},u_{0j})=0$. In other words, both u_{0j} and e_{ij} are assumed to be normally distributed, with means equal to zero and uncorrelated so that it is sufficient to estimate their variances. The model shown in (19) is also known as the 'Variance Components model' because the variance of the response y_{ij} can be decomposed into the sum of the level 1 and level 2 variances.

The 'intra-cluster or intra-village correlation', defined as a criterion for measuring the homogeneity of units within clusters/villages compared to between clusters/villages is given as:

$$\rho=corr(y_{ij},y_{i'j})=\frac{cov(y_{ij},y_{i'j})}{\sqrt{var(y_{ij})var(y_{i'j})}}=\frac{\sigma_0^2}{\sigma_0^2+\sigma_e^2} \quad (20)$$

This measures the proportion of the total variation $(\sigma_0^2+\sigma_e^2)$ which can be attributed to between-village/cluster variation. Hence if $\sigma_0^2 = 0$, that is, if there is no variation between the second level villages/clusters, responses within a village are uncorrelated and $y_{ij} = \beta_{0j} + \beta_1 X_{ij} + e_{ij}$ reduces to a single-level model.

3.5.2.3.2 The random slopes model

The random slopes model also known as the 'random coefficients model', allows the slope parameter to vary across clusters/villages, which means that the magnitude of effect of a covariate is different in each cluster. This model can be written as:

$$y_{ij} = \beta_{oj} + \beta_{1j} X_{ij} + e_{ij} \quad (21)$$

where

$$\beta_{0j} = \beta_0 + u_{0j} \quad (22)$$

$$\beta_{1j} = \beta_1 + u_{1j} \quad (23)$$

And assuming that $e_{ij} \sim , N(0, \sigma_e^2)$, $u_{0j} \sim N(0, \sigma_0^2)$, $u_{1j} \sim N(0, \sigma_1^2)$, $cov(u_{0j}, u_{1j}) = \sigma_{01}$, $cov(e_{ij}, u_{0j}) = cov(e_{ij}, u_{1j}) = 0$

Substituting Equations (22) and (23) in (21), the single-equation becomes:

$$y_{ij} = (\beta_0 + \beta_1 X_{ij}) + (u_{0j} + u_{1j} X_{ij} + e_{ij}) \quad (24)$$

where the first and second brackets display the 'fixed' and 'random' parts of the model respectively.

3.5.2.4 A three-level model

A three-level model can be easily understood from cross-sectional data, which normally selects a sample using geographical strata. Individuals nested within households within geographical areas such as sampling clusters. The two-level model above can be extended to a three-level model. In this model intercepts vary across both level 2 units and level 3 units. Below is a three-level model consisting of one level 1 covariate only,

$$y_{ijk} = \beta_{0jk} + \beta_1 X_{ij} + e_{ijk} \quad (25)$$

where

$$\beta_{0jk} = \beta_0 + u_{0jk} + v_{0k}. \quad (26)$$

The single-equation is

$$y_{ijk} = \beta_0 + \beta_1 X_{ijk} + u_{0jk} + v_{0k} + e_{ijk} \qquad (27)$$

In this model we can also add level 2 and level 3 covariates. For example, in a case of hierarchical student data, student background characteristics, classroom characteristics, and school characteristics can be added into the model. For a three-level model, we can calculate the intra-class correlation for level 3 units as well as for the level 2 units. For the three-level random intercepts model above, the total variation is:

$$\sigma_e^2 + \sigma_{\upsilon 0}^2 + \sigma_{v0}^2 \qquad (28)$$

Where: σ_e^2 is the variance between individuals;

$\sigma_{\upsilon 0}^2$ is the variance between level-2 groups (for example between clusters in this study)

σ_{v0}^2 is the variance between level-3 groups (for example between zones in this study)

Therefore, the proportion of the total variance due to variation among level 2 units is

$$\frac{\sigma_{\upsilon 0}^2 + \sigma_{v0}^2}{\sigma_e^2 + \sigma_{\upsilon 0}^2 + \sigma_{v0}^2} \qquad (29)$$

and the proportion due to level three units is

$$\frac{\sigma_{v0}^2}{\sigma_e^2 + \sigma_{\upsilon 0}^2 + \sigma_{v0}^2} \qquad (30)$$

For a random intercepts model fitted to discrete data, the expressions in (29) and (30) represent the variance partition coefficients (VPC) as the residual variance is partitioned into components corresponding to each level in the hierarchy (Rasbash *et al*, 2000). Note that for a random coefficients model the VPC and Intra-class correlation coefficients are not equivalent.

3.5.2.5 Multilevel models for categorical data

Survey data usually consist of continuous and discrete response variables and frequently have a hierarchical structure and quite often, these response variables are categorical in nature (Agresti, 1996). In the previous section, we saw the multilevel models for continuous response variables. As mentioned earlier, the response could either be a discrete variable such as fertility preference. In this section, multilevel models for binary and multinomial response variables are considered.

3.5.2.5.1 Multilevel models for binary response Data

A binary response variable takes values of zero and on. Whether a woman has had a pregnancy termination or not, whether she use contraceptive or not and so on. The multilevel model for a binary response can be written

$$y_{ij} = log\left(\frac{\pi_{ij}}{1 \quad \pi_{ij}}\right) = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij} \qquad (31)$$

where y_{ij} is a binary response for individual *i* in cluster *j*. The 'success' probability for individual *i* in cluster *j* is π_{ij} = Pr(y_{ij} = 1), or it can be expressed as:

$$\pi_{ij} = \frac{e^{\beta_{0j}+\beta_{1j}X_{ij}}}{1+e^{\beta_{0j}+\beta_{1j}X_{ij}}} \qquad (32)$$

The extension to higher level models is straightforward.

3.5.2.5.2 Multinomial multilevel models

In this section we extend the model for a single proportion as outcome to the case of a set of proportions. The response is now multivariate, which has more than two possible outcomes, and we generalize the ordinary logit model to define a multivariate logit model. For example, we may be interested in respondent's fertility intention such as wanting no more, being undecided or wanting more children. In this section, we will consider only models for nominal response categories. Suppose we have a response variable, Y, with M categories and let p_1, p_2, ..., p_M, be the corresponding probabilities. Then for n trial the probabilities that we observe y_1, y_2, ..., y_M, where y_i is the number of the *i*-th outcome is:

$$p(y_1,y_2,...,y_M) = \frac{n!}{y_1!y_2!...y_M!}p_1^{y_1}p_2^{y_2}...p_M^{y_T} \qquad (33)$$

where P_1+ P_2+ ...+ P_M = 1 and y_1 + y_2 + ... + y_n = n.

Suppose we have one explanatory covariate. If we choose M to be the reference category, then the M-1 logits will be of the form:

$$log\left(\frac{\pi_{sij}}{\pi_{Mij}}\right) = \beta_{s0} + \beta_{s1}X_{ij} + u_{sij} , \qquad (34)$$

where s = 1, 2, ... , M-1 in 'M' response categories.

The probabilities of the outcome corresponding to each explanatory variable controlling for all other variables in the model and assuming a multivariate logit-link function (Yang, *et al*, 2001) can be estimated as:

$$\pi_{sij} = \frac{e^{\beta_{so}+\beta_{s1}X_{sij}}}{1+\sum_{s=1}^{M-1} e^{\beta_{so}+\beta_{s1}X_{sij}}} \quad \text{for s = 1,2, ..., M-1} \qquad (35)$$

If M is the reference category, the denominator will be the same for all M probabilities but the numerator will be 1 since the parameter estimates for the baseline are restricted to zero. The probability of reference category will be

$$\pi_{Tij} = \frac{1}{1+\sum_{s=1}^{M-1} e^{\beta_{so}+\beta_{s1}X_{sij}}} \qquad (36)$$

3.5.2.6 Multilevel Models for count data

The main rationale for using specialised methods to handle count data is that the standard linear regression model ignores the restricted support - non-negativity and the integer-valued character of the dependent count variable. Assuming a Poisson distribution and conditional independence, the multilevel Poisson regression model can be written as:

$$\log(\pi_{sij}) = \log(M_j) + \beta_{s0} + \beta_{s1}X_{ij} + u_j \qquad (37)$$

Where: s = 1, 2....t is the number of categories of the response variable.

π_{sij} = expected count or frequency for the response variable when X equals X_{ij}.

$log(M_j)$ = is the fixed part used as an offset.

β_0 = the expected log frequency when X_{ij} = 0

β_1 = the expected change in the log frequency that corresponds to a one unit increase in X_{ij}.

From equation (37), the expected count π_{sij} can also be written as:

$$\pi_{sij} = M_j e^{\beta_{s0} + \beta_{s1} X_{ij} + u_j} \qquad (38)$$

Or

$$\pi_{sij} = e^{\ln(M_j) + \beta_{s0} + \beta_{s1} X_{ij} + u_j} \qquad (39)$$

However, we may be interested in comparing incidence rates such as finding out the relative incidence rate of childbearing among women with different characteristics. This is done using the '*incidence rate ratio (IRR)*'. The incidence rate ratio for a one-unit change in X_{ij} with all other variables in the model held constant is given by:

$$IRR = \frac{e^{ln(M_j) + \beta_{s0} + \beta_{s1}(X+1)_{ij} + u_j}}{ln(M_j) + \beta_{s0} + \beta_{s1} X_{ij} + u_j} \qquad (40)$$

Equation (40) implies that a one-unit increase in an explanatory variable has a multiplicative impact on the expected value of the dependent variable.

The multilevel negative binomial model is an extension of the Poisson model when an Over-dispersion occurs. Therefore, the above equations for the multilevel Poisson model also hold for multilevel negative binomial, but with a different variance specification as follows. Whereas the Poisson specification states that the mean and variance are equal as:

$$E(Y_{ij}) = \text{var}(Y_{ij}) = \mu_{ij} = X_i \beta$$

In the Negative binomial case, the mean and variance are defined as:

$E(Y_{ij}) = X_i \beta$ and $Var(Y_{ij}) = \lambda_{ij} + \alpha \lambda_{ij}^2$

Where λ_{ij} is the random Poisson parameter and α is the over-dispersion parameter that distinguishes Poisson and Negative binomial models.

3.5.3 Decomposition method

The decomposition technique used here is a modified form of the one that was first introduced by Ronald Oaxaca (1973) in the field of labour economics to determine the portion of the difference in wages between two groups that is due to differences in human capital (factors that we can explain) and the portion of the difference in wages that could be attributed to discrimination (unexplained factors).

The decomposition methodology has been extensively applied in explaining differences (Oaxaca; Blinder, 1973) and extended to the probit, logistic and Poisson models by Gomulka and Stern (1990), Nielsen (1997) and Yun (2000). However, a recent paper by Yun (2003) provides a refined approach to the decomposition technique for both linear and non-linear regression models.

3.5.3.1 Decomposition for continuous response models

Basically, the original Oaxaca Decomposition was used to decompose a continuous response variable into:

(a) a part that is explained by the populations' differences in characteristics (observed Xs) and
(b) a part that is due to the same characteristic having a different effect depending on which population the respondent belongs to.

To do the decomposition, let Y_i be a continuous outcome of interest and let X_i represent the explanatory variables. Suppose that there are two sub-populations of interest: A and B and suppose that the following regressions are run - the first run using observations on respondents who belong to group A and the second one run using observations on respondents who belong to group B.

$Y_i = \beta_0^A + \beta_1^A X_{1i} + ... + \beta_k^A X_{ki}$, where i belongs to group A (41)

$Y_i = \beta_0^B + \beta_1^B X_{1i} + ... + \beta_k^B X_{ki}$, where i belongs to group B

By definition, the mean of the outcome for each group is equal to the sum of the mean of each observed variable times the estimated coefficient on that variable:

$\bar{Y}_i = \beta_0^A + \beta_1^A \bar{X}_{1i} + ... + \beta_k^A \bar{X}_{ki}$, (42)

where the $\bar{x}_i$ are average characteristics of respondents such as age, education, marital status etc.

$$\bar{Y}_i = \beta_0^B + \beta_1^B \bar{X}_{1i} + ... + \beta_k^B \bar{X}_{ki} \quad (43)$$

where $\bar{Y}_i = \left(\frac{1}{N^A}\right)\sum_{1\varepsilon A}^{N^A} Y_i$, $\bar{Y}_i = \left(\frac{1}{N^B}\right)\sum_{1\varepsilon B}^{N^B} Y_i$ and N^A, N^B are the numbers of individuals in group A and group B respectively.

So, the difference between the average outcome for the two groups can be written as follows:

$$\bar{Y}_i^A - \bar{Y}_i^B = \left(\hat{\beta}_0^A + \hat{\beta}_1^A \bar{X}_{1i}^A + ... + \hat{\beta}_k^A \bar{X}_{ki}^A\right) - \left(\hat{\beta}_0^B + \hat{\beta}_1^B \bar{X}_{1i}^B + ... + \hat{\beta}_k^B \bar{X}_{Ki}^B\right) \quad (44)$$

Add and subtract $\hat{\beta}_0^A + \hat{\beta}_1^A \bar{X}_{1i}^B + ... + \hat{\beta}_k^A \bar{X}_{ki}^B$ from the right-hand-side of the above equation, and then rearrange terms:

$$\bar{Y}_i^A - \bar{Y}_i^B = \left(\hat{\beta}_0^A + \hat{\beta}_1^A \bar{X}_{1i}^A + .. + \hat{\beta}_k^A \bar{X}_{ki}^A\right) - \left(\hat{\beta}_0^B + \hat{\beta}_1^B \bar{X}_{1i}^B + .. + \hat{\beta}_k^B \bar{X}_{Ki}^B\right) + \left(\hat{\beta}_0^A + \hat{\beta}_1^A \bar{X}_{1i}^B + .. + \hat{\beta}_k^A \bar{X}_{Ki}^B\right) - \left(\hat{\beta}_0^A + \hat{\beta}_1^A \bar{X}_{1i}^B + .. + \hat{\beta}_k^A \bar{X}_{Ki}^B\right) \quad (45)$$

$$\bar{Y}_i^A - \bar{Y}_i^B = \left(\hat{\beta}_0^A - \hat{\beta}_0^B\right) + \left[\hat{\beta}_1^A * \left(\bar{X}_{1i}^A - \bar{X}_{1i}^B\right) + ... + \hat{\beta}_k^A * \left(\bar{X}_{ki}^A - \bar{X}_{ki}^B\right)\right] + \left[\left(\hat{\beta}_1^A - \hat{\beta}_1^B\right) * \bar{X}_{1i}^B + ... + \left(\hat{\beta}_k^A - \hat{\beta}_k^B\right) * \bar{X}_{ki}^B\right] \quad (46)$$

$$\bar{Y}_i^A - \bar{Y}_i^B = \left[\hat{\beta}_1^A * \left(\bar{X}_{1i}^A - \bar{X}_{1i}^B\right) + ... + \hat{\beta}_k^A * \left(\bar{X}_{ki}^A - \bar{X}_{ki}^B\right)\right] + \left[\left(\hat{\beta}_0^A - \hat{\beta}_0^B\right) + \left(\hat{\beta}_1^A - \hat{\beta}_1^B\right) * \bar{X}_{1i}^B + ... + \left(\hat{\beta}_k^A - \hat{\beta}_k^B\right) * \bar{X}_{ki}^B\right] \quad (47)$$

The first term in (47) is part (1) described above, that is, the portion of the difference between the average outcomes that is due to the difference in the Xs between the two groups. The second term in Equation (47) is part (2) described above, that is, the portion due to the difference in the estimated coefficients or the difference in the estimated effects of the Xs) between the two groups. Equation (47) is the key equation in the Oaxaca decomposition.

Note that we could do the decomposition equally well by adding and subtracting $\hat{\beta}_0^B + \hat{\beta}_1^B \bar{X}_{1i}^A + ... + \hat{\beta}_k^B \bar{X}_{ki}^A$ from the right-hand-side of the equation and rearranging terms. If we do the decomposition the first way, we are asking 'What if group A had the characteristics of group B?' If we do the decomposition the second way, we are asking 'What if group B had the characteristics of group A?'

3.5.3.2 Decomposition for discrete outcome models

The application of the decomposition approach has also been extended to extensively to probit, logistic and Poisson models (Gomulka and Stern, 1990; Nielsen, 1998; (Yun, 2000). However, a recent paper by Yun (2003) provides a refined approach to the decomposition technique for both linear and non-linear regression models. According to Yun (2003), the mean difference of a dependent variable (Y) between groups A and B can be decomposed as:

$$\overline{Y}_A - \overline{Y}_B = \underbrace{[\overline{F(X_A\beta_A)} - \overline{F(X_B\beta_A)}]}_{\text{Part 1}} + \underbrace{[\overline{F(X_B\beta_A)} - \overline{F(X_B\beta_B)}]}_{\text{Part 2}} \quad (48)$$

where:

$F(X)$ is the function that maps X into Y; X_A, X_B, β_A and β_B are the independent variables and their coefficients respectively. The function $F(X)$ used in this section takes the form of average predicted probability for the logistic regression function or relative rates ratio of occurrence of the outcome event in the case of the Poisson regression function.

Equation (48) shows the decomposition at the aggregate level and is widely accepted as a way to decompose the mean differences in terms of differences in characteristics (part 1 of Eq. 48):

$$\overline{F(X_A\beta_A)} - \overline{F(X_B\beta_A)}$$

and in terms of differences in coefficients (part 2 of Eq. 48)

$$\overline{F(X_B\beta_A)} - \overline{F(X_B\beta_B)}$$

The next phase in the decomposition is to calculate the contribution of each explanatory variable to the total variation (difference). While this is quite straight forward in the case of a linear regression model, there are a few but different approaches suggesting on how to calculate the detailed decomposition for non-linear models such as the logit, probit and Poisson. Among the alternative approaches include that of Even and Macpherson (1990), Gomulka and Stern (1990), Nielsen (1998) and Yun (2000, 2003). However, the latter's approach, which is suitable for this section, is discussed briefly below. As Yun (2003) argues, the important question is how to appropriately weight the contribution of each variable to the aggregate difference due to the characteristics and coefficients. The author uses two types of approximation - evaluating the value of the function using mean characteristics and using a first order Taylor expansion to arrive at the following.

$$\overline{Y}_A - \overline{Y}_B = \sum_{i=1}^{i=k} W^i_{\Delta X} [\overline{F(X_A\beta_A)} - \overline{F(X_B\beta_A)}] + \sum_{i=1}^{i=k} W^i_{\Delta\beta} [\overline{F(X_B\beta_A)} - \overline{F(X_B\beta_B)}] \quad (49)$$

where:

$$W^i_{\Delta X} = \frac{(\overline{X}^i_A - \overline{X}^i_B)\beta^i_A}{(\overline{X}_A - \overline{X}_B)\beta_A} \quad (50)$$

is the weight for the detailed decomposition for the characteristics effect and *i* represents each explanatory variable used in group 'A' and group 'B' models .

and

$$W^i_{\Delta\beta} = \frac{\overline{X}^i_B(\beta^i_A - \beta^i_B)}{\overline{X}_B(\beta_A - \beta_B)} \quad (51)$$

is the weight for the detailed decomposition to identify the difference due to the coefficients effect. In sum, an appropriate weight can be calculated by using a 'sequential replacement methodology' and the mean values of the characteristics (**X**s) and their coefficients (**β**s).

3.5.4 Survival models

Birth history or survival models are used in the analysis of birth intervals in chapter nine of this study. According to Allison (1995), an event is a transition from one discrete state to another that can be situated in time. For instance, marriage is a transition from the state of being unmarried to the state of being married; contraceptive use is a transition from the state of being a non-user to the state of being a user of contraceptive; a birth interval is the transition from either from one birth to the other or from one conception to another conception. The occurrence of an event is recognised only if there is an earlier time interval that represents its non-occurrence (Yamaguchi, 1991). In some cases individuals may or may not experience whether and when an event occurs and in other cases individuals may not experience the event of interest at all. Such observations are known as censored. To determine survival time or failure time precisely, there are three requirements: a time origin, a scale for measuring the passage of time and the occurrence of an event (Cox and Oakes, 1984).

Survival analysis is also known as event history analysis, duration analysis, or hazard modelling. Survival analysis models hazards as a function of time, that is, conditional probability of moving out of a state at time (t) given that exit has not already occurred. Two types of covariates can be considered in survival analysis, namely: (a) time-constant and (b) time-dependent or time-varying covariates. The former is usually attributed to status such as sex, ethnicity and religion while the later focuses on change in value over time such as the number of living children, marital status and birth intervals. This section discusses the techniques that will be used in the analysis of birth intervals with particular focus on discrete time models.

3.5.4.1 Discrete time survivor and hazard functions

Let T be a discrete random variable that takes the values $t_1 < t_2 < \ldots$ with probabilities

$$f(t_j) = f_j = P(T = t_j) \tag{52}$$

We define the survivor function at time t_j as the probability that the survival time T is at least t_j

$$S(t_j) = S_j = P(T \geq t_j) = \sum_{k=j}^{\infty} f_j \tag{53}$$

Or assuming $F(t)$ is the cumulative distribution function of t, the survivor function is defined as:

$$S(t) = P(T \geq t) = 1 - F(t) \tag{54}$$

That is, $S(t)=P(T \geq t)$ specifies the probability that the random variable T exceeds the specified time t. The survivor function is a non-increasing function with a value 1 at t=0 and a value 0 as t approaches infinity.

The hazard function at time t_j as the conditional probability of 'failure' at that time given that one has not failed up to that point becomes

$$\lambda(t_j) = \lambda_j = P(T = t_j \mid T \geq t_j) = \frac{f_j}{S_j} \tag{55}$$

In other words, the hazard is the rate of failure per unit time for subjects who have not yet failed. It represents the instantaneous death rate for an individual surviving to time t, and is defined as:

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta \mid T_i \geq t)}{\Delta t} = \lim_{\Delta \to 0} \frac{F(t + \Delta t) - F(t)}{\Delta S(t)} = \frac{f(t)}{s(t)} \tag{56}$$

where the term Δt represents a very small unit increment of time, $F(t)$ is the cumulative distribution function and $S(t)$ is the survival function. The hazard rate can be interpreted as the instantaneous probability of leaving entering into marriage in the interval [t, t+Δt] for tiny Δt conditional on survival up to time t. It should be stressed, however, that the continuous-time hazard rate is not a probability since it does not follow all the properties of probabilities; in particular, it may be greater than one. The only restriction implied by its specification is that it should be non-negative.

Again in discrete time, the survival function at time t_j can be written in terms of the hazard at prior times $t_1, \ldots, t_{j-1}$ as:

$$S_j = (1-\lambda_1)(1-\lambda_2)......(1-\lambda_{j-1}) \tag{57}$$

Equation (57) can be interpreted as that in order to survive to time t_j one must first survive t_1, then one must survive t_2 given that one survived t_1, and so on, finally surviving t_{j-1} given survival up to that point.

An example of a survival process that takes place in discrete time is time to conception measured in monthly cycles. In this case the possible values of T are the positive integers, f_j is the probability of conceiving in the j^{th} cycle, S_j is the probability of conceiving in the j^{th} cycle or later, and λ_j is the conditional probability of conceiving in the j^{th} cycle given that conception had not occurred earlier. The result relating the survival function to the hazard states that in order to get to the j^{th} cycle without conceiving, one has to fail in the first cycle, then fail in the second given that one didn't succeed in the first, and so on, finally failing in the $(j-1)^{st}$ cycle given that one hadn't succeeded yet.

3.5.4.1.2 Link between hazard, cumulative hazard and survivor functions

The cumulative hazard describes the accumulated risk up to time t or it is the cumulative sum of the hazard probability function and can be expressed as,

$$H(t) = -log\ s(t)$$

If we know any one of the functions - hazard $h(t)$, cumulative hazard $H(t)$, or survival $S(t)$, we can derive the other two functions.

$$h(t) = \frac{-d(log(S(t))}{dt} \tag{58}$$

$$H(t) = -\log(S(t)) \tag{59}$$

$$S(t) = exp(-H(t)) \tag{60}$$

In order to summarize the data and get an idea on the shape of distributions of 'time to event' as a whole or for the separate groups, the analysis begins with non-parametric estimation of the survivor and hazard functions based on Kaplan–Meier product-limit estimators.

Let $t1 < t_2 < \ldots < t_j < \ldots < t_k < \infty$ represent the survival times that are observed in the data set. Let d_j be the number of completed spells at t_j, let m_j be the number of observations censored in the interval $[t_j, t_{j+1})$, and let n_j be the number of observations ending their spell immediately prior to t_j , which is made up of those who have a censored or completed spell of length t_j or longer:

$$n_j = \sum_{i=j}^{k} (m_i + d_i) \qquad (60a)$$

Then the Kaplan–Meier estimate of the survivor function is given by the product of one minus the number of exits (d_j) divided by the number of persons (observations) at risk of exit just before t_j (n_j):

$$\hat{S}(t_j) = \prod_{j|t_j \geq t} (1 - \frac{d_j}{n_j}) \qquad (60b)$$

However, the Kaplan–Meier estimated hazard assumes that there is no heterogeneity which can depend on observable or unobservable factors, i.e. that the sample is homogeneous. Therefore, after a univariate analysis, it is worth proceeding to a multivariate parametric (or semi-parametric) analysis for the estimation of the effect of factors affecting the probability of exit from unmarried status.

3.5.4.2 The discrete time logistic model

The main reason for choosing the discrete time logistic model is due to the fact that duration time such as 'time to marriage', 'birth interval' etc. are discrete and the logit link has the advantage of interpretation in terms of conditional odds. The focus of parametric models is mainly the time function and the parameter estimates reflect effects on the timing of the event (Jenkins, 1995, 1997). If our time alignment is divided into a number of adjoining non-overlapping intervals $(a_j{-}1, a_j]$ for $j = 1, \ldots, k$, and each interval is of equal unit-length (e.g. months), *the discrete-time hazard function P(t)* for individual i of exit in the interval $(a_j{-}1, a_j] = (a_j{-}1, a_j]$, for the positive integers $a_j = 1, 2, \ldots$ can be written as:

$$P(t) = \frac{1}{1 + exp(-Z(t))} \quad (61)$$

Where

$$Z(t) = C(t) + X\beta = log\left[\frac{P(t)}{1 - p(t)}\right] \quad (62)$$

where C*(t)* is the baseline hazard in month *t* and $X\beta$ are vectors,

And the predicted logit hazard (probability) for each person *i* and month *t* can be estimated using,

$$P_i(t) = \frac{1}{1 + exp(-\hat{C}(t) - \hat{\beta}X_i)} \quad (63)$$

where $\hat{C}(t)$ and $\hat{\beta}$ are estimates of C*(t)* and *β*.

and $\hat{C}(t)$ is defined as $\hat{C}(t) = (q - 1)\ln(t)$ (64)

Transformation of data into person-month format also creates the covariate combination and survival times and the value of *P* can be estimated using the *predict* command after running the logistic model. This will in turn be used to create predicted logistic hazard and survivorship functions and their summary graphs as illustrated below.

When the coefficients are transformed into odds ratios, they can be interpreted as 'time ratios', where a time ratio greater/less than one indicates a longer/shorter duration (survival time) respectively for a particular category of a given covariate compared to a reference group.

CHAPTER FOUR
FERTILITY LEVELS AND TRENDS

4.1 Introduction

A trend is manifested when some phenomenon is observed to follow a specified direction with increasing or decreasing tendency. Trends can be built on events such as births, survival rates and habitation patterns, which change slowly over time. Levels and trends can be used to predict future patterns of these events at micro or macro levels. In this chapter, the fertility levels and trends in Ethiopia are examined in order to evaluate the fertility patterns and in light of their implications for fertility transition. The first task is to examine the fertility levels, trends and differentials at national level with emphasis on Addis Ababa and the 'Rest' of Ethiopia. The second task of this chapter is to evaluate the patterns of fertility between the two regions of interest for this study using various time series graphical techniques.

4.2 Has the fertility transition begun in Ethiopia? If so when?

This is the main research question to be answered in this section. Until the late 1980s, Sub-Saharan Africa was the only region where the fertility transition had not yet begun (Lesthaeghe, 1989). However, in the 1990s strong evidence emerged showing that the fertility decline had begun in some Sub-Saharan African countries (Cohen, 1998). Kenya and Zimbabwe are among the countries where fertility transition was convincingly detected in the early 1990s. The extent to which fertility has declined in Ethiopia has been a question being debated for sometime. As mentioned in the introductory chapter, it was not known in which direction fertility rates were moving until the 1984 census. Since then the 1990 Family and Fertility Survey, the 1994 census and recently the 2000 ETDHS have been conducted and revealed important demographic indicators. However, the fertility transition status in Ethiopia was not known until the 2000 Demographic and Health Survey revealed some interesting evidence. In the remaining part of this section, fertility levels and trends are examined in an effort to answer the above question.

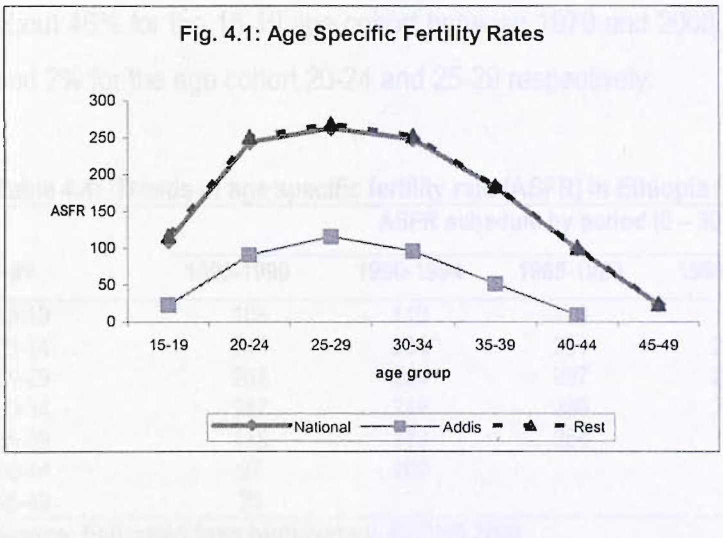
4.2.1 Fertility levels and trends

Table 4.2 and Figure (4.1) show the differentials in the fertility of major areas of interest for this study – National level, Addis Ababa and the 'Rest' of Ethiopia. Assuming the fertility schedule remained similar in the recent past (at least five yrs before the survey) and as was shown in a previous section on quality of data the reporting of births in the last five years is fairly accurate, the total fertility rate for national level, Addis Ababa and the 'Rest' are 5.86, 1.94 and 5.96 births per woman respectively at the time of the 2000 ETDHS.

Table 4.2: Age specific fertility schedules and total fertility rates (ETDHS 2000)

Region	Age Specific Fertility Rates (ASFR)							TFR
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
National	110	244	264	248	183	100	24	5.86
Addis	23	91	116	96	52	9		1.94
'Rest'	114	247	267	253	185	101	24	5.96

Figure (4.1) shows that the age specific fertility schedules for national and the 'Rest' resemble the theoretical shape of a typical age specific fertility rate, with the highest births being recorded by the 24-34 ages and lowest at the younger and older age groups. The fertility schedules of women in the 'Rest' of Ethiopia almost overlap with that of the national level but with slightly higher rates. On the other hand, the age specific fertility schedules of Addis Ababa lies far below the other two schedules with the conventional high fertility age group (25-29) observed at about 1 child per woman, which is a unique rate in Sub-Saharan Africa standard (see more discussion on this in the section on fertility transition in Addis Ababa).



4.2.2 Fertility trends and transition time

As depicted in Tables 4.3 and 4.4, as well as Figures 4.2, 4.3 and 4.4, fertility has shown some considerable downward trend between the 1984 census and the 2000 DHS. The estimates in Table 4.3 suggest that fertility fell by about 10 percentage points at national level between 1984 and 1994 census and then further declined by about 12 percentage points from 1994 census to 2000 DHS. Therefore a woman who was expected to have about eight children in 1984 is now expected to have about six children. Similarly, total fertility rate fell by about 13% in the 'Rest' of Ethiopia between 1984 and 1994 and in the same period and 15% between 1994 and 2000.

Table 4.3: Recent Total Fertility Rate estimates for Ethiopia

		TFR		
	Time and type of data source	National	Addis Ababa	'Rest' of Ethiopia
1	1984 Housing and Population Census	7.51*	3.53	8.1*
2	1994 Housing and Population Census	6.74	2.14	7.02
3	2000 Demographic and Health Survey	5.86	1.94	5.96

Source: estimated from 1984 & 1994 Censuses as well as 2000 DHS; * re-estimated without data on Eritrea

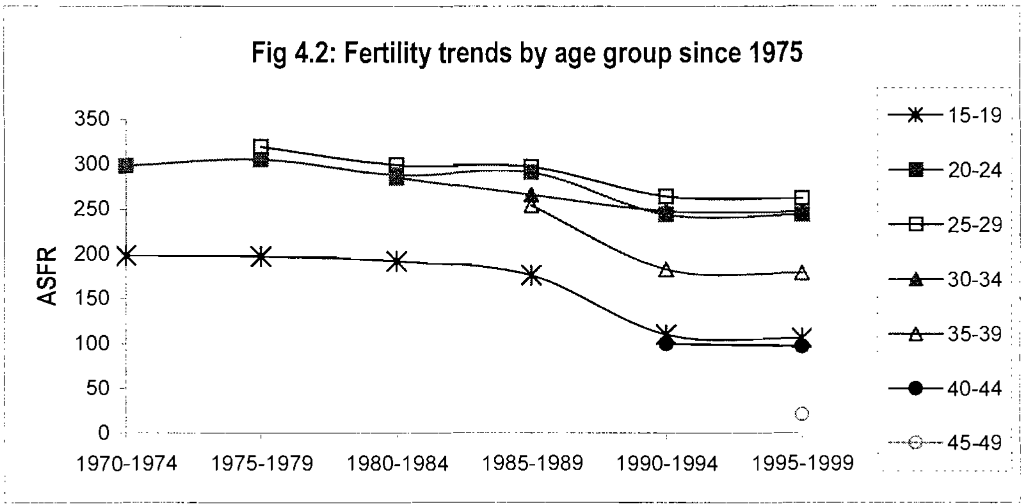
Birth history data permit the comparison of historical and current fertility in the same way as for single-period data (Hobcraft et al, 1982). In order to assess the changes relating to reproductive behaviour of individual cohorts, it is important to examine trends in cohort fertility. Table 4.4 shows a half-diagonal matrix of the reproductive age cohorts at different stages of their reproductive span. Exploring these values diagonally gives the period observations and reproductive career stages, represented by five-year age groups. Table 4.4 also reveals that cohort fertility remained fairly stable from 1970-74 up to 1975-79 and declined thereafter. Cohort age specific fertility rates were also fairly stable in the early 1970s and then steadily decreased from the 1980s to 2000. For instance, the ASFR has decreased by about 46% for the 15-19 age cohort between 1970 and 2000. Similarly the ASFR fell by about 15% and 2% for the age cohort 20-24 and 25-29 respectively.

Table 4.4: Trends of age specific fertility rate (ASFR) in Ethiopia from 1975 to 2000.

	ASFR schedule by period (0 – 30 yrs) before survey					
Age	1995-1999	1990-1994	1985-1989	1980-1984	1975-1979	1970-1974
15-19	106	110	176	192	197	198
20-24	244	244	291	288	305	298
25-29	262	264	297	299	319	
30-34	247	248	266	285		
35-39	179	183	254			
40-44	97	100				
45-49	21					

Source: Estimated from birth history, ETDHS 2000

Figure 4.2 displays the fertility trends observed for the past 25 years based on the 2000 ETDHS and provide further evidence of an ongoing decline of fertility in Ethiopia. The age specific fertility rates show a sharp declining trend during the 15-year period from 1985 to 1999). The most pronounced fertility decline was observed in all age groups in the late 1980s and early 1990s.



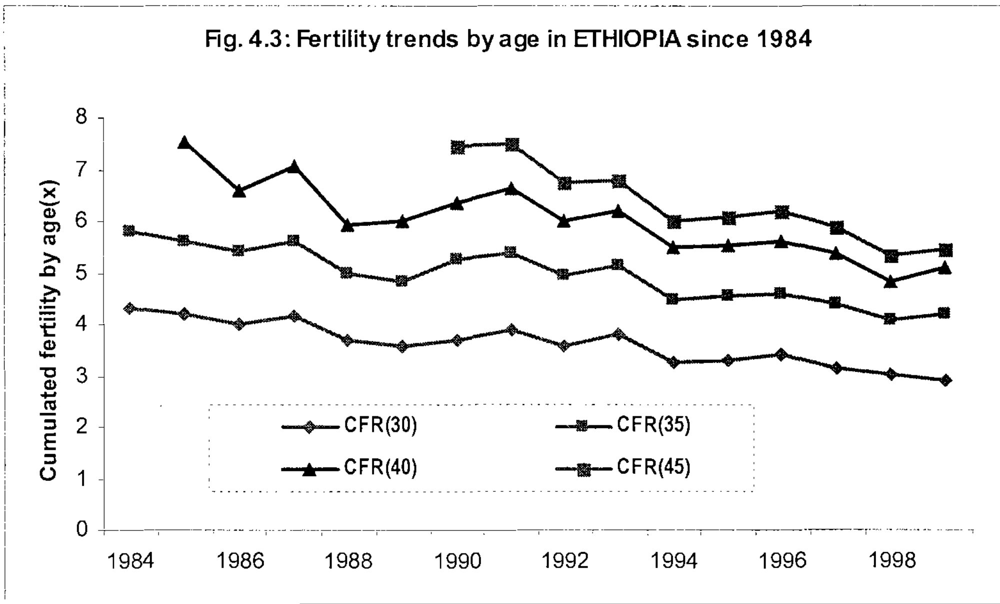
As indicated in the literature, the transition from high to low fertility is a universal characteristic, which developed country went through, and is now an ongoing feature of most developing countries. Although the overall pattern is repeated, the speed and timing of the fertility decline during the transition varies widely across countries. This argument is supported by Cleland (1997), which he describes as follows:

> *'........Why these variations in the fertility response to mortality decline exist is an interesting but as yet unresolved question. I very much doubt, however, whether a standard or universal answer exists ...It is much more likely that explanations of the precise timing, nature and speed of fertility transitions need to be sought on a country-by-country basis'.*

4.2.3 Fertility trends in Ethiopia

Figure 4.3 displays the trends in the cumulated fertility rate by age by single year for Ethiopia. Note that CFR here replaces TFR as total fertility rate is a cumulative measure of the separate fertility rates for women of different ages. The Cumulated Fertility Rates (CFR) were constructed by first taking the person years lived in each calendar year and the births corresponding to them. The next step in estimating the CFR is to estimate the age specific fertility rate and cumulate it up to a given age to obtain the CFR by that age.

For instance CFR (30) indicates the cumulative fertility rate of a woman or group of women, by the time they reached the age of 30. As shown in the figure, the cumulative fertility rate (CFR) for the country increased between 1980 and 1984 after which there was a downward trend. Figure 4.3 also reveals that the fertility transition probably began in 1984.



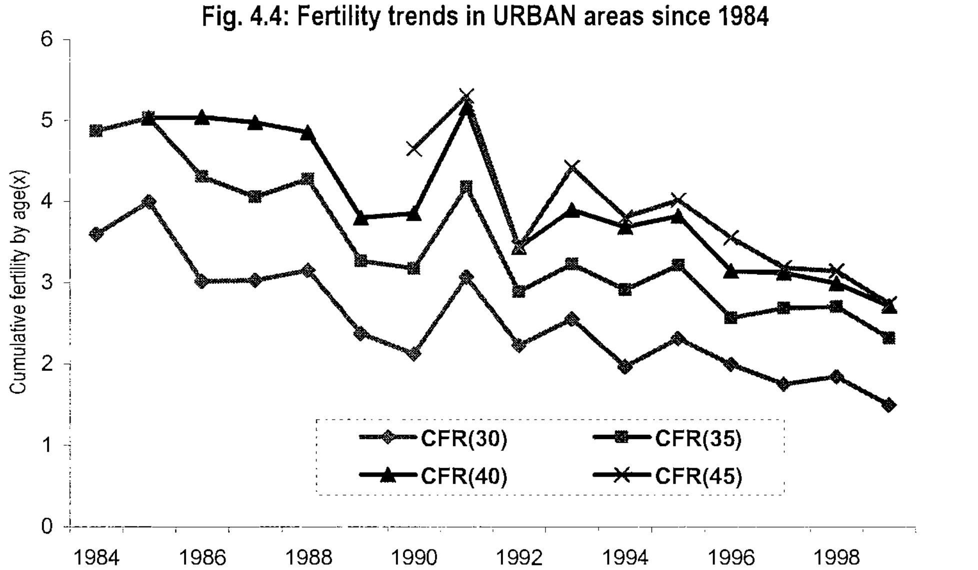
Source: Constructed from ETDHS 2000

Figures 4.4 and 4.5 display the fertility trends for urban and rural areas by age and single year since 1975. As indicated in the literature review, urban areas have been touted as the places of origin of fertility transition in Sub-Saharan Africa (Shapiro et al, 2001). According to Fig 4.4, there was a sharp drop in the cumulated fertility rate by age 35 between 1980 and 1982. The downward trend in urban areas continued until 1990 after which there was a sharp increase between mid-1990 and mid-1991.

This sharp rise in fertility during this period also coincides with a transition in the political system that took place around the same time. It may be difficult to justify why exactly such sudden rise had taken place in relation with the coincidence of the change of political system that was taking place at that time. However, given the fact that Ethiopia had been immersed in one of the longest internal conflicts and period of civil unrest in Africa, the sudden increase in fertility during the change of political system in the short interval could be linked to the uncertainty of the situation when a desperate and intense fighting broke out between the government of the time and the opposition forces. Moreover, the uncertainty may have been coupled with fear of losing young members of the family due to imposition of forced services such as the 'National Service' in which young people had been forced to go to the war front where many lost their lives. Therefore, we could see the sudden increase in fertility as being some form of 'insurance' of replacing lives that might be lost due to the war.

The sharp increase was short-lived and there was a steep decline in the cumulated fertility rate for all ages between mid-1991 and mid-1992 and extending with less intensity until mid-1996 which is followed by a steady downward trend. Again the sharp fall after the change of political structure in 1991 could be linked to the introduction of the Structural Adjustment Programme (SAP) that was accompanied by massive redundancies among government employees including the armed forces, but this can only be confirmed using qualitative research.

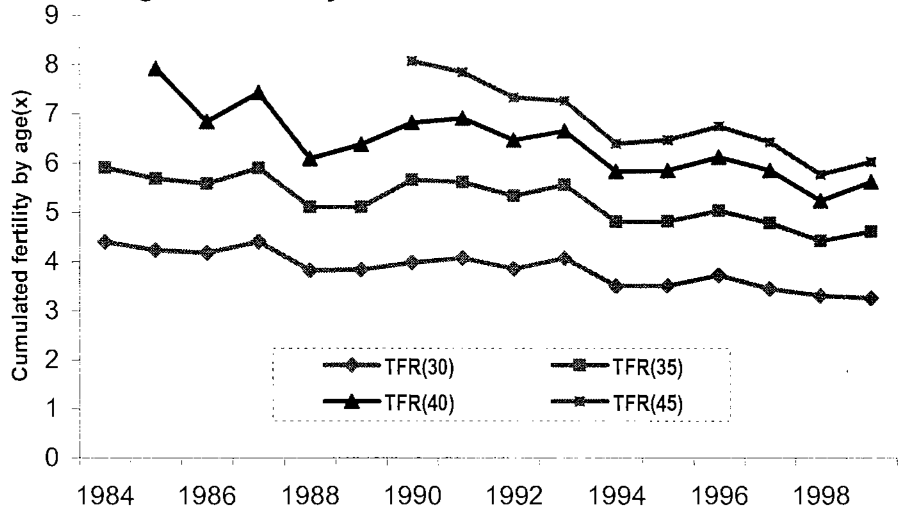
Fig. 4.4: Fertility trends in URBAN areas since 1984



Source: Constructed from ETDHS 2000

On the other hand, the fertility trends in rural areas as shown in Fig. 4.5, while showing a similar downward trend as urban areas, are not characterised by sharp rise and fall. The decline in the fertility in the rural areas, particularly that of the traditionally high fertility age groups (by age 30 and 35) began as early as 1984 shown by the dotted trend line. The period of 1984/85 is well known as the period when Ethiopia was affected by a severe famine that seriously affected the rural areas. Whether the fertility decline that has likely began in the rural areas around 1984 is a 'crisis-driven' fertility decline induced by the famine is something that needs further investigation through qualitative research such as in-depth interviews and focus group discussions.

Fig. 4.5: Fertility trends in RURAL areas since 1984



Source: Constructed from ETDHS 2000

Although there is marked difference in the tempo, it is apparent that fertility transition is underway in both urban and rural areas in Ethiopia. Fertility increased in both urban and rural areas from 1980-84 and 1990-1993 with more fluctuations in urban areas. Fertility decline has likely begun in urban areas since 1980. It is also evident from Fig 4.4 that cumulated fertility by age 30 declined more steadily after mid-1996 than the other ages in urban areas.

It is, therefore, evident from the above discussion that fertility transition has indeed begun in Ethiopia. Given Ethiopia's deteriorating economic situation, low level of modernization and extremely low level of contraceptive use, the observed fertility decline makes Ethiopia's fertility transition 'unique', and encourages further investigation to explore for a specific type of model that best fits the country's specific contexts.

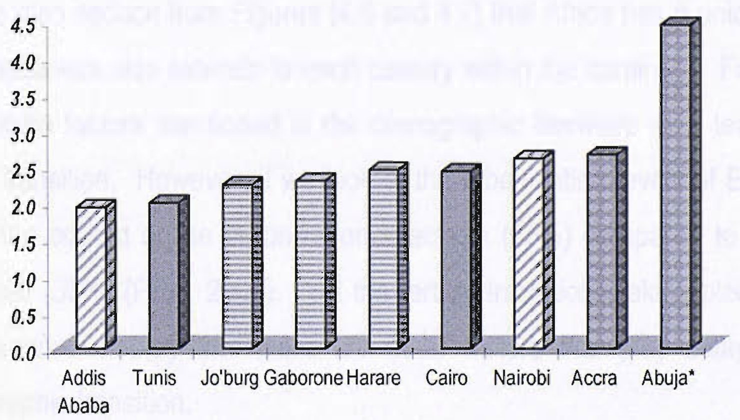
4.3 Fertility trends and transition time in Addis Ababa

4.3.1 Introduction

In May 2001, the Government of Ethiopia through the 2000 Ethiopia Demographic and Health Survey (ETDHS 2000) announced that the fertility level of the Ethiopian capital, Addis Ababa has approached below-replacement level (CSA, Ethiopia and ORC Macro, 2001). The survey revealed that while a woman in Ethiopia on average expects to have about 6 children in her entire reproductive life, the total fertility rate of the capital city, Addis Ababa has declined to below-replacement level (1.9 children per woman). This has raised many questions including: 'How can below-replacement level fertility be possible in a Sub-Saharan African country like Ethiopia where fertility is still among the highest in the region? The section begins with the fertility levels and trends in the capital city in comparison with other capital cities in Africa and proceeds to explore fertility trends by various socio-economic factors.

Fig (4.6) displays the status of fertility levels for some selected cities in Africa. Addis Ababa and Tunis are heading toward below replacement fertility, Gaborone and Johannesburg are approaching replacement fertility, while Abuja and Lagos (not included in the graph but slightly lower than Abuja) stand at a level with a TFR more than twice that of Addis Ababa. This piece of evidence supports the argument that the demographic transition in general and the fertility transition in particular should be assessed on country-by-country basis (Cleland, 1997).

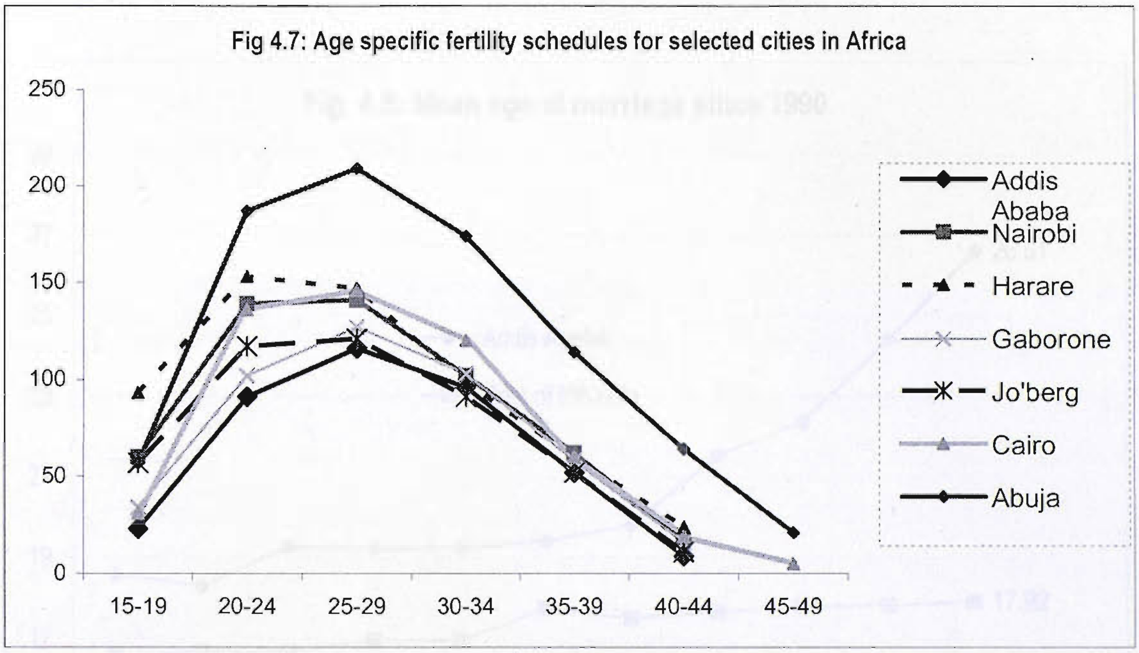
Fig 4.6: TFR for selected cities in Africa



Source: obtained from DHS reports 1998-2003; * Estimate for Lagos slightly less than Abuja

4.3.2 Fertility levels and trends in Addis Ababa

Figure (4.7) shows the age specific fertility curves for Addis Ababa in comparison with other capital cities in Africa. As expected the age specific fertility rate curve approximates the theoretical curve, in which the younger and the older age groups have smaller age specific fertility rates (ASFR) while the 20-34 age groups record higher ASFR. As can be seen from the same figure Addis Ababa's age specific fertility curve lies at the lower end compared to the same curves of selected cities in Africa.

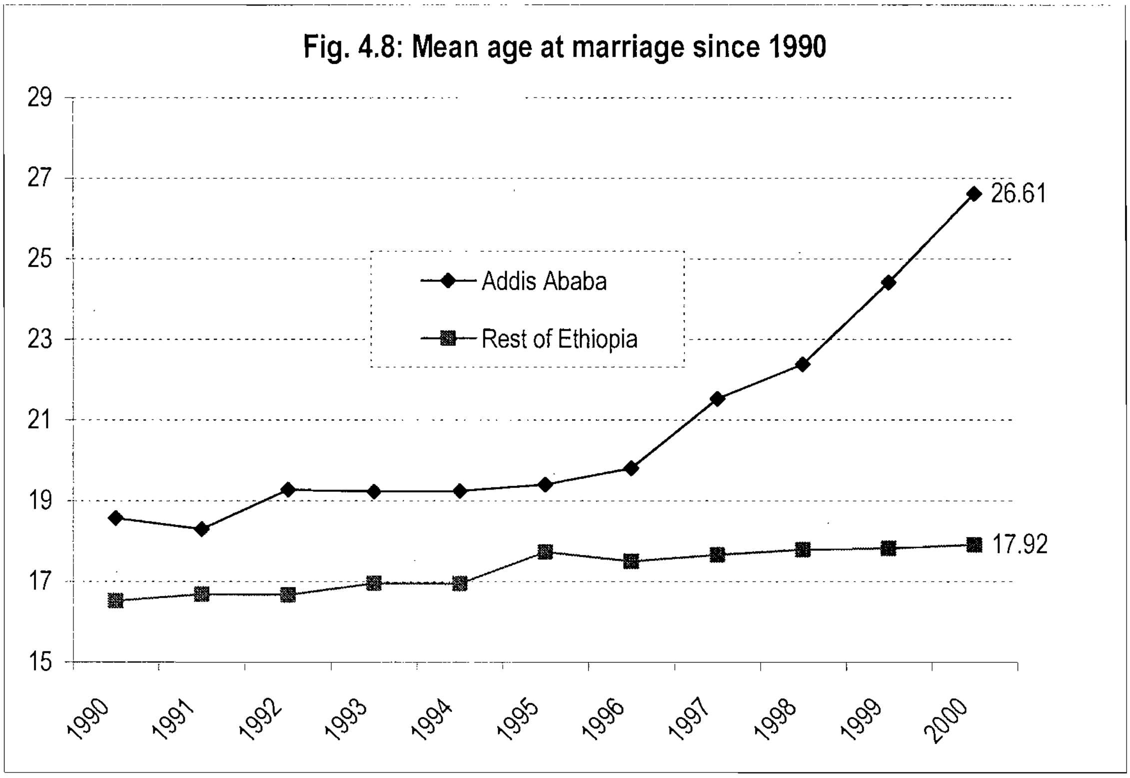


Source: estimated from DHS and obtained from reports

We can also deduce from Figures (4.6 and 4.7) that Africa has a unique demographic transition and this uniqueness also extends to each country within the continent. For instance, urbanization is one of the main factors mentioned in the demographic literature as a leading indicator for the onset of fertility transition. However, if we look at the urbanization levels of Ethiopia and Nigeria, the former lies at the bottom of the urbanization spectrum (15%) compared to the latter which is twice more urbanized (36%) (PRB, 2004). Yet the fertility transitions taking place in the capital cities of these two countries display that there are other factors that play delaying or speeding roles in the demographic transition.

4.3.3 Trends in age at marriage and proportions married

Figure 4.8 displays the trends in mean age at marriage for Addis Ababa and the 'Rest' of Ethiopia since 1990. The mean age at marriage for both regions were calculated using the SMAM (Singulate mean age at marriage) introduced by Hajinal (1953). Between 1990 and the 2000 DHS, the gap in age at marriage had reached to about 10 years with the mean age at marriage of about 27 and 18 years for Addis Ababa and the 'Rest' respectively. The median age at marriage for Addis Ababa is much higher than most Sub-Saharan African cities where as many as two-thirds of young women in some of these countries get married before age 20 (Westoff et al, 1994).



Source: SMAM estimated from ETDHS 2000

Availability of data on year of marriage enables to carry out cohort analysis of the proportions married. The results of the analysis of proportions married for the 15-19, 20-24 and 25-29 cohorts are shown in Figs 4.9a-4.9b. As shown in Fig 4.9a, respondents who were in the 15-19 cohort in 1991 were slow to get married while those in the 'Rest' began to diverge. We also observe an interesting trend in the proportions married for the 25-29 cohorts in both regions. Whereas only 15% of the 25-29 cohorts in Addis Ababa were married in 1991, more than half of the same cohorts in the 'Rest' were married in 1991. Then, the curves for the proportions married for these cohorts go in opposite direction with a fast drop and rise in the proportions married. At the time of the 2000 DHS, that is, when the 25-29 cohorts become 35-39 only about half of Addis Ababa women are married while more than nine out of ten women in 'Rest' were married. This is a significant indicator of marriage postponement in Addis Ababa.

Fig 4.9a: Trends in proportion married for 15-19 cohort

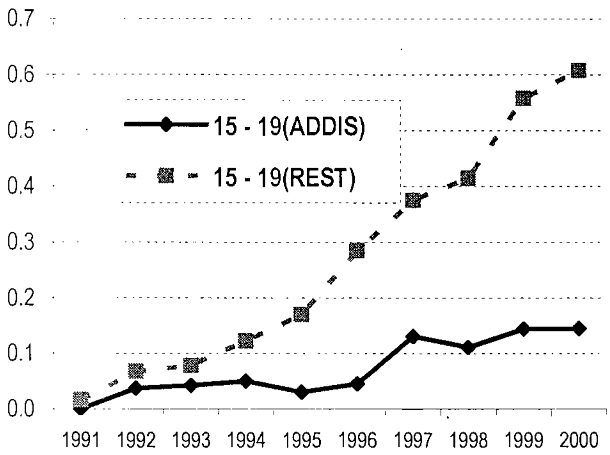
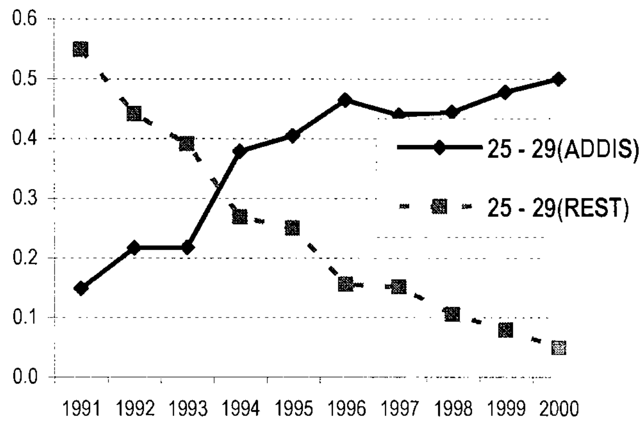


Fig 4.9b: Trends in proportion married for 25-29 cohort

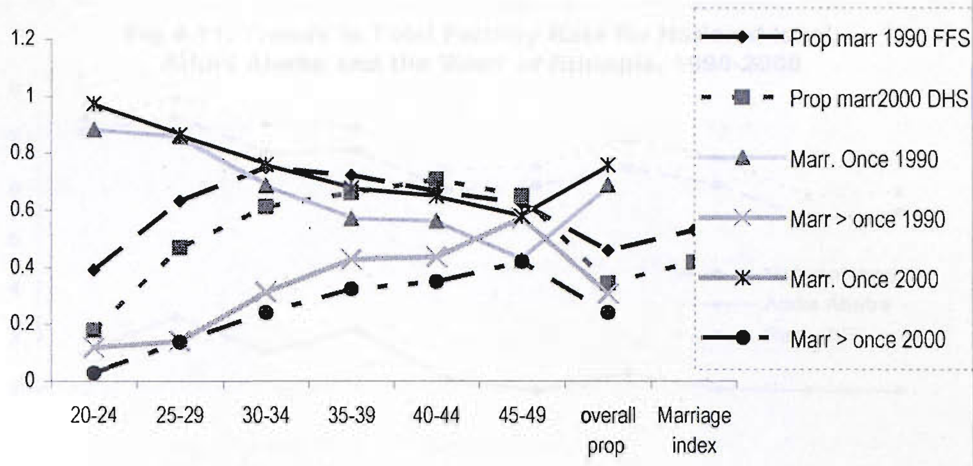


In the demographic literature, it is argued that age at marriage may have no effect on fertility in some circumstances. For instance, if fertility is regulated or controlled within marriage by using contraceptives, age at marriage may have no effect on fertility because couples may decide how many children they would like to have regardless of the age at marriage (Chowdhury et al, 1996). On the other hand, when viewed in terms of other factors such as the capability (time and cost) of raising children, it is unlikely that women who marry early and those who marry 'late' would achieve the same completed family size. As Addis Ababa is the place where the biggest proportion of the country's manpower is accumulated (at least in terms of industrial work force as most of the country's industries are based in the capital city), it is likely that couples/families would feel the pressure of child raising and equally likely that family formation could be delayed through delayed age at marriage. However, whether these facts hold true need to be confirmed through various modelling techniques discussed in subsequent chapters.

4.3.3.1 Trends in union status and stability in Addis Ababa

The proportion married in Addis Ababa in the 1990 Family and Fertility Survey and 2000 Demographic and Health Survey including those who had been married more than once are presented in Fig (4.10). It is evident that the proportions of married women have decreased between 1990 and 2000. The decline ranges from about 50% in the younger ages (15-19 & 20-24) and less than 5% in the older ages. Of particular importance is the marriage index which when used in the estimation of total fertility rate contributes the most in the fertility decline in Addis Ababa.

Fig. 4.10: Trends in union status and stability in Addis Ababa (1990 & 2000)



Source: Estimated from the 1990 FFS and ETDHS 2000.

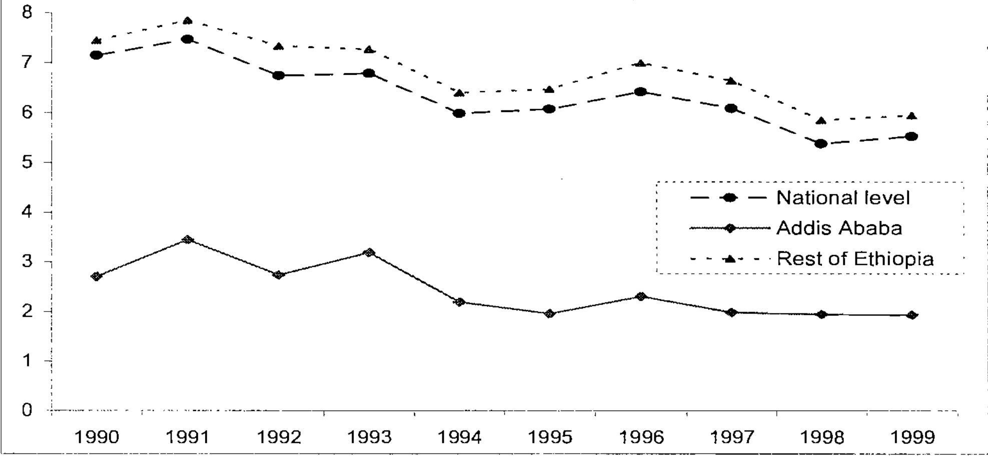
Among the currently married women in Addis Ababa, about one-third in 1990 and about a quarter in 2000 had been married more than once. Similarly, the number of marriages among the currently married increased up to 57% in 1990 and 42% in 2000. While some researchers are of the view that increased marital instability and spousal separation might act to reduce fertility, others suggest that union instability has a positive effect on fertility (Palabrica-Costello and Casterline, 2002; Leone and Hinde, 2001). Although, this needs further examination in order to establish whether marriage disruption in the past has left any noticeable imprint on Addis Ababa's fertility decline, it is adequate to say that higher union stability is observed in Addis Ababa in 2000 than in 1990. However, the union stability could also be a result of increasing awareness of the HIV/AIDS pandemic, which in turn needs further investigation in terms of the relationship between the pandemic and fertility.

4.3.4 Summary of fertility trends at national level, Addis Ababa and the 'Rest' of Ethiopia

Fig (4.11) displays the trend in total fertility rates for national level, Addis Ababa and the 'Rest' of Ethiopia. Around 1990, the total fertility rate for the Ethiopian capital was way beyond replacement level (about 2.6) while the national level and the 'Rest' of Ethiopia were among the highest (about 7.1 and 7.4 respectively)

As shown in Figure (4.11), the total fertility rate of Addis Ababa had long began branching off and the gap grew wider until it reached below-replacement level around 1995. As indicated in previous sections the gap between the fertility level of the capital city and that of the 'Rest' of Ethiopia became more pronounced after the 1984 famine and particularly after 1990/91, which also coincides with a change in the political system along with all the changes in policy such as population policy and structural adjustment programme.

Fig 4.11: Trends in Total Fertility Rate for National level, Addis Ababa and the 'Rest' of Ethiopia, 1990-2000



Source: Constructed from the 1990 FFS and ETDHS 2000 data

Although the factors for the big gap between the capital city and the rest will be examined in subsequent chapters, researchers have argued that diminishing nutritional status, stress and labour migration associated with famine tend to reduce fecundity and the frequency of sexual activity (Bongaarts and Cain 1981; Caldwell and Caldwell 1992). These researchers further argue that crisis-induced falls in fertility are usually followed by a rebound as the severity of the conditions that prompted the decline to diminish.

The fertility decline in Addis Ababa to below replacement level has received tremendous publicity and has been described as a 'revolution' (Kinfu, 2001) and 'African mystery' (Sibanda *et al*, 2003). However, researchers agree that the fertility decline in Addis Ababa did not happen abruptly and cannot be written off as a simple 'mystery'. Neither is it an anomaly resulting from the nature of data used to estimate fertility indicators as the quality of data has been checked in earlier sections and major errors have been identified.

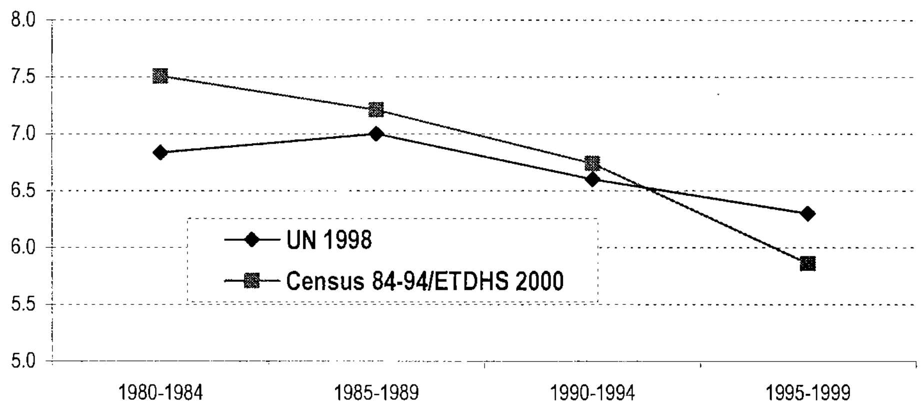
Table 4.5: classification of fertility transition

Transition stage	TFR range
Pre	7+
Early	6.0 to 6.9
Early-mid	5.0 to 5.9
Mid	4.0 to 4.9
Mid-late	3.0 to 3.9
Late	2.1 to 2.9
Post	0 to 2.0

Source: Taken from Bongaarts (2003)

Bongaarts (2003), based on empirical evidence, classifies the transition stages as in Table (4.5). In view of the classification given in Table (4.5), and all the evidences presented in the preceding sections, it is adequate to claim that the fertility level of Addis Ababa has indeed reached the post transition stage (below-replacement level) and that the fertility transition has been underway in the 'Rest' of Ethiopia since 1984 but in a consistent trend since the early 1990s and can be classified to be in the 'Early-to-mid' stage of the transition.

Fig. 4.12: Observed fertility trends vs UN projection



Source: Constructed from UN 1998 & Census 84-94/ETDHS2000

In 1998, the United Nations published revised projections of fertility trends for each country of the world. Fig (4.12) shows the UN projection of TFR for Ethiopia compared to that obtained from the 2000 ETDHS. Note that Figure (4.12) was constructed from various data sets including the 1984 and 1994 censuses and ETDHS 2000. On realisation of the emerging evidence of the demographic transition and the new trends in mortality due to HIV/AIDS in developing countries, the United Nations published the 1998 'United Nations Revised World Population Estimates and Projections'. Basically, the UN estimates and projections of the total fertility rate for Ethiopia also indicate a declining trend as shown in Fig (4.12). However, the trend in the estimated TFRs obtained from the ETDHS 2000 data illustrate that the fertility decline in Ethiopia is even faster than that predicted by the United Nations.

The remaining challenge is the search for explanations of why and how, in a country with serious economic problems, low urbanization level and diverse cultural makeup, such a dramatic decline can take place within its boundary. This triggers a set of research questions mentioned in the problem statement in chapter one. In the subsequent chapters attempt is made to partially answer these questions through various ways of statistical modelling.

CHAPTER FIVE
FACTORS INFLUENCING MARRIAGE AND FERTILITY IN ETHIOPIA

5.0 Introduction

One of the recent remarkable demographic changes observed in Ethiopia has been the fertility decline in the capital city to below replacement level (Kinfu, 2001; ETDHS, 2000). It was also indicated in chapter four of this study that fertility is indeed declining in Ethiopia and that the decline particularly occurred with an extraordinary speed in the capital city - Addis Ababa compared to the 'Rest' of Ethiopia.

In an attempt to answer why such dramatic fertility decline took place in Addis Ababa while fertility level of the rest of the country was still high, some studies suggested that marriage postponement coupled with higher proportion of contraceptive use in Addis Ababa could have played the leading role in the decline (Sibanda et al, 2003); while others (Kinfu, 2001) suggested that in addition to these factors acute housing problem in the capital city may have contributed the fertility decline in Addis Ababa.

The main focus of this chapter is to closely examine factors that influence marriage and fertility in Ethiopia. As part of the effort to establish answers to questions on time to marriage and low fertility, the determinants of marriage are examined through a survival analysis in section one and factors influencing fertility are examined through design-based analysis of 'births in the last five years' in section two of this chapter. Further analysis of non-marriage will be discussed in chapter seven.

The main departure of the study in this chapter is perhaps its comparative feature in that the factors that might have influenced time to marriage and fertility are presented in comparison between Addis Ababa and the 'Rest' of Ethiopia and the use of advanced modelling techniques such as design-based modelling (see discussion in section 5.2).

Section one of the chapter begins with the analysis of 'time to first marriage' in Addis Ababa and the 'Rest' of Ethiopia. This is followed by section two that deals with a design-based analysis of 'births in the last five years' in a comparative way to look at the factors responsible for the observed fertility variation between Addis Ababa and the 'Rest' of Ethiopia.

SECTION 5.1
FACTORS INFLUENCING MARRIAGE:
A SURVIVAL ANALYSIS OF TIME TO MARRIAGE

According to ETDHS 2000, the proportion of unmarried without children has increased considerably leading to persistent fertility decline particularly in the capital city. There has been an increase in the percentage of women never married over the last ten years, from 18 percent in the 1990 National Family and Fertility Survey to 24 percent in the 2000 ETDHS (CSA, 1993; ETDHS, 2000). The overall mean age at marriage for Addis Ababa women is about 27 years while that of the 'Rest' of Ethiopia is about 18 years.

Marriage is highly regarded as a central aspect of life in most countries of the world. In Ethiopia, where cultural and religious norms dictate life in most of the regions, marriage is regarded as inevitable to life. As a proximate determinant of fertility, the study of marriage is important for better understanding. Van de Walle (1993) emphasizes on the need to study about marriage patterns due to the fact that understanding marriage can supplement the understanding of other social change. (see chapter two for detailed literature review on marriage).

Moreover, explanation of fertility decline in countries like Ethiopia that enter late into the transition continues to be a topic of great theoretical and empirical interest to demographers. Among the main agents of fertility decline, marriage has been increasingly featuring in recent studies. Studying the factors that influence fertility decline in Addis Ababa, Sibanda et al (2003) found out that marriage has played relatively greater role in the capital city than other. The same authors found out that there was a 35% change in TFR due to change in marriage index. They argue that a decline in the proportions married coupled with contraceptive use have played in the dramatic fertility decline in the capital city.

However, their study does not extend to examining factors associated to delaying marriage in Addis Ababa. In this chapter attempt is made to examine possible factors that influence marriage in Ethiopia, particularly why Addis Ababa women postpone marriage much more than the women in the 'Rest' of the country.

5.1.1 Methodology and Data

5.1.1.1 Methodology

The analysis of 'time to marriage' is carried out using event history or survival method as described in detail in the methodology section of chapter three and which is briefly summarized below.

Assuming T_i to be the length of individual i's 'unmarried' spell with the continuous density function f(t), the cumulative distribution function can be specified as:

$$F(t) = \int_0^i f(s)ds = \Pr(T_i < t)$$

Taking into account that some individual observations may be right-censored, the probability that the spell is of length 't' is given by the survivor function

$$S(t) = 1 - F(t) = \Pr(T_i < t)$$

Then the continuous-time hazard (rate) for individual 'i' at time 't' is defined by the equation:

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t \le T < t + \Delta \mid T_i \ge t)}{\Delta t} = \lim_{\Delta \to 0} \frac{F(t + \Delta t) - F(t)}{\Delta S(t)} = \frac{f(t)}{s(t)}$$

In order to summarize the data and get an idea on the shape of distributions of 'time to marriage' as a whole or for the separate groups, the analysis begins with non-parametric estimation of the survivor and hazard functions based on Kaplan–Meier product-limit estimators.

Let $t1 < t_2 < ... < t_j < ... < t_k < \infty$ represent the survival times that are observed in the data set. Let d_j be the number of completed spells at t_j, let m_j be the number of observations censored in the interval $[t_j, t_{j+1})$, and let n_j be the number of observations ending their spell immediately prior to t_j , which is made up of those who have a censored or completed spell of length t_j or longer:

$$n_j = \sum_{i=j}^{k} (m_i + d_i)$$

Then the Kaplan–Meier estimate of the survivor function is given by the product of one minus the number of exits (d_j) divided by the number of persons (observations) at risk of exit just before t_j (n_j):

$$\hat{S}(t_j) = \prod_{j \mid t_j \ge t} (1 - \frac{d_j}{n_j})$$

However, the Kaplan–Meier estimated hazard assumes that there is no heterogeneity which can depend on observable or unobservable factors, i.e. that the sample is homogeneous. Therefore, after a univariate analysis, it is worth proceeding to a multivariate parametric (or semi-parametric) analysis for the estimation of the effect of factors affecting the probability of exit from unmarried status.

Although the exit from unmarried state may occur at any particular instant in time, usually the data on 'time to marriage' spell lengths are provided in discrete rather than continuous form (Jenkins, 2003). Therefore, the discrete logistic model is more appropriate to model 'time to marriage'. Moreover, the discrete-time logistic model assumes the logit of the discrete hazard is a linear combination of the logit of the baseline hazard rate (not depending on the covariates) and some suitably flexible function of the covariates (often linear).

The focus of parametric models is mainly the time function and the parameter estimates reflect effects on the timing of the event (Jenkins, 1995, 1997). If our time alignment is divided into a number of adjoining non-overlapping intervals (a_j–1, a_j] for j = 1, ..., k, and each interval is of equal unit-length (e.g. months), *the discrete-time hazard function P(t)* for individual '*i*' of exit in the interval (a_j–1, a_j] = (a_j–1, a_j], for the positive integers a_j = 1, 2, ... can be written as:

$$P(t) = \frac{1}{1 + exp(-Z(t))}$$

Where

$$Z(t) = C(t) + X\beta = log\left[\frac{P(t)}{1 - p(t)}\right]$$

where C*(t)* is the baseline hazard in month *t* and $X\beta$ are vectors,

And the predicted logit hazard (probability) for each person *i* and month *t* can be estimated using,

$$P_i(t) = \frac{1}{1 + exp(-\hat{C}(t) - \hat{\beta}X_i)}$$

where $\hat{C}(t)$ and $\hat{\beta}$ are estimates of C*(t)* and β.

and $\hat{C}(t)$ is defined as $\hat{C}(t) = (q-1)\,ln(t)$

A flexible specification of the baseline hazard is preferable since it allows for non-monotonic variation with duration, and therefore a wider range of possible effects of duration on the hazard rate can be captured. In this study, a flexible parametric (semi-parametric) proportional hazards model is employed where the baseline hazard is non-parametric while the effect of covariates takes a particular functional form.

5.1.1.2 Data

The data employed to analyze 'time to marriage' in Ethiopia are taken from the 2000 Demographic and Health Survey (ETDHS 2000), which was carried out by the collaboration of the Ethiopian Statistical Authority and ORC Macro between February and June 2000. ETDHS 2000 is designed as a nationally representative random sample of the population of Ethiopia living in households, consisting of 14,072 households covering 15,367 women respondents aged 15-49 (ETDHS, 2001).

The survey is designed to measure various rates and provides duration data in terms of calendar month code (CMC) which is helpful in survival analysis. It also contains retrospective information gathered about marital status over a period of 10-30 years. The dependent variable is the length of time to first marriage in spells defined in months. To each unmarried spell experienced by a respondent various demographic and other individual characteristics (covariates) are attached.

5. 1.2 Estimation Results

5.1.2.0 Preliminary descriptive analysis

Table 5.0: Proportion never married for the under 30 by selected factors

Factors	Addis		Rest	
	<24	25-29	<24	25-29
Total	0.829	0.426	0.505	0.086
Education				
No education	0.041	0.062	0.172	0.212
1-3 yrs of education	0.050	0.040	0.147	0.154
4-6 yrs of education	0.152	0.119	0.215	0.228
7+ yrs of education	0.757	0.790	0.466	0.407
Occupation				
Not working	0.229	0.345	0.208	0.309
sales/services	0.115	0.167	0.578	0.583
Prof./technical	0.656	0.468	0.214	0.108
Migration				
Migrated ≤ 5yrs	0.256	0.151	0.623	0.530
Migrated > 5yrs	0.744	0.849	0.377	0.470
HH asset index				
Low HH assets	0.900	0.855	0.373	0.473
Higher HH assets	0.100	0.145	0.627	0.527
Housing status				
No own/council house	0.792	0.750	0.526	0.507
Own/council house	0.208	0.250	0.474	0.493
Religion				
Orthodox	0.344	0.385	0.382	0.230
Moslem	0.066	0.073	0.172	0.255
Protestant	0.591	0.542	0.446	0.515
Ethnic background				
Amhara	0.486	0.493	0.236	0.319
SNNP	0.209	0.211	0.268	0.235
Oromia	0.233	0.257	0.420	0.382
Tigray	0.072	0.040	0.077	0.064

The proportion of respondents who stated as never married are shown in Table 5.0. Note that the proportions married are not indicated in Table 5.0 as the focus is on those never married. More than 8 out of 10 of the under 24 Addis Ababa women were never married at the time of the 2000 ETDHS. The opposite is true in the 'Rest of Ethiopia' where about half the women under 24 reported to have been married at the time of the survey. The proportion never married drops to nearly half in Addis Ababa by age 30 while almost all women in the 'Rest' (9 out of 10) are married by 30.

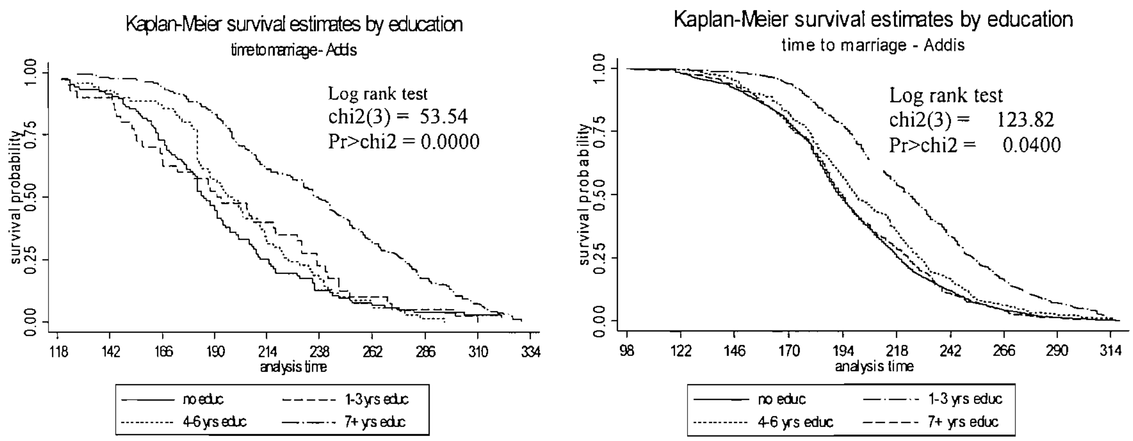
A similar picture is observed when the proportion never married is categorized by various characteristics. Among these, higher proportion of the never married is observed in Addis Ababa than in the 'Rest' when considering at least 7+ year of education, professional occupation, lower household assets, not having own/rented house, being affiliated to Protestant Christianity and being a member of the Amhara ethnic group.

5.1.2.1 Preliminary non-parametric duration analysis

The survivor function shows graphs in this section show the proportion of 'time to marriage' spells surviving for a given period in time conditional on having survived up to that point. In general, survival plots can be used for two main purposes: (i) to see the form of the baseline hazards (e.g. are they exponential, logarithmic, polynomial, etc?) and (ii) to test the assumption of hazard models for the stratification variable (e.g. rural/urban). For instance in a proportional hazards model, if the baseline hazard functions are relative to each other, we will have a constant vertical distance between the curves.

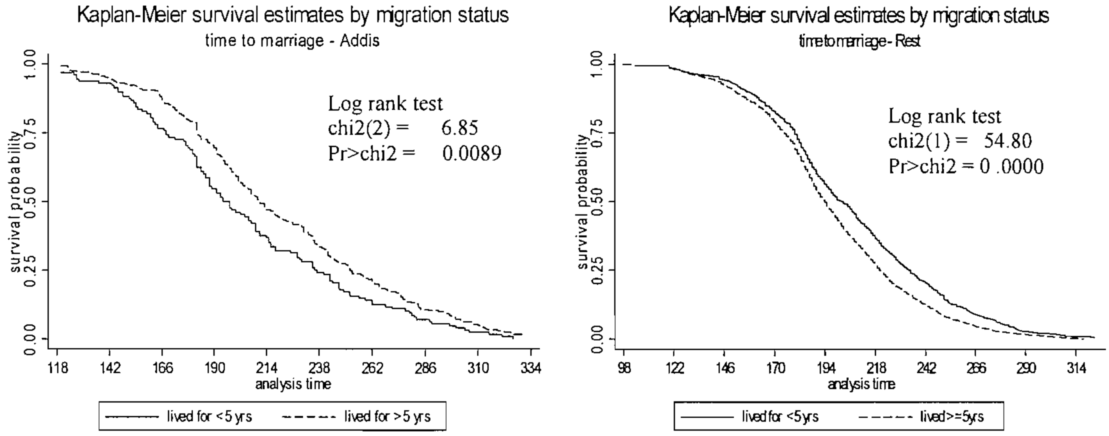
The effect of education on 'time to marriage' duration is very important. Under 30 years of age Addis Ababa women with 7+ years of education experience longer unmarried spells than those with no education and 1-6 years of education. Addis Ababa women with 7+ years of education stay single for longer than their counterparts in the 'Rest' of Ethiopia (Fig. 5.1a & 5.1b). On the other hand, women in the 'Rest' of Ethiopia marry earlier (about 15 months) despite having attained the same level of education and this could in turn be attributed to the cultural pressure to marry early in the rural areas.

Fig. 5.1a & 5.1b: Estimated Survivor functions by education



Looking at the survival plots of time to marriage by migration, we observe some interesting result in Addis Ababa that those who migrated to the area less than 5 years ago have lower survival time to marriage than those who migrated to the area or lived there for more than 5 years. On the other hand, the opposite is true in the 'rest' of Ethiopia (Fig 5.1c & 5.1d). This could be explained that rural-urban migrants might come to cities with cultural norms and practices such as marrying early. Alternatively, most of the women who migrate from rural to urban areas might have already been married at their previous place of residence.

Fig. 5.1c & 5.1d: Estimated Survivor functions by migration status

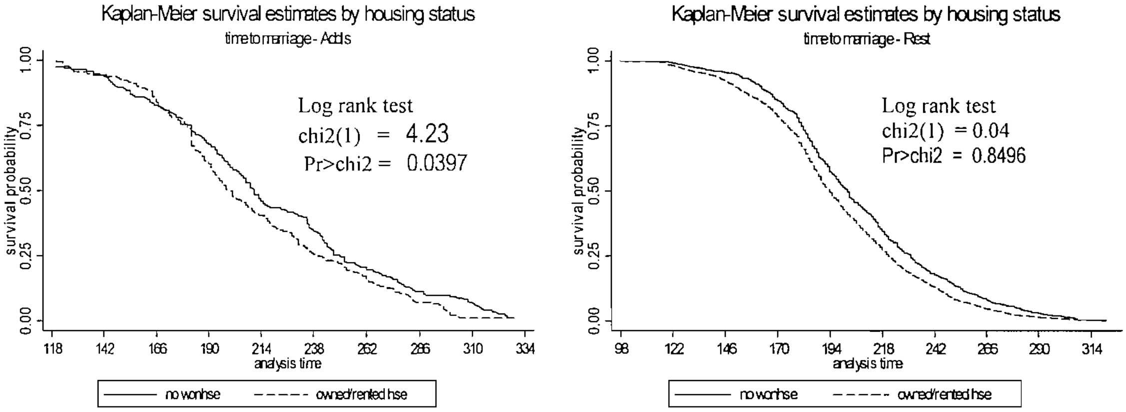


The other issue is regarding interpretation of the role of changing housing status. In this study, only women aged less than 30 years at the time of the 2000 survey are considered for the analysis of time to marriage. Given the fact that the median age at marriage is about 26 years in Addis Ababa, it becomes clearer that the analysis examines the housing status of a short period of time (about 5 years for Addis Ababa), which is assumed to be constant or with negligible difference.

It is true that housing shortage is universal in both developing and developed countries but is it among the leading factors that cause late marriage and hence low level of fertility? In this study, housing status was included in the analysis due to the fact that in the Ethiopian context, getting housing is the most important factor in the decision to get married because child bearing is expected immediately after marriage. In the rural areas in Ethiopia, preparation for marriage involves constructing a traditional thatched house with the help of a peer group who also wait for their turn or had gone through the same process, with the exception that some get married and stay with their parents until their house is constructed. A similar preparation process takes place in cities with the exception that in cities like Addis Ababa it is much harder to acquire a house and prospective couples can either construct their own houses or rent houses before getting married.

Due to availability of data on the housing status of respondents in the ETDHS 2000, it was included in the examination of factors influencing 'time to marriage' in both Addis Ababa and the 'Rest' of Ethiopia. Figs (5.1e & 5.1f) show the survival graphs of time to marriage by housing status for Addis Ababa and the 'Rest' of Ethiopia. These survival graphs and the corresponding log rank tests show that Addis Ababa respondents who don't own/rent a house have higher survival time to marriage. We observe a similar picture in the 'Rest' of Ethiopia, but not significant as shown in the log rank test.

Fig. 5.1e & 5.1f: Estimated Survivor functions by housing status



5.1.2 Results of the discrete-time logistic model of time to marriage

In the preliminary section categories of covariates were compared using a graphical method along with a logrank test. In order to assess the joint effect of various individual characteristics affecting the probability of marrying, a discrete-time logistic model with a polynomial baseline hazard was employed (Table 5.2).

Education is identified as one of the factors in determining 'time to marriage' that differentiates Addis Ababa women from the 'Rest' of Ethiopia. As in the non-parametric analysis, 'time to marriage' increases with education level for Addis Ababa with the exception of women with only 1-3 years of education, which is not significantly associated with longer time to marriage. Attainment of at least 4-6 years of education has some positive effect on time to marriage perhaps indicating the postponement of marriage until these women attain the desired level of education. Higher level of education (7+) has the strongest effect on time to marriage. Addis Ababa women with 7+ years of education have twice higher survival rate in terms of 'time to marriage' than women with the same educational level in the 'Rest' of Ethiopia.

Table 5.2: Survival analysis of 'time to marriage' in Addis Ababa and the 'Rest' of Ethiopia

Factor	Addis Ababa Est. Coeff. with (significance*)	Addis Ababa z	Rest of Ethiopia Est. Coeff. with (significance*)	Rest of Ethiopia z
Education				
1-3 yrs of education	-0.041	-0.09	0.296***	8.64
4-6 yrs of education	0.061**	2.01	-0.316	-0.58
7+ yrs of education	0.538***	6.84	-0.390	-0.72
Occupation				
sales/services	-0.083***	-1.39	0.129***	3.9
Prof./technical	-0.657***	-5.04	-0.221**	-2.28
Migration				
Migrated ≤ 5yrs	-0.228***	3.4	0.244***	-7.66
HH asset index				
Higher HH assets	-0.404***	-4.25	-0.029**	-1.01
Housing status				
No own/council house	0.236***	6.4	0.014	0.13
Religion				
Moslem	-0.206**	-2.41	-0.028***	-2.98
Protestant	0.034	0.34	-0.089**	-2.35
Ethnic background				
Amhara	-0.123*	-1.72	0.083***	2.7
SNNP	0.192**	2.21	0.115***	3.62
Tigray	-0.308**	-2.49	0.091**	2.05
Polynomial(order3)	0.0014***	8.66	-0.134***	-6.36
Constant	-3.954	-19.39	-4.729	-10.93

NB: Categories: no education, Not working, migrated >10yrs ago, low hh asset, own hse, Orthodox/Catholic, Oromo ethnic group are the reference categories for each of the covariates used in the analysis. *, ** and * denote significance at the 1%, 5% and 10% levels, respectively.**

On the other hand, we observe the opposite in the 'Rest' of Ethiopia. Except for women with 1-3 years of education that show slightly longer time to marriage (perhaps related to age rather than the effect of education at this level), women with 4-6 or 7+ years of education have relatively less survival time to marriage. This could be attributed to the fact that most women in the vast rural areas who remain unmarried up to 1-3 years of education may finally succumb to family and community pressure to get married even if it means they still have to attend school perhaps until the birth of the first child. This finding may be partly attributed to the well functioning education system in Addis Ababa and the lesser focus given to education in the 'Rest' of Ethiopia.

From the models shown in (Table 5.2), it appears that the professional category is strongly but negatively associated, while the effect of being in the sales or services occupation is positively associated with time to marriage. As expected, Addis Ababa women who are in the professional or technical occupation have shorter survival time to marriage because this group of women may have reached a stage where they have attained a certain level of education and secured employment thus time to start a family.

As shown in the preliminary section, the sales and services category in Addis Ababa is not significantly associated with time to marriage possibly due to the fact that sales and services includes those working in bars and street vendors who have higher chances of exposure to relationships though for commercial purpose that may end up in marriage or cohabitation. On the other hand, the observed positive effect of sales/services on time to marriage in the 'Rest' of Ethiopia may be in part due to the fact that these are 'peasant traders' who spend much of their time travelling between the countryside and cities to sell agricultural produce and may opt to enjoy temporal relationships in the new exposure areas - in the cities hence taking a little longer time to marry.

As shown in Table (5.2), migration status has a significant negative effect on 'time to marriage' in Addis Ababa implying that the rural-urban migrants may take time to adapt urban life and in the mean time follow the cultural norm of their origin and either may have already been married before migrating or get married on arrival to the city or they migrated to join their new spouses as it is a common practice that most Addis Ababa residents get married at their origin and bring their spouses immediately. On the other hand, we observe a positive effect of migration status on time to marriage in the 'Rest' of Ethiopia.

The results in (Table 5.2) suggest that differences in hazards of 'time to marriage' between women with higher household assets have negative effect on time to marriage of under 30 years old women in both Addis Ababa and the 'Rest'. This suggests that wealth may operate as an incentive to start a family and to even have a multiple marriage.

The housing issue has featured in previous studies as the possible major factor for the fertility decline in Addis Ababa (Kinfu, 2001; Sibanda et al, 2003). For instance, Kinfu (2001) argues that the housing policy introduced in the 1970s destabilised the housing market leading to severe shortage and that this may have led to late marriage and subsequent fertility decline. Sibanda et al (2003) also are argue that they 'suspect that the severe housing shortage' is among the 'driving forces behind the increased proportions of never married'. However both of the above studies did not include housing data in their analyses.

It is note worthy here that there is a debatable issue about the changing behaviour of respondents' housing status in the analyses of marriage and fertility. It may be argued that the decision to get married depends on a range of other factors such as adequate income (economic), mutual understanding and respect (behavioural) as well as religious and cultural factors. In the Ethiopian context, getting married involves similar factors but housing is the most important among them because child bearing is expected immediately after marriage and to raise children one needs a house.

In the vast rural areas in Ethiopia, part of the preparation for marriage involves constructing a traditional thatched house with the help of a peer group who also wait for their turn or had gone through the same process, with the exception that some get married and stay with their parents until their house is constructed. This makes marriage easier in rural areas than in cities. A similar preparation process takes place in cities with the exception that in cities like Addis Ababa it is much harder to acquire a house and would be couples can either construct their own houses or rent houses before getting married. The other issue is regarding interpretation of the role of changing housing status. In this study, only women aged less than 30 years at the time of the 2000 survey are considered for the analysis of time to marriage. Given the fact that the median age at marriage is about 26 years in Addis Ababa, it becomes clearer that the analysis examines the housing status of a short period of time (about 5 years for Addis Ababa), which is assumed to be constant or with negligible difference.

Based on this validation, this study examined the association of 'housing status' with 'time to marriage'. The results show Addis Ababa respondents who don't live in own/rented house are more likely to have longer time to marriage, which confirms previous claims by Kinfu (2001) and Sibanda et al (2003). On the other hand, having no own house was not significant in the 'Rest' of Ethiopia model but negatively associated with time to marriage indicating that it doesn't matter whether one owns a house or not as marriage is early and almost universal.

Culture plays a vital role in society's various institutions and marriage is one of the core institutions in every society. Religion and ethnicity were included in the survival analysis as representatives of cultural forces that influence marriage and due to the fact that these cultural norms have strong connection with religious doctrines and ethnic background in Ethiopia. According to the results in (Table 5.2) the Muslim category in Addis Ababa is negatively associated with 'time to marriage' indicating lower survival time to marriage compared to those in the Orthodox and Protestant Christian categories. On the other hand in the 'Rest', women in both Muslim and Protestant categories have shorter survival time to marriage which supports the claim that in the vast rural areas, religion is so intermingled with cultural norms that dictate early marriage.

Regarding ethnic groups an interesting result is that Addis Ababa women of Tigriyan ethnic background followed women from the Amhara ethnic group have lower survival time to marriage compared to women with other ethnic background. Interestingly, women with Tigriyan ethnic background living Addis Ababa have shorter survival time to marriage compared to the same group in the Rest who had longer survival time to marriage.

5.1.3. Summary of results of the analysis of time to marriage

As mentioned in the beginning of this section, marriage has featured in previous studies as having played a major role in the fertility transition in Addis Ababa (Kinfu, 2001; Sibanda et al, 2003). In chapter four of this study where the relative role of the proximate determinants examined and in the studies carried out by the above authors, the marriage index has stood out from the rest of the proximate determinants. It was also argued elsewhere that 'rise in the proportion of unmarried women' due to 'late marriage' (Sibanda et al, 2003) and 'non-marriage' and 'delayed marriage' (Kinfu, 2001) was the most important factor for the fertility decline in Addis Ababa.

In view of this and the fact that previous studies only focused on the fertility decline in Addis Ababa and did not indicate what was missing in the fertility transition in the 'Rest' of Ethiopia, this study was prompted to raise the question: If late marriage is the main factor that was effective in the fertility decline in Addis Ababa, what are the determinants of marriage in general and 'late marriage' in particular? Although the determinants of marriage in Addis Ababa have also been examined previously (Kinfu, 2001), the departure in this study is the attempt to examine the determinants of 'time to marriage' in both Addis Ababa and the 'Rest' of Ethiopia in order to arrive at a comparative conclusion.

Among the interesting findings of the analysis of time to marriage include: the positive effect of housing status, the negative association between 'time to marriage' and professional occupation and the negative association between household wealth and time to marriage. The observed positive effect of sales/services occupation on time to marriage in the 'Rest' of Ethiopia may be in part due to the fact that these are 'peasant traders' who spend much of their time travelling between the countryside and cities to sell agricultural produce and may opt to enjoy temporal relationships in the new exposure areas particularly in the city hence taking a little longer time to marry.

According to the results, education, household wealth status and housing status are identified as the most important factors influencing 'time to marriage' that distinguishes Addis Ababa from the 'Rest' of Ethiopia as far as late marriage is concerned. Addis Ababa women with 4-6 and 7+ years of education have higher survival rate in terms of 'time to marriage' than women with the same educational levels in the 'Rest' of Ethiopia. On the other hand, women in the 'Rest' with 4-6 or 7+ years of education have relatively less survival time to marriage than their counterpart in Addis Ababa perhaps due to the fact that most women in the vast rural areas who start schooling may finally succumb to family and community pressure to get married even if it means they still have to attend school perhaps until the birth of the first child.

Although housing status is an important factor in the process of marriage, identifying the effect of changing housing status needs justification. It may be argued that the decision to get married depends on a range of other factors such as adequate income (economic), mutual understanding and respect (behavioural) as well as religious and cultural factors. In the Ethiopian context, getting married involves similar factors but housing is the most important among them because children are expected immediately after marriage and to raise children one needs a house.

In the vast rural areas in Ethiopia, part of the preparation for marriage involves constructing a traditional thatched house with the help of a peer group who also wait for their turn or had gone through the same process, with the exception that some get married and stay with their parents until their house is constructed. This makes marriage easier in rural areas than in cities. A similar preparation process takes place in cities with the exception that in cities like Addis Ababa it is much harder to acquire a house and prospective couples can either construct their own houses or rent houses before or immediately after getting married.

Therefore, for the purpose of simplifying the problem of interpreting the effect of changing housing status on time to marriage, this study uses data on women aged less than 30 years at the time of the 2000 survey. Moreover, given the fact that the median age at marriage is about 26 years in Addis Ababa, it becomes clearer that the analysis examines the housing status of a short period of time (about 5 years for Addis Ababa), which is assumed to be constant or with negligible difference. This study found that Addis Ababa women who don't have their own or rented houses are more likely to have longer time to marriage while on the other hand, having no own house was not significant in the 'Rest' of Ethiopia model but negatively associated with time to marriage indicating that it doesn't matter whether one owns a house or not as marriage is early and almost universal.

Also among the findings is that of the unusual direction of association between women with Tigriyan background living in Addis Ababa and the 'Rest' of Ethiopia. Women with Tigriyan ethnic background were found to have lower survival time to marriage in Addis Ababa compared to the same group in the Rest who had longer survival time to marriage. This could be related to an emerging difference in the economic status within the members of the Tigriyan ethnic group living in Addis Ababa and those living in the 'Rest' of Ethiopia.

SECTION 5.2
FACTORS INFLUENCING FERTILITY: A DESIGN-BASED ANALYSIS OF BIRTHS IN THE LAST FIVE YEARS

5.2.1 Introduction

The study of fertility dynamics requires documenting past, present and future fertility trends and their determinants. As mentioned earlier, the main departure of this study from those indicated in the literature is the analysis of fertility using recent data and advanced statistical techniques of analysis such as design-based survey analysis that takes account of the sampling design of large scale surveys which are drawn using stratified multistage sampling designs. Moreover, this study examines the fertility dynamics comparing Addis Ababa and the 'Rest of Ethiopia and using the current sample frame, which is the main departure from earlier studies (Kinfu, 2001; Sibanda *et* al, 2003), which focused mainly on Addis Ababa.

In view of the above, the focus of this section is to examine the factors influencing 'recent fertility', which is termed in this study as 'births in the last 5 years' defined here as the total number of children borne by a respondent in the past five years before the 2000 Ethiopian Demographic and Health Survey (ETDHS 2000). The first part of the section presents preliminary analysis of births in the last 5 years and subsequent sections of the chapter deal with the exploration of factors that influence fertility using 'births in the last five years' through a design-based modelling approach.

5.2.2 Data and Methodology

5.2.2.1 A brief description of the Poisson and Negative binomial models

In this section, two approaches are followed to study 'births in the last 5 years' - to model the sub-population sample for Addis Ababa and the sub-population sample for the 'Rest' of Ethiopia using the Poisson and negative binomial regression models. Before proceeding to the analysis, brief specifications of both models and explanation of design-based modelling are presented below.

The availability of count data such as rare events of discrete nature in every day life has given rise to the increased use of Poisson and negative binomial models interchangeably. Poisson regression is often used to the number of occurrences of an event of interest or the rate of occurrence of an event of interest, as a function of some explanatory variables. The basic assumption of the Poisson distribution is the so called 'equi-dispersion', that is, the equality of the mean and the variance.

$$P(x) = \frac{e^{-\mu} \mu^{x}}{x!} \qquad (8)$$

Where x = 0, 1, 2, and μ is the Poisson parameter (mean number of events occurring), and

$$Var\ (y \setminus x) = E(y \mid x) = \mu_i$$

As in a loglinear model, if we assume that μ is the expected number of events (births in the last five years as in this study), N number of respondents at risk and λ be the underlying incidence rate, then the Poisson regression model component can be written as:

$$\mu = e^{\chi_i \beta}$$

In many cases the rate of incidence of an event is modelled instead of the number of occurrences, in which case an offset is incorporated in the model (see details in chapter three).

When the variance is greater than the mean the distribution is said to display over-dispersion. When there is over-dispersion, the Poisson estimates are inefficient with standard errors biased downward yielding false large z-values. The negative binomial regression is used to estimate count models when the Poisson estimation is inappropriate due to over-dispersion. For this reason, the negative binomial distribution includes an additional parameter α which is an estimate of the degree of over-dispersion. When α is zero, the negative binomial has the same distribution as Poisson. Therefore, the larger the value of α the greater the amount of over-dispersion will be. We recall from chapter three that the negative binomial distribution can be written as:

$$\Pr(y \mid x) = \frac{\Gamma(y+\nu)}{y!\Gamma(\nu)} \left(\frac{\nu}{\nu+\mu} \right)^{\nu} \left(\frac{\mu}{\nu+\mu} \right)^{y}$$

Where, $\Gamma =$ Gamma function; $\mu =$ conditional mean; $\nu = 1/\alpha$ and α = dispersion parameter with variance:

$$\text{var}(y \mid x) = \mu \left(1 + \frac{\mu}{\alpha} \right),$$

This shows that in the negative binomial distribution the variance is always larger than the mean.

The negative binomial distribution can be considered as a Poisson distribution with unobserved heterogeneity. It can also be assumed to be a mixture Poisson and gamma distributions incorporating observed and unobserved heterogeneity into the conditional mean (Long 1997). Thus when a random variable is introduced into the regression component, the negative binomial model becomes:

$\mu_i = e^{(\chi_i \beta + \varepsilon_i)}$ where $\chi_i \beta$ is the linear predictor, ε_i is a random variable for the unobserved informaton.

Cameron and Trivedi (1998) and Long (1997) argue that the estimates of a Poisson regression model for over-dispersed data are unbiased, but inefficient with standard errors biased downward. The likelihood ratio test for over-dispersion examines the null hypothesis of α =0. The likelihood ratio (LR) statistic follows the Chi-squared distribution with one degree of freedom. In a negative binomial model, if the null hypothesis is rejected, then the negative binomial regression model is preferred to the Poisson regression model (Cameron and Trivedi 1998; Long 1997).

5.2.2.2 Why design based modelling?

As indicated in chapter three, most surveys like the 2000 Ethiopian Demographic and Health Survey (ETDHS 2000) collect data based on multistage sampling. Design-based modelling refers to the analysis of complex surveys by taking account of the sampling design of large scale surveys which are drawn using stratified multistage sampling designs (Chambers, 1986; Korn and Graubard 1995).

Design-based modelling was developed arising from the need to correct sample data for the unequal selection probabilities (i.e. sample weight), the need for precision in standard errors (i.e. stratification) and the need to account for homogeneity and independence (i.e. clustering - as individuals in one cluster are more alike than another cluster) (Chambers, 1986; Pfeffermann and La Vange, 1989; Korn and Graubard, 1995).

Thus failure to consider stratification, clustering and sampling weights in the modelling process can result in very large standard errors, smaller than the true standard errors and biased parameter estimators respectively. Thus a design-based negative binomial and Poisson modelling techniques are used in the analysis fertility.

5.2.3 Discussion of results

5.2.3.1 Introduction

The analysis begins with descriptive statistics before embarking on to complex modelling. The distribution of births in the last 5 years in the Addis Ababa sub-sample as shown in Figs (5.2.1a) has longer upper tail and is fairly skewed to the right which is evident from the skewness value of 0.93, which is higher than the value (0) for a normal distribution and symmetric data. The distribution of the response variable - 'births in the last 5 year' for the Addis Ababa sample has mean 0.616 with a standard deviation of 0.732 showing a significant difference between the mean and standard deviation. Similarly, the distribution of births in the last 5 years before the survey in the 'Rest of Ethiopia sample Fig (5.2.1b) shows that it is also skewed to the right but with almost similar mean and standard deviation of 1.01 and 0.99 respectively.

Fig 5.2.1a: Distribution of births in the last 5 yrs before ETDHS 2000

Married women - Addis Ababa

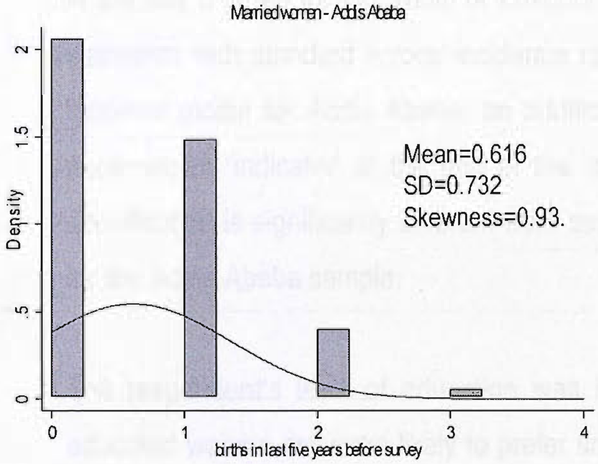
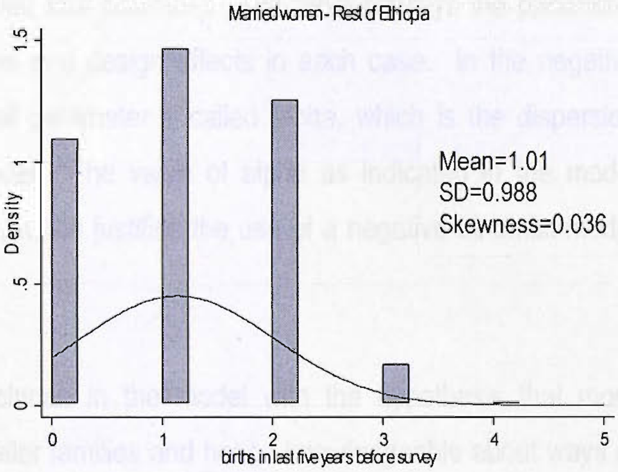


Fig 5.2.1b: Distribution of births in the last 5 yrs before ETDHS 2000

Married women - Rest of Ethiopia



Looking at the graphs for married samples of the two major regions, and comparing the skewness values, we observe that both graphs are fairly skewed to the right with a higher skewness value for Addis Ababa (0.93) compared to a (0) value for a normal distribution and symmetric data. As indicated above the graph and summary statistics for Addis Ababa shown in Fig (5.2.1a), indicate that there is some degree of over-dispersion and also higher values of 'zeros' in the married data set. On the other hand, Fig (5.2.1b) and the summary statistics for the 'Rest' of Ethiopia married data set show a mean of almost twice that of Addis Ababa (1.12) with a standard deviation of about 0.99, indicating a close mean and standard deviation with a skewness value close to zero that will be used in deciding the type of model to run for the sample.

The preliminary analysis prompted the use of all options of models for count data such as a zero-inflated Poisson or negative binomial model for the Addis Ababa sample and a Poisson model for the 'Rest' of Ethiopia sample. However, after running a 'zero-inflated Poisson' and 'Negative binomial' models , the outputs revealed the same results for the Addis Ababa model, which suggests that the over-dispersion in the raw data and the significance of alpha after running these models may be results of a process that gave rise to the zero inflation (Long, 1997; Cameron and Trivedi, 1998).

It is worth noting that in the analysis of the married samples, an exposure variable was created by taking the difference between age of the respondent and her age at first marriage. The final results of the survey design-based negative binomial and Poisson regression models are presented in Table (5.3) below.

Table 5.3 displays the results of design-based negative binomial model results of births in the last 5 years for Addis Ababa (the first four columns) and the design-based Poisson model results of births in the last 5 years for the 'Rest' of Ethiopia (last four columns). The table displays the parameter estimates with standard errors, incidence rates and design effects in each case. In the negative binomial model for Addis Ababa, an additional parameter – called alpha, which is the dispersion parameter is indicated at the end of the model. The value of alpha as indicated in the model specification is significantly different from zero, which justifies the use of a negative binomial model for the Addis Ababa sample.

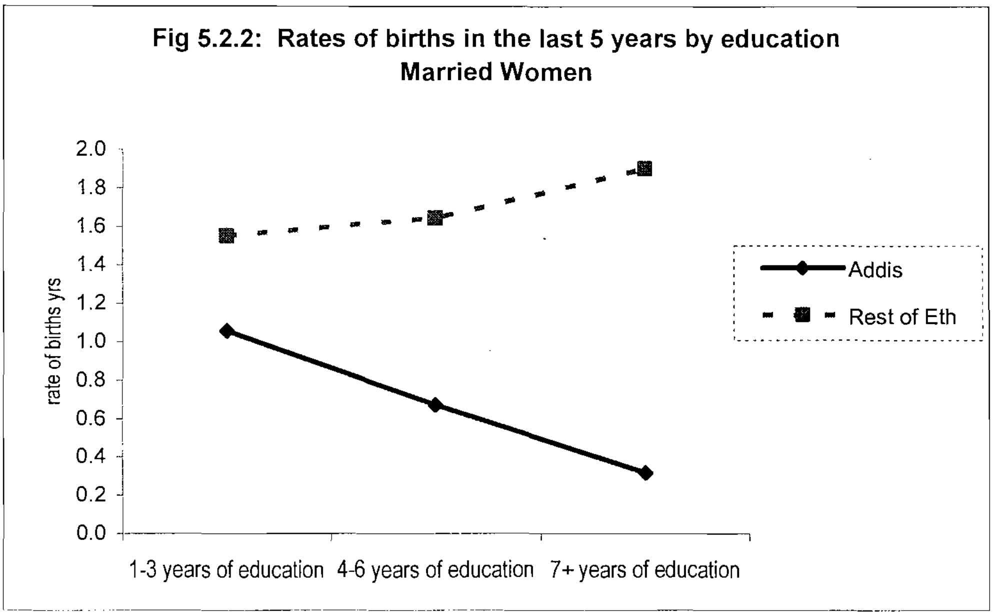
The respondent's level of education was included in the model with the hypothesis that more educated women are more likely to prefer smaller families and hence knowledgeable about ways of spacing or limiting their family planning. From the incidence rates shown in Table (5.3), after accounting for other factors included in the model, being educated up to 7+ years decreases the expected number of births in the last five years by a factor of 0.316, or equivalently, it decreases the expected number by 68%. In other words, Addis Ababa women with at least 7+ years of education have about 11 times lower births in the last 5 years than those with no education. This is clearly shown in Fig (5.2) where the rates of births in the last five years decrease as education level of the respondents increases

Table 5.3: Design-based Negative Binomial model for Addis Ababa and Design-based Poisson model for the 'Rest of Ethiopia (married women - ETDHS 2000)

Characteristics	Design-based Negative Binomial model Addis Ababa (N= 770)				Design-based Poisson model 'Rest' of Ethiopia (N= 8864)			
	Parameter estimates	S.E	Inciden -ce rate	Design effect	Parameter estimates	S.E	Incide -nce rate	Design effect
Education								
1-3 years of education	0.058	0.191	1.060	0.684	0.441***	0.076	1.554	3.407
4-6 years of education	-0.399**	0.18	0.671	0.922	0.498*	0.273	1.645	2.006
7+ years of education	-1.152***	0.16	0.316	0.938	0.643***	0.101	1.902	2.569
Occupation								
Sales/services	-0.095	0.128	0.909	0.829	-0.216***	0.051	0.806	2.786
Prof./technical/clerical	-0.789**	0.264	0.454	1.049	-0.489**	0.177	0.613	1.165
HH assets Index								
High HH asset	0.216**	0.101	1.241	1.205	0.417***	0.038	1.517	2.308
Housing status								
no own/council hse	-0.398**	0.141	0.672	0.997	0.106	0.078	1.112	2.238
Migration status								
migrated ≥5yrs/lived always	-0.593**	0.198	0.553	0.821	0.389	0.294	1.476	3.327
Religion								
Moslem	0.362*	0.121	1.436	1.133	0.247	0.146	1.280	2.410
Protestant	-0.182	0.272	0.834	1.572	0.116	0.077	1.123	3.887
Ethnic background								
Amhara	-0.392	0.256	0.676	2.304	-0.23***	0.051	0.795	3.165
SNNP	0.261**	0.116	1.298	2.519	0.293***	0.062	1.340	3.335
Tigray	0.317***	0.054	1.373	0.900	0.109**	0.035	1.115	1.405
Constant	-0.991***	0.209			-2.577***	0.043	0.076	
Dispersion param.								
Alpha	0.867***	0.164						

NB: 'no educ', 'not working', 'low hh assets index', 'lives in own/council hse', 'migrated ≤ 5 yrs', Orthodox Christianity and Oromia ethnic group are reference categories respectively not shown in the table; * sig. at 10%; ** sig. at 5% * sig. at ≤1%**

However, this is not the case in the 'Rest' of Ethiopia as education is positively associated with births in the last five years in the 'Rest' of Ethiopia model. In fact being educated up to 4-6 or 7+ years of education increases the expected number of births by a factor of 1.65 and 1.90 times or (65% and 90%) respectively. This is expected as the proportion of literate women is much higher in urban areas (69 percent) than in rural areas (15 percent). According to the 1994 Census, women in Affar and Somali regions have the lowest literacy level (7 and 8 percent) respectively perhaps due to the semi-nomadic nature of the people residing in the areas.



Among the income covariates included in both models, respondent's occupation was negatively associated with births in the last 5 years in both regions. The results shown in Table 5.3 indicate that employment opportunity is generally associated with lower rate of births in both regions. However, Addis Ababa women engaged in professional or technical work have about 16 percentage points lower rate of births in the previous 5 years before the survey than their counterparts in the 'Rest' of Ethiopia.

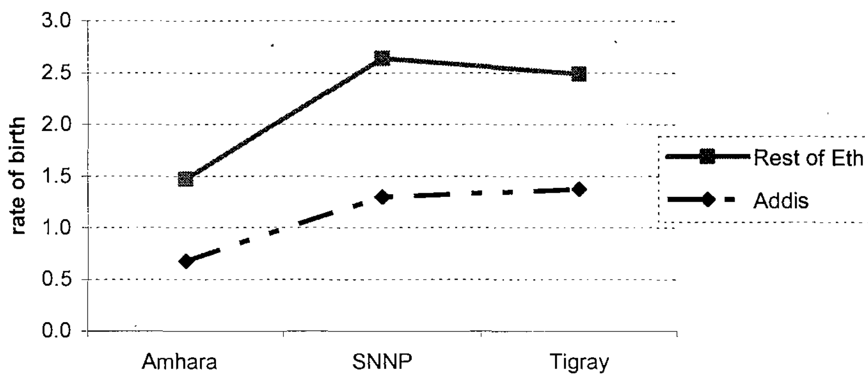
An index of household assets was created from a set of variables using the principal components analysis (see Appendix for detail). According to the results shown in Table (5.3), the incidence rates of household assets index for Addis Ababa and the 'Rest' of Ethiopia indicate that rate of births in the last five years increase with increasing household assets index in both regions. Although household assets index is not a complete representative of 'poverty index', it is considered as a directional indicator. It has been noted in the demographic literature that the number of children has been an overriding factor in rural areas in some developing countries showing a negative relationship between wealth and fertility, while in others household wealth and fertility have been found to have positive relationship. Ethiopia being among the poorest countries, the above result contradicts existing evidence. This adds emphasis on the need to look at poverty and the forces that cause it (e.g. famine in some of low fertility rural areas and unemployment in cities like Addis Ababa) to be closely examined in the search for a complete answer.

Consistent with the observations made in section (5.1) that dealt with marriage, housing status was found to have a negative relationship in Addis Ababa but a positive relationship in the 'Rest' of Ethiopia. As shown in Table (5.3), in Addis Ababa, not living in one's own or council house reduces the expected number of births in the five years before the survey by a factor of 0.67 or by 33%. However, this does not matter in the 'Rest' of Ethiopia, due to the positive relationship between housing status and fertility in the vast rural areas.

It is to be recalled that Kinfu (2001) and Sibanda *et al* (2003) mentioned the housing issue, although both studies did not include the housing variable in their analyses, as a possible factor that played a vital role in the fertility decline in Addis Ababa. This study included the 'housing status' covariate in the analysis to check the earlier suggestion and the negative relationship between the covariate and fertility in the Addis Ababa model confirms these earlier views. Therefore, it is likely that housing problem has played a vital role in the dramatic fertility decline in Addis Ababa.

In the previous section, migration status was found to have no significant effect on 'time to marriage' in Addis Ababa. The analysis of births in the last five years as shown in Table (5.2) also revealed that women who migrated before a long time or who have lived in the current residence always have lower rate of birth in Addis Ababa. However, migration and fertility are positively related in the 'Rest' of Ethiopia indicating that other factors such as cultural norms may have stronger influence than migration.

Fig 5.2.3: Rates of births in the last 5 years by ethnic background - Married Women



Ethnic background was included in the analysis of recent fertility because different cultural attitudes, for example restrictions on family-planning activities in some communities may affect fertility. Table 5.3 and Figure 5.3 reveal that among the major ethnic groups included in the analysis of births in the last five years, women with Tigriyan ethnic background have about 37% higher rate of births in Addis Ababa and about 11% higher rate of births in the 'Rest' of Ethiopia respectively. This result concurs with the results obtained in the analysis o f marriage that women from the same ethnic group

(Tigriyan) were found to be more likely to get married faster than the other major ethnic groups for the reasons given in the previous section.

As the main objective of this study is to examine marriage and fertility dynamics by comparing the two major regions, women from the same ethnic background but living in the 'Rest' of Ethiopia have higher rate of births in the last five years before the survey, with the highest rates recorded in SNNP. It is worth noting here that although SNNP is a conglomeration of several ethnic groups, the culture norms prevailing in the area are more or less uniform and hence the similarity in the fertility behaviour.

5.2.3.2 Design Effect (DEFF)

As mentioned at the beginning of this chapter, one of the departures of this study from previous fertility studies in Ethiopia is the application of advanced statistical techniques of analysis, particularly the design-based survey analytical technique. As described in chapter three, the design effect (DEFF) is the loss of precision in estimating parameters by the use of cluster sampling instead of simple random sampling. In other words, the design effect (DEFF) is a measure of the variance taking into account the survey design compared to what would have been obtained ignoring the survey design and computed the variance based on the assumption that the data was collected from a simple random sample. It is a factor which introduces the effects of stratification and clustering into the simple random sampling variance formula (STATA Corp., 2001).

The DEFF values have been estimated along with the parameter estimates and standard errors (see Table 5.3). Generally, except for a few subgroups of women in the 'Rest of Ethiopia' sub-population, which have bigger DEFF values than the range for a well designed survey (1-3), the DEFF values for Addis Ababa show that they are well within the normal range indicating a well designed sampling in the capital city evident from the smaller DEFF values. In general, the smaller the DEFF value the more efficient the survey design will be. For instance, if DEFF<1, this results in smaller standard errors and the design is more efficient.

Among some of the factors for the 'Rest' of Ethiopia sample with higher DEFF values include: no education (DEFF=3.4), migrated≥5 years/lived always (DEFF=3.3), Protestant Christian (DEFF=3.9), Amhara and SNNP ethnic groups (DEFF=3.2 & 3.3 respectively) all lie above the normal range indicating some discrepancy in the multi stage sampling. Higher DEFF values could also be interpreted as, for instance, a DEFF of 3.9 for 'Protestant Christian' sub-group in the 'Rest' means that the variance taking into account the survey design is about 4 times that of what would have been obtained by ignoring the survey design. In other words, about half as many sample cases would have been needed to measure the variance and other related parameters if a simple random sample were used instead of the cluster sample with its (design effect) of 3.9. In other words, only one-fourth as many sample cases would have been needed to measure the variance and other related parameters if a simple random sample were used instead of the cluster sample with its (design effect) of 3.9.

The sub-group with the smallest DEFF value is the 'no education' group in the Addis Ababa sample (DEFF=0.68), which means that the variance taking account of the survey design is about 0.7 times less than that of what would have been obtained using a simple random sample as far as this dummy variable is concerned.

5.2.4 Summary of results of the analysis of births in the last five years

As indicated at the beginning, the purpose in section (5.2) was to examine the factors influencing recent fertility, that is, factors influencing 'births in the last 5 years' before the ETDHS 2000. More specifically, the analysis was done for the purpose of identifying factors that explain the observed difference in the fertility levels between the capital city – Addis Ababa and the 'Rest' of Ethiopia. The study of recent fertility was necessitated due to the fact that explanations of the changes that have taken place in a short period of time could be easily captured and provide a better understanding of the difference between the two regions.

It was indicated in chapter four that fertility has been declining in Ethiopia since the 1980s. The onset of the fertility transition in the country was further substantiated by the decline in the Total Fertility Rate from about 7.5 children per women in 1984 to 6.7 in 1994 and to 5.9 in 2000. Moreover, the fertility level of the capital city (Addis Ababa) has been widely touted for the unique fertility transition to below-replacement level with a total fertility rate of less than two children per woman (TFR=1.9). These results coupled with the fact that the fertility transition is taking place with low development level necessitated the study of factors influencing fertility to improve our understanding.

The response variable used in the modelling - 'births in the last 5 years' is the number of children born to a woman in the five years before the 2000 Ethiopian Demographic and Health Survey irrespective of the children's survival status. Multivariate analyses using the negative binomial and

Poisson regression modelling techniques with a design-based approach that accounts for the survey design such as stratification and clustering were employed.

Besides confirming findings by other studies, the analysis on fertility has revealed that socio economic factors, particularly education, employment and housing status have much stronger influence on births in the last 5 years in Addis Ababa than in the 'Rest' of Ethiopia, where cultural factors had relatively better influence.

The evidence presented in the preceding sections draws attention to the important role played by women's education in fertility decline in Addis Ababa compared to the rest of the regions. The upward trend in women's education is associated with a downward trend in fertility level in Addis Ababa. Women's education does not operate in isolation from agents of modernization such as urbanization. Education equips with a new viewpoint about one's own life as well as skills for participating in the labour force. A rise in the level of women's education also leads to a rise in age at first marriage and consequently to a decline in fertility.

There are also differing results - the marked drop in fertility with the participation in the labour force, which has strongly featured in the Addis Ababa sample and an increase in fertility with increasing household wealth in both areas and raises a theoretical importance for the topic under study and a closer examination of income and fertility in general. There is adequate literature regarding the impact of wealth in rural areas operating as an incentive for bigger family size but its positive relation with fertility in urban areas is a matter for further investigation.

Following the suggestions by recent studies on Addis Ababa that housing might have played a role in the fertility decline in the capital city, this study included the 'housing status' covariate in the analysis to check the earlier suggestion and the negative relationship between the covariate and fertility in the Addis Ababa model confirms these earlier views. Therefore, it is likely that housing problem has played a vital role in the dramatic fertility decline in Addis Ababa.

Migration issue has also featured in Kinfu (2001), but only on Addis Ababa data. Therefore this study included migration status to examine its differential effect between the two major regions of study. The analysis of births in the last five years revealed that women who migrated before a long time or who have lived in the current residence always have lower rate of birth in Addis Ababa. However, migration and fertility are positively related in the 'Rest' of Ethiopia indicating that other factors such as cultural norms may have stronger influence than migration.

Yet again, the analysis of births in the last five years also found that among the ethnic/regional categories, women with Tigriyan background living in Addis Ababa were found to have about 11% higher births in the last five years concurring with the results found in the marriage analysis

Generally, the analysis of fertility in this section has resulted in the findings that women who are educated up to 7+ years of education, who participate in paid work such as professional or technical occupations, women who don't have their own or council houses have lower rate of births and hence lower fertility – making these factors as the main source of the difference between Addis Ababa and the 'Rest' of Ethiopia

CHAPTER SIX

FACTORS INFLUENCING FERTILITY INTENT IN ETHIOPIA: A DESIGN-BASED ANALYSIS

6.1 Introduction

Research on fertility intentions has received considerable attention in the recent past in developing countries because of its relevance to the future course of fertility in a society and also due to the fact that a survey respondent's stated fertility intentions are related in some way to her eventual fertility. Therefore, information on current fertility intents has a predictive capacity in forecasting the future course of fertility.

However, there has also been some concern regarding the quality of data on fertility intentions particularly in developing countries. It has been long felt that an assessment of the quality of data on fertility preferences with a view to establishing their meaningfulness, reliability and validity is one of the first and most important steps in any attempt to analyse fertility preference data particularly in the context of developing countries. The quality of data on fertility responses has been discussed in chapter three and the response rate to the question in the ETDHS 2000 on whether the respondent wants a/another child was very high (99.9%). The issue of the validity of the responses in the should be seen from the point of view that fertility intentions are not only attitudes but also future plans and plans are not simple wishes but indicative of what may take place in the course of time.

As was done in chapter five, the analysis of fertility intent is carried out using advanced statistical techniques of analysis such as design-based survey analysis that considers the complex and multistage sampling design of the ETDHS. Once again, the design-based survey analysis and the fact that there is little or inadequate literature on the study of 'fertility intentions' in Ethiopia, particularly since the restructuring of the sample frame and conducting of the first ever DHS survey, make this study different from previous studies on fertility in the country.

The analysis is carried out excluding never married women for the purpose of simplifying interpretation of fertility preference against period factors. Sample data were split into two sub-populations - Addis Ababa and the 'Rest' of Ethiopia with the same rationale indicated in chapter five. The first part of this chapter provides description of variables and background characteristics of women, which is followed by an examination of the association between fertility intentions and various factors. The last part of the chapter deals with modelling the outcome variables - desire for additional children, using design based multinomial regression technique.

6.2 Background characteristics

The distributions of desire for additional children for selected characteristics of women in Addis Ababa and the rest of the regions are presented in Table (6.1). Note that never married women are omitted from the analysis to simplify interpretation of fertility preferences. According to these results, the desire to have another child dwindles with increasing age, with about three-fourth of younger women (<24 years) in Addis Ababa and about eight out of ten in the 'Rest' of Ethiopia desiring to have a/another child.

Some communities in Ethiopia have a long tradition of early marriage among females (FFS, 1990) and this situation still prevails. However, the 2000 Demographic and Health Survey data suggest that the median age at marriage in Ethiopia has increased. Marital duration indicates the length of time a woman is exposed to childbearing and influences the number of children a woman desire to have throughout her reproductive period in the absence of any active fertility control, although pre-marital childbearing does exist.

According to the results indicated in Table (6.1), more than two-third of women in Addis Ababa who were married for less than four years want to have more children than women married for more that 5 years. A considerable difference is observed between Addis Ababa women and those from the rest of the regions who had been married for more than ten years, in that, higher proportion from the rest of the regions still want to add more children. However, this should be viewed in terms of the fact that there is quite high marital instability in Addis Ababa, with about a quarter of the respondents reporting that they have been married more than once.

The number of children and their survival can influence a woman's desire to have another child. As expected, either the total number of children ever born or the number of children alive has a positive association with not wanting additional children. Furthermore, this impact seems stronger for the variable 'total children alive.' Having at least a son or a daughter alive seems to have a large and significant association with fertility preferences. It is interesting to note that desire to have no more children in Addis Ababa increases dramatically after having one or two children while three-fourth of women in the Rest still want more after having the second child. In fact half of the respondents in the 'Rest' of Ethiopia still want to add more after the third child.

With regard to gender preference, Table (6.1) portrays interesting results. A higher proportion of Addis Ababa women who have daughter preference want more children than amongst those who have son preference. On the other hand, women in the 'Rest' of Ethiopia who have son preference have higher desire for more children. This is perhaps due to the fact that more female children are needed to help in the domestic work in Addis Ababa, while more sons are needed in the rest of the regions where most of the families make their living through farming. Moreover, male children can bring income by working as farm labourers in rural areas. It is a common practice in Ethiopia, particularly in the rural areas to hire young males as unskilled labourers known as 'bala-kenja' or 'siso-arash' (meaning 'farm labourer' – a person working for some proportion of the produce paid in kind at the end of the harvesting season'). A second explanation to the desire for more male children in the 'Rest' of the Ethiopia is perhaps as a result of the recently ended long internal conflict in the country, which may have motivated women in the past to desire for more male children for the purpose of 'security' of having enough children after replacing those who might be lost while actively taking part in the conflicts.

Child loss experience has been established as one of the reasons for high fertility levels in developing countries (UN, 1988; Koenig et al, 1990). The death of an infant is posited to interrupt lactation and shorten postpartum insusceptibility and subsequent birth interval. Similarly, another behavioural mechanism could inspire couples to have more children to be safe from the fear of losing children due to any cause. According to the results in Table (6.1), higher proportion of both Addis Ababa and 'Rest' women who had experienced loss of 1 or more children want no more children.

As mentioned in chapter five, the household assets index was created from several household items and amenities using principal components data reduction technique suggested by Filmer and Pritchett (2001). According to the results in Table (6.1), a slightly higher proportion of Addis Ababa women in the upper assets index category want more children. Whether this means that parents are more capable of supporting increased number of surviving children with increase in household wealth needs further examination in relation to other factors in the multivariate analysis. A similar picture is observed in 'Rest' where slightly higher proportion of women with upper assets index want more children.

Previous studies have repeatedly shown that women with more schooling tend to have smaller families and that more education is associated with smaller family size. We would expect fertility preference to be lowest among women with secondary or higher education and highest among those who have never been to school. Better-educated women have broader knowledge, higher socio-economic status and less fatalistic attitudes toward reproduction than do less educated women. In other words, women with more education usually make a later, healthier transition into adulthood. They marry later, and are more likely to want smaller families than their less educated counterparts (Diamond et al, 1999; Lloyd et al, 1999; Jejeebhoy, 1995).

According to the results in Table (6.1), a higher proportion of women with seven and above years of education in Addis Ababa want no more, while more than half women in the 'Rest' with the same level of education still want more children. But the picture in Addis Ababa changes when we combine those who want more children and those who are unsure or undecided. Combining the 'undecided' category to any of the 'no more' or 'want more' categories makes a higher proportion to either side. This is an interesting aspect as the undecided can be influenced to either side through various ways, one of which could be promoting the 'sustainable family size concept'.

Regarding the higher proportion of 4-6 years of education, two possible explanations can be provided for this. First, women with 4-6 years of education might have postponed childbearing until completing a certain level of education and desire more to compensate the lapsed childbearing span of their reproductive age and women with no education are likely to have slightly lower desire for additional children as they may have completed their childbearing early. The second possible explanation could be that arising from a wrong interpretation of literacy or commonly known as 'mass education' into the level of education particularly the case of rural women who might have recorded an equivalent level of education in single years without a substantial change of attitude towards the traditional values brought about by education.

Table 6.1: Percentage distribution of desire for additional children by selected factors for Addis Ababa and the 'Rest' of Ethiopia (ETDHS 2000)

Characteristics	Desire for additional children							
	Addis Ababa				'Rest' of Ethiopia			
	Want nomore	Undec -ided	Want more	Number	Want nomore	Undec -ided	Want more	Number
Intermediate/Demographic factors								
Age group* **								
<24	23.8	2.3	73.9	170	13.9	3.4	82.7	2756
25-29	33.5	2	64.5	212	23.5	4.3	72.2	2131
30-34	38.5	2.8	58.7	133	31	4.1	64.9	1680
35+	80.4	0.5	19.1	444				3817
Marital duration* **								
Married for <4 yrs	16.5	3.5	80	183	9.3	3.1	87.6	1851
Married for 5-9 yrs	36	0.6	63.4	167	19.4	4.1	76.5	1925
Married for >10 yrs	71.5	1.1	27.4	609	50.8	3.7	45.5	6608
Parity* **								
Has no child	15.1	1.8	83.1	140	13.6	2.9	83.5	1208
Has 1 to 2 children	57.3	3	39.7	366	17.7	3.8	78.5	2883
Has 3+ children	80	0.1	19.9	453	50.6	3.8	45.6	6293
Gender Preference* **								
No preference	55.1	1.6	43.3	832	39.6	3.9	56.5	7208
Daughter preference	45.6	0.2	54.2	41	37.4	2.7	59.9	800
Son preference	52.6	1.1	46.3	86	34.3	3.1	62.6	2376
Child loss experience* **								
No child loss	48.3	1.6	50.1	715	27.9	3.5	68.6	5645
1 or more children lost	44.9	1	54.1	244	41.3	3.8	54.9	4739
Opportunity cost/ Economic factors								
Household assets index***								
Poor					37.5	3.8	58.7	6374
Middle	52.6	2.7	44.7	578	38.1	3.8	58.1	3284
Rich	52.9	1.2	45.9	339	48.3	1.3	50.4	312
Respondent's Education* **								
No education	32.5	3.8	63.7	321	18.8	3.7	77.5	8607
1-3 years of education	42.9	3.4	53.7	98	21.8	2.4	75.8	647
4-6 years of education	52.7	2.4	44.9	169	33.8	4.4	61.8	503
7+ years of education	41.1	21.4	37.5	371	35.9	4.6	59.5	627
Respondent's Work*								
Agricultural/unskilled	45.2	1.7	53.1	562	29.1	3.4	67.5	8911
Sales/services	55.6	1.1	43.3	291	37.4	3.2	59.4	1341
Professional/clerical	46.5	1.3	52.2	106	36.5	1.5	62	132
Cultural and ecological factors								
Religion* **								
Orthodox/Catholic	58.2	1.5	40.3	782	42.7	3.7	53.6	4966
Moslem	29.6	1.8	68.6	112	34.4	2.5	63.1	4013
Protestant	53.4	0.2	46.4	65	29.5	5.9	64.6	1405
Ethnicity/Region* **								
Amhara	59.4	1.2	39.4	504	45.5	2.7	51.8	3280
SNNP	49.5	1.5	49	149	35.5	2.4	62.1	1505
Oromia	58.1	1.2	40.7	222	36.1	4.5	59.4	4413
Tigray	46	0.9	53.1	82	34.5	2.7	62.8	1174

Significance: *p <0.05; ** p <0.01; *** p <0.001; n/a ≡ not applicable

It is hypothesised that a woman's work career minimises her time for child bearing and rearing, thus influencing her fertility to her desire for additional children. According to Table (6.1), more than half of women in the sales and services category in Addis Ababa want no more children, while more than half of women in the professional category in Addis Ababa reported they want more children. The picture for the 'Rest' is different where six out of ten women in any of the occupation categories want more children. This is perhaps due to the fact that women working in the above job categories may be able to handle both childcare and employment with the help of the extended family (Standing, 1983; Lloyd, 1991; Shapiro, 1991).

With regard to religion, the results in Table (6.1) indicate that Moslem and protestant women in Addis Ababa have higher desire to add more children than Orthodox Christians. Orthodox Christianity, historically linked with the state, has been the predominant religion in Ethiopia. However, in recent years this influence has diminished partly due to the coercive approach of handling the Orthodox Church during the communist era resulting in the eventual relaxation of the denomination's pronatalist doctrines regarding fertility regulation, and partly (perhaps the main reason) due to the increase of protestant Christianity and Islam followers since 1991. Moreover, it may also be related to recent events of religious fundamentalism that have been observed in big cities rather than in rural areas, which promote pronatalist values. A similar pattern is observed in the rest of the regions with the addition of the 'traditionalist' women which also have higher desire for more children.

Earlier studies have shown that in the transition to lower fertility, the fertility of different ethnic groups did not decline uniformly (Govindasamy et al, 1992). Ethiopia has recently adapted an ethnic-based federal system where the country is re-mapped into federal states along major ethnic groups. The results in Table (6.1) show that women in of Tigriyan ethnic background have the highest desire for additional children in Addis Ababa. On the other hand, more than half of women of all ethnic backgrounds in the 'Rest' have a desire for more children. Finally, the results in Table (6.1) show that there is no significant difference in the pattern of desire for more children among women in the 'Rest' with respect to current place of residence.

6.2 Factors influencing fertility intent in Addis Ababa and the 'Rest' of Ethiopia

As indicated earlier, the main purpose in this section is to examine the factors influencing current and future fertility preference (desire for additional children) in Addis Ababa and the 'Rest' of Ethiopia. Multinomial logistic regression that accounts for the survey design was used to classify factors associated with the response variable. Two multinomial models - one for Addis Ababa respondent women and the second for women in the 'Rest' of Ethiopia were fitted to the data on desire for additional children. The main reason behind this partition is to examine the effect of the same set of factors in both regions in order to identify similarities and differences as well as factors that played a better role in influencing women's fertility intentions. Since parity has a major effect on the likelihood of childbearing it was used as a control factor together with age of women in all the models.

Model building was carried out in steps starting with a basic model that contains the response and age. The discussions of results are presented below in the sub-sections 6.2.1-6.2.3. Note that these tables were not separately run models, but extracted from the final model containing all covariates. The reason for the partition is for the purpose of discussing each major group of factors.

6.2.1 Results of the design-based survey analysis of desire for additional children by intermediate and demographic factors

Table 6.2 presents the estimated probabilities of desire for additional children by some of the intermediate and demographic factors. These probabilities were calculated by transforming the estimated equations and then setting all other variables other than that of interest at their mean value (See chapter three for details). Figure 6.1 shows the probabilities of desire for additional children plotted against age of the respondent. It is evident from the same figure that desire for 'no more' and 'want more' criss-cross at around mid-thirties. Women in Addis Ababa prefer to stop childbearing faster than those in the rest of the regions. However, there is little difference between the younger and older age groups in terms of probabilities of being undecided to have a/another child.

Table 6.2: Estimated probabilities of desire for additional children by intermediate & demographic factors

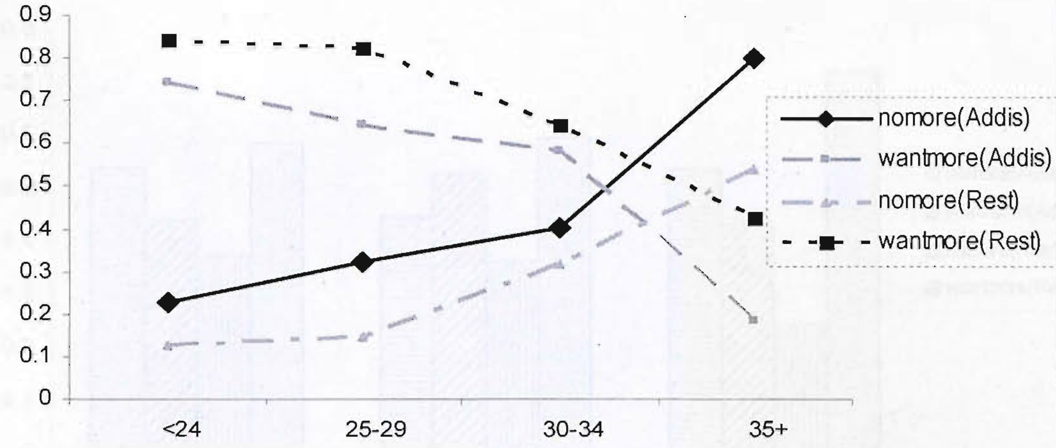
Factors	Addis Ababa			'Rest' of Ethiopia		
	no more	undecided	want more	no more	undecided	want more
Intermediate/Demographic factors						
Age group						
<24	0.226	0.032	0.742	0.127	0.031	0.842
25-29	0.324	0.033	0.643	0.145	0.032	0.823
30-34	0.401	0.016	0.583	0.318	0.04	0.642
35+ R	0.801	0.016	0.183	0.538	0.034	0.428
Marital duration						
Married for <4 yrs	0.176	0.042	0.782	0.088	0.031	0.881
Married for 5-9 yrs	0.37	0.016	0.614	0.174	0.042	0.784
Married for >10 yrs R	0.815	0.013	0.172	0.406	0.039	0.555
Parity						
Has no child R	0.12	0.039	0.841	0.103	0.059	0.838
Has 1 to 2 children	0.673	0.035	0.292	0.167	0.038	0.795
Has 3+ children	0.89	0.002	0.108	0.505	0.028	0.467
Gender Preference						
No preference R	0.541	0.018	0.441	0.375	0.039	0.586
Daughter preference	0.448	0.022	0.53	0.361	0.041	0.598
Son preference	0.536	0.031	0.433	0.243	0.033	0.724
Child loss experience						
No child loss R	0.462	0.026	0.512	0.269	0.035	0.696
1 or more children lost	0.447	0.029	0.524	0.415	0.037	0.548

R ≡ reference category; NB: never married women are omitted from the analysis.

The probability of adding more children for Addis Ababa women first peaks at younger ages and then drops faster than that for the 'Rest' of Ethiopia. This confirms what was mentioned in the bivariate analysis that Addis Ababa has higher marital instability than in the 'Rest' of Ethiopia with about a quarter of the respondents reporting that they have been married more than once.

Among the demographic factors, marital duration was significantly associated with desire for additional children. According to Table 6.2 and Fig. 6.2, the probability of wanting no more children increases with increasing duration of marriage for both regions. Among the factors found to have significant association with fertility intent in Addis Ababa and the 'Rest' of Ethiopia is gender preference. According to Table 6.2 and Figure 6.3, when all other factors are accounted for, women in Addis Ababa who have daughter preference are less likely to say no more children and more likely to add more.

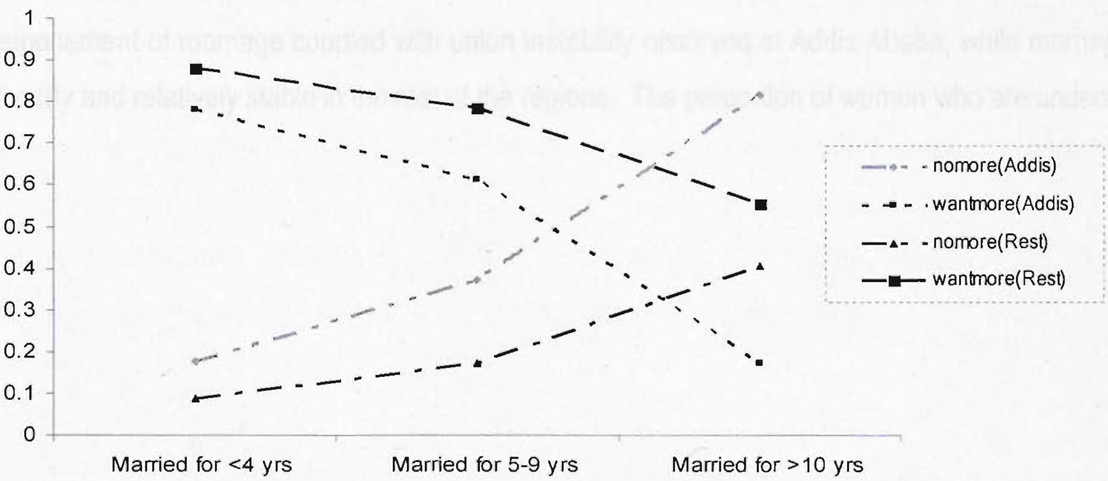
Fig.6.1: Probabilities of desire for additional children by age for Addis Ababa and the rest of Ethiopia



NB: The graph compares only 'no more' and 'want more' as the effect of the 'undecided' category is minimal

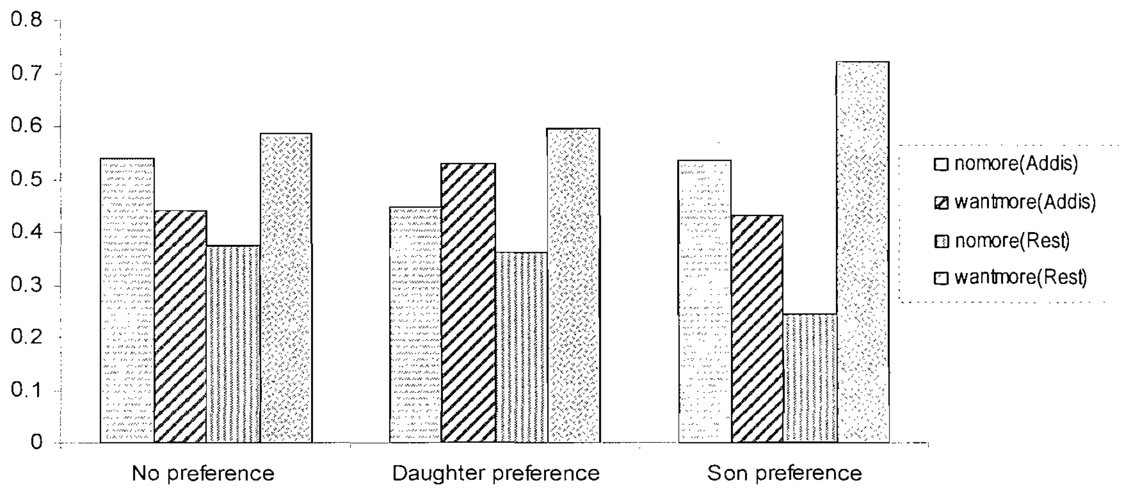
On the other hand, the analysis also found out that women in the 'Rest' of Ethiopia with son preference have relatively higher probability of desire for more children. These findings support earlier arguments that Addis Ababa women, who might want to handle childbearing and labour force participation are likely to prefer daughters to help in the domestic work that includes baby sitting, while in the rest of the regions, sons may be preferred to help in the farm.

Fig. 6.2 Probabilities of desire for additional children by marital duration for Addis Ababa and the rest of Ethiopia



Moreover, the main source of the demand for large family sizes in the vast rural areas is the fact that old age security for parents comes from children. One important aspect of son preference in rural area in Ethiopia is that parents cannot expect much help from their daughters after their marriage.

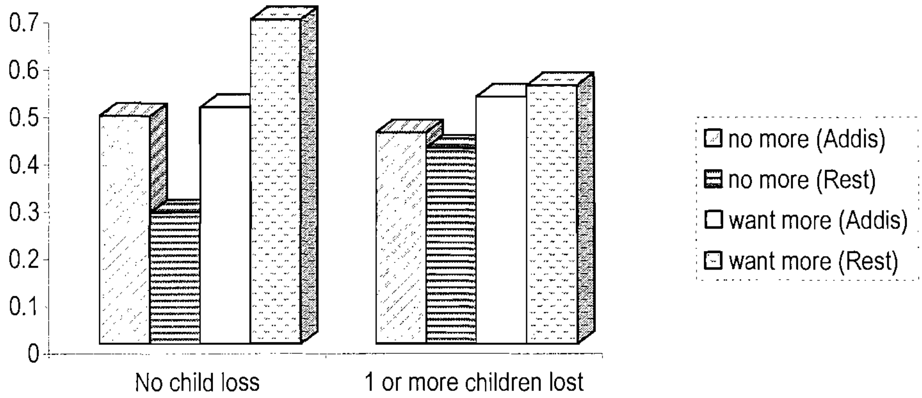
Fig. 6.3: Probabilities of desire for additional children by gender preference for Addis Ababa and the rest of Ethiopia



There is adequate literature regarding the 'replacement' hypothesis that a death of a child triggers a decision to have more children to replace and for security purpose. Table 6.2 displays the probabilities of desire for additional children by child loss experience. Women who experienced the loss of one or more children are more likely to desire more children than those who had no child loss experience (see Fig. 6.4).

To sum up the results of this sub-section, in all intermediate and demographic factors discussed above, Addis Ababa women had higher probabilities of desiring 'no more children' compared to women in the 'Rest' of Ethiopia. The reasons behind this pattern is perhaps due to the high postponement of marriage coupled with union instability observed in Addis Ababa, while marriage is still early and relatively stable in the rest of the regions. The proportion of women who are undecided

Fig6.4: Probabilities of desire for additional children by child loss experience for Addis Ababa and the Rest of Ethiopia

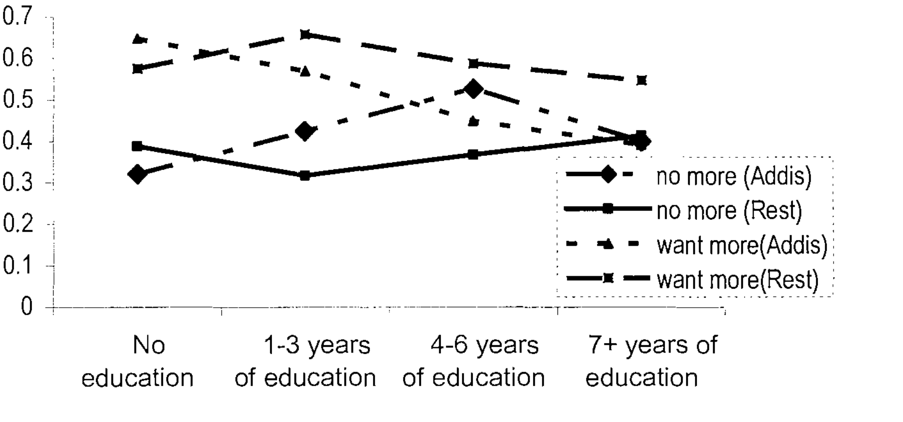


6.2.2 Results of the design-based survey analysis of desire for additional children by opportunity cost economic factors

The type of household assets, women's level of education and labour force participation and their partners' level of education and occupations were considered as proxies for the opportunity cost/economic status of the respondent in this study.

Table 6.3, shows the estimated probabilities of some of the opportunity cost or socio-economic factors included in the model. Out of five explanatory variables included in this group, women's education and work status in both regions and household wealth only in Addis Ababa were significantly associated with desire for additional children. As can be seen in Table 6.3 and Figure 6.5, Addis Ababa women with at least 7+ years of education have higher probability of being undecided to have a/another child. On the other hand, women in the 'Rest' of Ethiopia with similar level of education have higher probabilities of 'want more children'. This is in line with what was obtained in chapter five that after controlling for urbanization in both regions, education was found to have significant influence on the 'births in the last 5 years' only in Addis Ababa.

Fig6.5: Probabilities of desire for additional children by education for Addis Ababa and the Rest of Ethiopia



It is also evident from Figure 6.5 that the probabilities of desiring no more children fall sharply for Addis Ababa women after they have attained at least six years of formal education while for women in the rest of the regions, the probabilities follow a zigzag pattern as the level of education increases. Given the high migration to Addis Ababa from rural areas, the attitude of some of the women may have changed over time toward having children in the future as a result of 'social learning' where uneducated women who live in places where the average level of education is high may also behave in a similar way as the members of that community and change their fertility intention even if they came from a community that has high values for children. Therefore, once again women's education has come out to be the most important factor that explains fertility differences between Addis Ababa and the rest of the regions.

Table 6.3: Estimated probabilities of 'desire for additional children' by opportunity cost and economic factors

	Addis Ababa			'Rest' of Ethiopia		
Factors	no more	undecided	want more	no more	undecided	want more
Opportunity cost/ Economic factors						
Household assets index						
Lower [R]	n/a	n/a	n/a	0.364	0.039	0.597
Middle	0.509	0.024	0.467	0.391	0.038	0.571
Upper	0.429	0.014	0.557	0.451	0.015	0.534
Respondent's Education						
No education [R]	0.323	0.033	0.644	0.198	0.047	0.755
1-3 years of education	0.495	0.028	0.477	0.318	0.024	0.658
4-6 years of education	0.527	0.024	0.449	0.368	0.044	0.588
7+ years of education	0.401	0.206	0.393	0.415	0.037	0.548
Respondent's Work						
Agricultural/domestic/unskilled [R]	0.432	0.019	0.549	0.279	0.034	0.687
Sales/services	0.543	0.031	0.426	0.365	0.048	0.587
Management/technical/clerical	0.457	0.031	0.512	0.345	0.014	0.641

NB: [n/a] ≡ not applicable/significant; [R] ≡ reference category

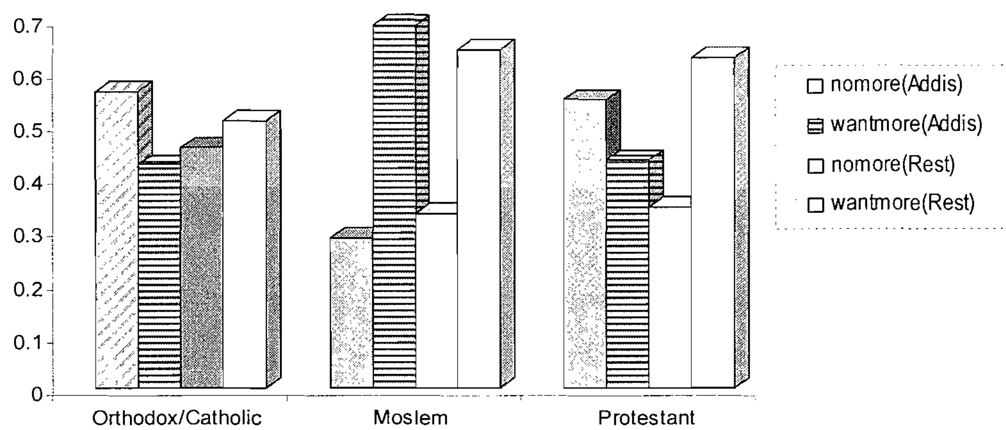
Apart from the level of education, household assets index and labour force participation were also considered as proxies for the economic status of the respondent. As mentioned in chapter five, Addis Ababa women fall only in the 'middle' and 'rich' categories of the household assets index as the index was created for the whole country data. The results show that women falling under the 'rich' category have higher probability of desiring for more children than those in the 'middle' category.

Similarly, women from both regions in the professional/technical categories have lower probabilities of fertility preference than women engaged in sales/services and agricultural/domestic occupations. This is in line with the arguments forwarded by Boserup (1985) that the relationship between economic conditions and fertility can only be determined by the net effects of both income and structural changes due to the fact that changes in income may have positive effects on family size pattern while structural changes such as in situations where women are engaged in paid employment or move to areas that are more favourable to lower fertility may have negative effects.

6.2.3 Results of the design-based survey analysis of desire for additional children by cultural and ecological factors

As shown in Table 6.4 and Figure 6.6, religion exhibited to be an important factor for Addis Ababa women in the decision to have additional children. Moslems are most likely to desire for more children than Orthodox/Catholic and Protestant Christians. On the other hand, Protestant Christians have slightly higher probability of desiring for more children than Orthodox/Catholic Christians.

Fig. 6.6: Probabilities of desire for additional children by religion for Addis Ababa and the rest of Ethiopia



Ethno-federal region was included in the model for women in the rest of the regions. The results in Table 6.3 show that the probabilities of adding more children are relatively higher for women with Tigriyan background residing in Addis Ababa than the other groups.

Table 6.4: Estimated probabilities desire for additional children by cultural and ecological factors

	Addis Ababa			'Rest' of Ethiopia		
Factors	no more	undecided	want more	no more	undecided	want more
Cultural, social & ecological factors						
Religion						
Orthodox/Catholic [R]	0.562	0.015	0.423	0.455	0.039	0.506
Moslem	0.285	0.028	0.687	0.332	0.027	0.641
Protestant	0.546	0.022	0.432	0.343	0.031	0.626
Ethnicity/Region						
Amhara	0.581	0.016	0.403	0.396	0.039	0.565
SNNP	0.472	0.016	0.512	0.374	0.027	0.599
Oromia [R]	0.574	0.014	0.412	0.342	0.049	0.609
Tigray	0.463	0.012	0.525	0.343	0.031	0.626
Current type residence						
Rural [R]	n/a	n/a	n/a	0.371	0.039	0.59
Urban	n/a	n/a	n/a	0.485	0.019	0.496

NB: [n/a] ≡ not applicable/significant; [R] ≡ reference category

6.3 Summary and conclusion

This chapter presented the results of a design based analysis of desire for additional children comparing the capital city – Addis Ababa with the 'Rest' of Ethiopia. Apart from carrying out a bivariate analysis to examine the association between the various explanatory variables and the response variable, multinomial logistic regression modelling technique that accounts for the survey design was employed for modelling desire for additional children using two sub-population samples for Addis Ababa and the 'Rest' of Ethiopia. The modelling was carried out with parity and age as the main control variables. A total of 16 explanatory variables were initially used, of which three were dropped from due to insignificance. The summary of the results and discussion are presented in the following paragraphs.

The importance of marital duration in determining fertility has long been identified (Davis and Blake, 1956; Coale, 1971; Bongaarts, 1982). Since marriage is early and almost universal in Ethiopia and contraceptive use is very low, the influence of marital duration on fertility is meaningful. The results of the preceding analyses show that Addis Ababa women have lower preference for more children despite the fact that they have been exposed for the same duration of marriage as those in the 'Rest' of Ethiopia. This may be due to either the high rate of union instability or due to the high prevalence of contraceptive use among married women observed in the capital city. Furthermore, exposure to mass media and high level of education of most of the women together with urbanization may have contributed indirectly.

Several studies have documented that in societies of Asia, the Middle East and Africa couples have been observed to have a strong preference for sons over daughters (Arnold 1996; Cleland, Verrall, and Vaessen, 1983). These characteristics of gender preference are also reflected in Ethiopia as many couples, who have preference for either sex of the child, continue to have children even after achieving their desired family size. The analysis clearly showed that gender preference is selective according to the purpose they are needed. In Addis Ababa, where there is relatively higher participation of labour force, there is relatively higher preference for daughters as they are needed to help in the domestic work such as baby sitting while the mother is at work. On the other hand, in the 'Rest' of Ethiopia, where most of the respondents depend on agricultural production, more hands are needed to help in the farm and sons are preferred as they do most of the farming work.

There is a need to create an atmosphere which can help to reduce the existing gender preference. One way to curb this bias is to increase the IEC approach in both cases with particular emphasis on 'the advantage of small family size' and also to intensify rural development such as increase in the provision of agricultural implements that can be operated by a few people compared to the traditional way 'using oxen as farm implements'.

Regarding household wealth and desire for additional children in Addis Ababa, results of the preceding analysis show that as accumulation of household assets increases, desire for more children also increases. This is contrary to what is expected with respect to earlier studies, which found that higher wealth has a fertility-reducing effect because people may have a greater preference for a higher quality of children, the rising opportunity costs of parental time, and the reduced reliance on children for old age support. However, this finding has more significance for policy targeting as it implies the fertility decline in Addis Ababa might be associated with poverty.

According to documented demographic literature, women with more education usually make a later, healthier transition into adulthood. They marry later, and are more likely to want smaller families than their less educated counterparts (Diamond et al, 1999; Lloyd et al, 1999; Jejeebhoy, 1995). According to the results of the preceding analysis of fertility preference, women with at least 7+ years of education are more likely to be undecided whether to have a/additional child. However, being undecided can be influenced to either 'no more' or 'want more' side and is also an important aspect for policy targeting. However, the fact that there is a sharp drop in the probability of desire for more children with increase in education from 4-6 to 7+ years, the undecided women are likely to add more children. It has been put forward that a woman's work career minimises her time for child bearing and rearing, thus influencing her fertility desire. Accordingly, respondent's work status was significantly associated with desire for additional children with women with professional jobs want no more children.

Despite the existence of abundant literature on the relationship between fertility and religion, the generalisations have been switching from one religious denomination to the other. For instance, traditionally it has been generalised that Muslim groups consistently showed to favour higher family size than any other religious group and that the Catholics have higher fertility than Protestant Christians (Westoff *et al*, 1979, Chaudhary, 1982). As expected, Muslim women are most likely to desire for additional children than the rest of the categories of religion. However, one of the interesting results is that the influence of religion, particularly the attitude of Moslems toward fertility is being associated to pronatalist values. This is perhaps as a result of the emergence of recent phenomena in cities where there is strong resistance toward a controlled family building.

As mentioned in earlier sections, ethnicity serves a dual purpose, representing ethnic lineage and federal region as it has been utilised to introduce the new ethnocentric federal system of administration. According to ETDHS 2000 as indicated in the model, women with Tigriyan background living in Addis Ababa are associated with a higher intention to have additional children than women in the other regions.

To sum up, the positive effect of household assets and higher education as well as professional occupation, all of which are related to higher income raises an important question whether the fertility decline in Addis Ababa is a result of the opposite direction of these factors.

CHAPTER SEVEN

ACCOUNTING FOR THE DISPARITY IN MARRIAGE AND FERTILITY BETWEEN ADDIS ABABA AND THE 'REST' OF ETHIOPIA: A DECOMPOSITION APPROACH

7.1 Introduction

The main difference between the analysis of marriage and fertility in chapter five and the current chapter is that although the parameter estimates for the covariates included may be similar, the amount of contribution of each factor is distinguished in the decomposition analysis and quantifying the gap between the two major regions in terms of the disparity due to the imbalance and the various characteristics of the respondents in each region. The main aim in this chapter is to answer the question(s): 'How much is the gap in 'non-marriage', 'births in the last five years' and 'fertility intention' between Addis Ababa and the 'Rest' of Ethiopia? And what is the contribution of each explanatory variable to this disparity?'

In the first part of this chapter, the decomposition method is briefly described. This is followed by discussion of the decomposition analysis of 'births in the last five years', 'fertility intention' and 'non-marriage' obtained using multivariate analyses. Finally an attempt is made to break up the gap into detailed contributions by each explanatory variable.

7.1.1 Data and Method

The decomposition technique used here is a modified form of the one that was first introduced by Ronald Oaxaca (1973) in the field of labour economics to determine the portion of the difference in wages between two groups that is due to differences in human capital (factors that we can explain) and the portion of the difference in wages that could be attributed to discrimination (unexplained factors).

The decomposition approach has been extensively used to quantify inter-group differences in mean levels of an outcome into a part due to different observable characteristics across groups and a part due to different effects of characteristics or "coefficients" of groups. The decomposition technique is useful for identifying and quantifying the separate contributions of geographical differences in measurable characteristics, such as education, occupation etc. to gaps in outcomes.

The decomposition methodology has been extensively applied in explaining differences (Oaxaca; Blinder, 1973) and extended to the probit, logistic and Poisson models by Gomulka and Stern (1990), Nielsen (1997) and Yun (2000). However, a recent paper by Yun (2003) provides a new approach extending the decomposition technique for application in linear and non-linear regression models.

Let's suppose we want to decompose the difference in 'births in the last five years' between women in Addis Ababa and the 'Rest' of Ethiopia. To do this, the difference in births in the last five years will be broken down into (1) a portion explained by differences in respondents' characteristics (like age at first birth, education, religion, child loss experience, etc.) and (2) into a portion due to respondents' characteristics. According to Yun (2003), the mean difference of a dependent variable (Y) between groups A and B can be decomposed as:

$$\overline{Y}_A - \overline{Y}_B = \underbrace{[\overline{F(X_A\beta_A)} - \overline{F(X_B\beta_A)}]}_{\text{Part 1}} + \underbrace{[\overline{F(X_B\beta_A)} - \overline{F(X_B\beta_B)}]}_{\text{Part 2}} \qquad (7.1)$$

where:

$F(X)$ is the function that maps X into Y;

X_A, X_B, β_A and β_B are the independent variables and their coefficients respectively. The function $F(X)$ used in this section takes the form of average predicted probability for the logistic regression function or relative rates ratio of occurrence of the outcome event in the case of the Poisson regression function. Note that the 'over bar' represents the value of the sub-sample's average for each major region.

Equation (7.1) above is represents the decomposition at the aggregate or overall level and consists of the mean differences in terms of differences in characteristics (part 1 of Eq. 7.1) as:

$$\overline{F(X_A\beta_A)} - \overline{F(X_B\beta_A)}$$

and in terms of differences in coefficients (part 2 of Eq. 7.1) as:

$$\overline{F(X_B\beta_A)} - \overline{F(X_B\beta_B)}$$

The next phase in the decomposition is to calculate the contribution of each explanatory variable to the total variation (difference). While this is quite straight forward in the case of a linear regression model, there are a few but different approaches suggesting on how to calculate the detailed decomposition for non-linear models such as the logit, probit and Poisson models. Other alternative approaches include that of Macpherson (1990), Gomluka and Stern (1990), Nielsen (1998) and Yun (2000, 2003). However, the latter's approach is applied for the analysis in this chapter. As Yun (2003) argues, the important question is how to appropriately weight the contribution of each variable to the aggregate difference due to the characteristics and coefficients. The author uses two types of approximation - evaluating the value of the function using mean characteristics and using a first order Taylor expansion to arrive at:

$$\overline{Y}_A - \overline{Y}_B = \sum_{i=1}^{i=k} W^i_{\Delta X}[\overline{F(X_A\beta_A)} - \overline{F(X_B\beta_A)}] + \sum_{i=1}^{i=k} W^i_{\Delta\beta}[\overline{F(X_B\beta_A)} - \overline{F(X_B\beta_B)}] \quad (7.2)$$

where:

$$W^i_{\Delta X} = \frac{(\overline{X}^i_A - \overline{X}^i_B)\beta^i_A}{(\overline{X}_A - \overline{X}_B)\beta_A} \quad (7.3)$$

Equation (7.3) is the weight for the detailed decomposition for the characteristics effect and *i* represents each explanatory variable used in group 'A' and group 'B' models.

$$W^i_{\Delta\beta} = \frac{\overline{X}^i_B(\beta^i_A - \beta^i_B)}{\overline{X}_B(\beta_A - \beta_B)} \quad (7.4)$$

Equation (7.4) is the weight for the detailed decomposition to identify the difference due to the coefficients effect. In sum, an appropriate weight can be calculated by using a 'sequential replacement methodology' and the mean values of the characteristics (Xs) and their coefficients (βs).

SECTION 7.2:
ACCOUNTING FOR THE DISPARITY OF BIRTHS IN THE LAST FIVE YEARS BETWEEN ADDIS ABABA AND THE 'REST' OF ETHIOPIA

7.2.1 Introduction

As indicated in the beginning of this chapter, the decomposition analysis of fertility is carried out using births in the last five years. The decomposition technique extended for count models is used in the analysis. Therefore, the parameter estimates are similar to that discussed in chapter five and only the significance and contribution of each explanatory variable to the overall gap in births in the last five years are discussed. The interpretation of the contributions of each explanatory variable is categorised into two - a part that indicates the difference in characteristics and a part that indicates the difference in coefficients (effects resulting behaviour change).

Table (7.1) displays the results of the negative binomial and Poisson regression models of births in the last five years for Addis Ababa and the 'Rest' of Ethiopia respectively. Education of the respondent is significant in both samples but in opposite direction for Addis Ababa the 'Rest' of Ethiopia with a negative association in the former and a positive association in the latter case. After accounting for other socio-economic and cultural factors included in the model, education contributes about 11 percentage points to the difference in characteristic and about 39 percentage points to the difference in coefficients (effects). Among the education categories, having had at least 7+ years of education contributes much of the difference (6% and -34%) towards the difference in characteristic and coefficients respectively.

Table 7.1: Decomposition of 'births in the last five years' between Addis Ababa and the 'Rest'

	Parameter estimates	|t|	Parameter estimates	|t|	Difference in characteristics	Difference in coefficients
Education						
1-3 years of education	0.058	0.30	0.441***	5.80	0.016	0.003
4-6 years of education	-0.399**	2.22	0.498*	1.82	0.028	-0.053
7+ years of education	-1.152***	7.20	0.643***	6.37	0.062	-0.342
Occupation						
Sales/services	-0.095	0.74	-0.216***	4.24	-0.015	-0.015
Prof./technical/clerical	-0.789**	2.99	-0.489**	2.76	-0.003	-0.095
HH assets Index						
High HH asset	0.216**	2.14	0.417***	10.97	0.004	0.063
Housing status						
no own/council house	-0.398**	2.82	0.106	1.36	0.002	-0.058
Migration status						
migrated ≥5yrs/lived always	-0.593**	2.99	0.389	1.32	0.011	-0.247
Religion						
Moslem	0.362*	1.72	0.247	1.69	0.032	0.102
Protestant	-0.182	0.67	0.116	1.51	0.028	-0.015
Ethnic background						
Amhara	-0.392	1.53	-0.23***	4.51	-0.031	-0.086
SNNP	0.261**	2.25	0.293***	4.73	0.005	0.008
Tigray	0.317***	5.87	0.109**	3.11	0.016	0.061
Constant	-0.991***	4.74	-2.577***	59.93		
Dispersion parameter						
Alpha	0.867***	5.29				

NB: 'no educ', 'not working', 'low hh assets index', 'lives in own/council hse', 'migrated ≤ 5 yrs', Orthodox Christianity & Oromo ethnic group are reference categories respectively not shown in the table; * sig. at 10%; ** sig. at 5% * sig. at ≤1%**

Among the socioeconomic covariates included in the decomposition analysis of births in the last five years is respondent's occupation. The results shown in Table (7.1) indicate that employment opportunity is associated with lower family size in both regions evident in the negative association between the covariate and the dependent variable. In terms of its contribution to the total gap in fertility between the two major regions, occupation reduces the total gap by about 2 percentage points in the difference in characteristics and by about 11 percentage points in terms of coefficients. Professional or technical occupation category contributes the highest (about -10%) to the differences in coefficients (effects).

Household assets index, which is positively associated to births in the last five years, also contributes about 6 percentage points to the difference in coefficients. Having no own house also contributes about 6 percentage points to the overall gap in fertility through the difference in coefficients.

Surprisingly, migration explains most of the gap in fertility next to education (about -24%). Having migrated a long time ago or always living at the current residence contributes the most to the difference coefficients (about -25%) indicating that if women in the 'Rest' of Ethiopia were to behave like those in Addis Ababa, their fertility would be lower by about 25 percentage points. This is perhaps a result of the long term effect of urban life and all modernization factors attached to it.

Consistent with the observations made in earlier sections, Table (7.1) displays that being Muslim has an increasing effect on childbearing than Orthodox Christians especially in Addis Ababa with a contribution of about 10 percentage points to the difference in coefficients. Christianity has been the predominant religion in Ethiopia historically linked the state. However, in recent years this influence has decreased partly as a result of the fast spread of Islam with a more pronatalist tendency.

Among the ethnic background factors included in the decomposition analysis, being from the Amhara and Tigray ethnic backgrounds contribute about 9% and 6 % respectively to the gap in fertility but in the opposite direction, which agrees with the earlier result that the latter group's marriage and fertility pattern are higher than the traditional larger groups in the country.

Table (7.2) presents the overall decomposition of the two measures of the differential of births in the last five years – due to 'characteristic' and due to 'coefficients' between Addis Ababa and the 'Rest' of Ethiopia. According to Table (7.2), the overall gap in births in the last five years between Addis Ababa and the 'Rest' after accounting for various factors is about 52 percentage points. When the overall gap is broken down in to the two major differentials, most of the difference appears to be due to the coefficients with about -67% while that due to the differences in characteristics is relatively small with about 16%. Note that the total contribution of main variables is an aggregate of their dummy variables. The contributions of each of the categories/dummy variables of these main variables are presented in Table (7.1).

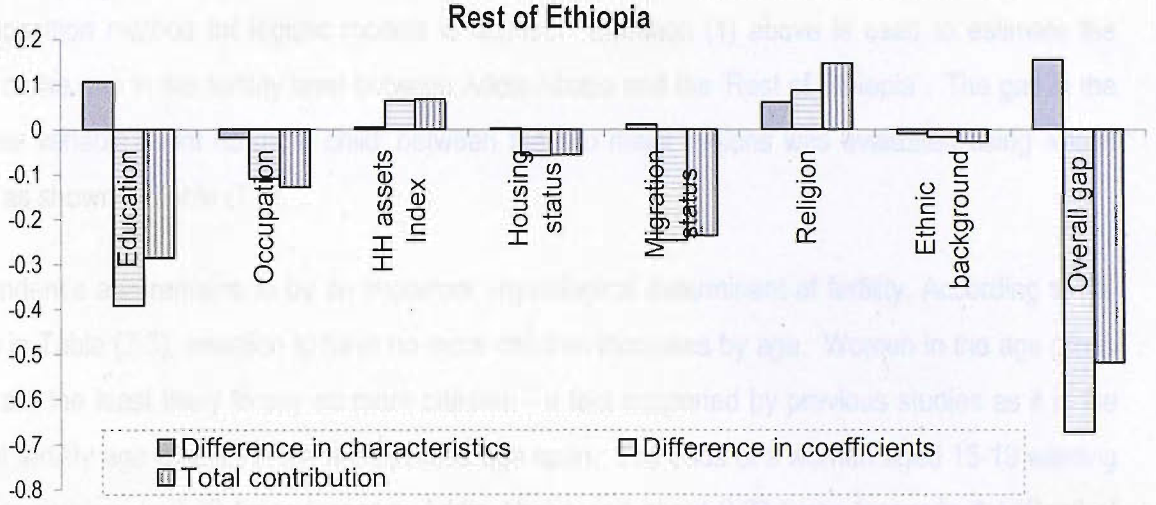
Table 7.2: Decomposition of gap in 'actual fertility' between Addis Ababa and the 'Rest' of Ethiopia

Decomposing factor	Difference in characteristics	Difference in coefficients	Total contribution
Education	0.106	-0.392	-0.286
Occupation	-0.018	-0.11	-0.128
HH assets Index	0.004	0.063	0.067
Housing status	0.002	-0.058	-0.056
Migration status	0.011	-0.247	-0.236
Religion	0.06	0.087	0.147
Ethnic background	-0.01	-0.017	-0.027
Overall gap*	**0.155**	**-0.674**	**-0.519**

NB: * the 'overall gap' in the last row and 'total contribution' in the last column are sum totals of the individual values from the covariates used in the decomposition.

Particular attention is given to the contribution of each explanatory variable to the difference in coefficients. Most of the explanatory variables contribute more to the difference in coefficients (behavioural effect) than to the difference in characteristics. Education, occupation, migration and religion have relatively higher contribution to the difference in coefficients (effects).

Fig 7.1: Decomposition of the gap in fertility between Addis Ababa and the Rest of Ethiopia



The negative sign has an important implication as illustrated in Fig (7.1) in that if women in the 'Rest' of Ethiopia were to behave like those in Addis Ababa (the standard population) then many more of them would have lesser rate of childbearing than their current pace. Therefore the main difference in births in the last five years between the two major regions is due to the differences in coefficients, which would in turn be attributed to behavioural change.

SECTION 7.3:
ACCOUNTING FOR THE DISPARITY OF FERTILITY INTENTIONS BETWEEN ADDIS ABABA AND THE 'REST' OF ETHIOPIA

7.3.1 Introduction

To examine the factors that contribute to the gap in and affect women's fertility intention, a decomposition method for logistic models is applied. Equation (1) above is used to estimate the extent of the gap in the fertility level between Addis Ababa and the 'Rest of Ethiopia'. The gap in the outcome variable 'want no more child' between the two major regions was evaluated using a logit model as shown in Table (7.3).

Respondent's age remains to be an important physiological determinant of fertility. According to the results in Table (7.3), intention to have no more children increases by age. Women in the age group 25-29 are the least likely to say no more children - a fact supported by previous studies as it is the highest fertility age bracket in the reproductive age span. The odds of a woman aged 15-19 wanting no more children is 0.32 times lesser in Addis Ababa and about 0.26 times lesser in the 'Rest' of Ethiopia than the older age group (>35). Age contributes more to difference in coefficients than to the differences in characteristics. It contributes about 4 percentage points to the differences in coefficients (effects).

Statistically significant differences in fertility intention are also observed in the categories of duration of marriage. The odds of a woman in the 'Rest' of Ethiopia who had been married for more than 10 years and not wanting any more children is about 2.4 times greater than those not married or in the early years of marriage. Marital duration contributes about 6 percentage points to the differences in coefficients and only 1 percentage point to the differences in characteristic. In total, marital duration contributes about 7 percentage points to the gap in fertility intentions between Addis Ababa and the 'Rest' of Ethiopia.

Table 7.3: Decomposition using logistic regression of 'fertility intention' (ETDHS 2000)

	Addis Ababa		Rest of Ethiopia		Decomposition	
Explanatory variables	Coefficient	|t|	Coefficient	|t|	Difference in characteristics	Difference in coefficients
Age group						
<24	-1.139***	-2.92	-1.302***	-11.8	0.0064	0.0293
25-29	-1.481***	-5.35	-1.504***	-20.06	0.0004	-0.0104
30-34	-1.582***	-5.7	-1.113***	-17.08	0.0008	-0.00023
Marital duration						
Married for <4 yrs	-0.727**	-2.09	-0.763***	-5.87	-0.0015	0.0606
Married for 5-9 yrs	-0.021	-0.08	-0.501***	-5.29	0.0101	-0.0592
Parity						
Has 1 to 2 children	1.491***	4.55	0.661***	5.73	-0.0262	0.035
Has 3+ children	3.166***	8.34	1.401***	11.15	0.0837	0.0904
Child loss experience						
1 or more children lost	-0.450*	-1.97	-0.026	-0.47	0.0161	0.2015
Household assets index						
Middle	-0.501**	-2.32	0.393	7.38	-0.0505	-0.043
Upper	0.549***	4.29	0.261**	1.69	-0.0172	-0.0536
Respondent's Education						
1-3 yrs of education	-0.272	-0.82	0.265	0.254	-0.002	-0.0219
4-6 yrs of education	-0.406*	-1.46	0.667	0.583	-0.018	-0.0505
7+ yrs of education	-0.174***	-2.68	0.638	0.517	-0.0623	-0.0719
Respondent's Work						
Sales/services	-0.029	-0.14	0.282***	3.91	0.0002	-0.0216
Professional	-0.664**	-2.01	-0.166	-0.7	0.028	0.0406
Religion						
Moslem	-1.353***	-4.6	-0.555***	-10.54	0.064	0.089
Protestant	-0.337	-0.9	-0.401***	-5.39	-0.03	-0.034
Kinship support						
Fostered/adopted	0.729**	2.22	0.943	6.44***	0.0032	-0.0037
Supported kins	0.204	0.6	0.588	6.5***	0.0042	-0.0062
Reproductive rights awareness						
Unaware	0.077	0.27	-0.056	-0.14	0.0061	0.0084
Constant	0.033	0.08	-0.720	-5.55		

Source: 35+, mar>10, no child, no child loss, low asset, no educ, not working, orthodox, hh head and aware are reference categories not shown in the table; * signif. at 10%; ** signif at 5% * signif at ≤1%**

Parity is introduced explicitly into the model, together with age and marital duration in order to decide on empirical grounds whether fertility intention is parity-dependent. The odds of a woman who has three or more children wanting no more is about 23 times greater than a woman with no children in Addis Ababa compared to only 4 times in the 'Rest' of Ethiopia. Parity also contributes about 6 and 12 percentage points to the differences in characteristics and coefficients respectively.

Child loss experience was controlled for in both models as it is a proxy to fertility intention. Death of an infant is supposed to interrupt breastfeeding and shorten subsequent birth interval. In situations where high child mortality or insecurity prevails, behavioural and cultural mechanisms may compel couples to have more children in fear of future child loss. As a result, the contribution of child loss experience to the overall gap between the two major regions in wanting no more children is significant. This assertion is supported by the fact that the odds of a woman with one or more child loss experience is about 0.63 times in Addis Ababa and about 0.97 times in the Rest less likely to say no more children. For this reason the contribution of child loss experience to the overall gap in fertility intention is high (2 and 20 percentage points contributing to the differences in characteristic and coefficients respectively.

The fertility intention model was controlled among others for household assets. This was positively associated with fertility intention in both Addis Ababa and the 'Rest' of Ethiopia model, though the later was not significant. However, its contribution to the difference in the overall gap is also smaller with less than 2 percentage points contributing to the differences in coefficients.

Much of the explanation in fertility intention is contributed by respondent's education. Education explains about 8 and 19 percentage points to the differences in characteristics and coefficient. So, it contributes about 27 percentage points to the overall gap, which is the highest among the covariates included in the model.

The results presented for work status of the respondent perhaps reflect the effects of age and education, because younger and better-educated women are more likely to be engaged in some kind of paid work thereby delaying childbearing. Consequently, women in the professional category are less likely to say no more children than those not working. In both cases, we observe that working career has a strong influence on fertility intention and contributes about 7 percentage points to the gap between the two regions.

The contribution of religion to fertility intention is about 7 percentage point, although Muslim women in Addis Ababa are less likely to say no more children than their counterpart in the 'Rest' of Ethiopia. Among the factors that influence the fertility intention of women in a given community is kinship network mainly relating to the type and size of the extended family. If the direction of a kinship network is either pronatalist or anti-natalist, it can considerably determine the intention of those 'benefiting' from the network. For instance, a fostered/adopted woman living within a pronatalist network is highly likely to adopt a tendency that having high number of children is rewarding or that childlessness entails negative sanctions. In this regard, fostered/adopted women and supported kin are less likely than household head women to say no more, but when controlling for age and other individual characteristics, these group of women are more likely to delay having a child or another child childbearing than household head women. But its contribution to the gap is negligible.

Men head households in most communities in Ethiopia. Except retaining their parental family name, women derive their residence, nationality and sustenance from their husbands. Consequently, men enjoy a huge benefit at the expense of the cultural bias prevalent in the rural areas. This is reflected in the association between reproductive rights and intention to have a child or add another child where more than three-quarters (81%) of women in Addis Ababa are aware of their reproductive rights compared to only less than half of women (46%) in the 'Rest' of Ethiopia. However, the category (unaware) was insignificant in both models and this is reflected in its contribution to the overall gap in fertility intention.

To summarize the decomposition of fertility intentions, as indicated earlier, the main questions the decomposition technique helps to answer are:

a) What would the gap be if the behaviour of women did not differ between Addis Ababa and the 'Rest' of Ethiopia but their characteristics did; or
b) What would the gap be if their characteristics did not differ but their behaviour did?'

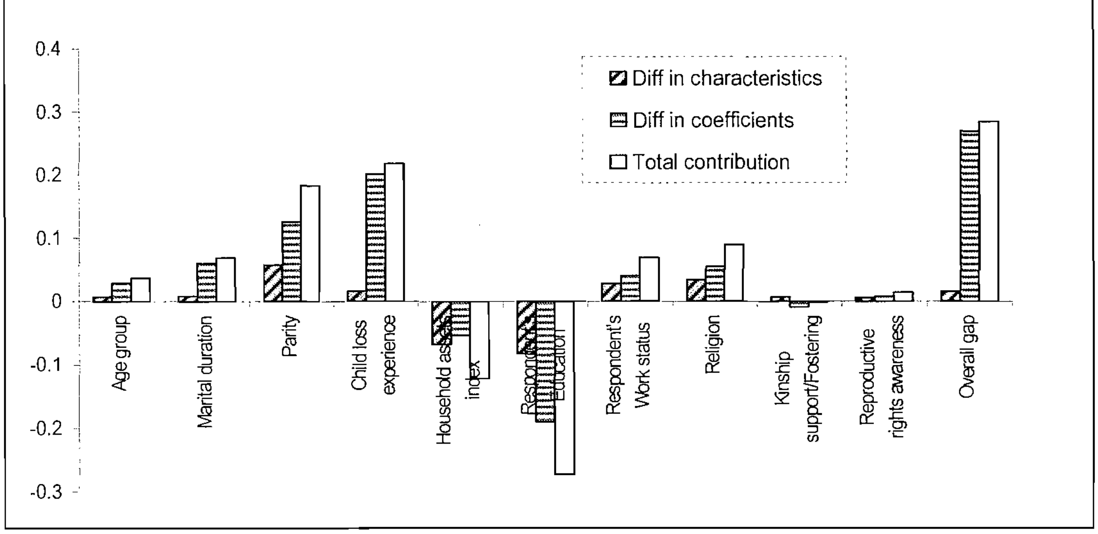
The total contributions of each explanatory variable, estimated using separate weighting factors are presented in Table (7.4). The overall differential in fertility intention between Addis Ababa and the 'Rest' of Ethiopia is about 28 percentage points. Of this, the gap due to differences in characteristic is 2 percentage points while about 26 percentage points of the gap is due to differences in the coefficients.

Table 7.4: Decomposition of gap in 'fertility intention' between Addis Ababa and the 'Rest' of Ethiopia

Decomposing factor	Diff in characteristics	Diff in coefficients	Total contribution
Age group	0.0076	0.0293	0.0369
Marital duration	0.0086	0.0606	0.0692
Parity	0.0575	0.1254	0.1829
Child loss experience	0.0161	0.2015	0.2176
Household assets index	-0.0677	-0.0536	-0.1213
Respondent's Education	-0.0823	-0.1895	-0.2718
Respondent's Work status	0.0282	0.0406	0.0688
Religion	0.034	0.055	0.089
Kinship support/Fostering	0.0074	-0.009	-0.0016
Reproductive rights awareness	0.0061	0.0084	0.0145
Overall gap	**0.0155**	**0.2687**	**0.2842**

The explanatory variable with the highest contribution is marital duration as illustrated in (Fig 7.2) with most of its contribution attributable to the difference in coefficient (16 percentage points) and about 1 percentage point due to differences in characteristics. The second highest contributor is education of the respondent. The total contribution of education through all of its categories to the overall differential in fertility intention between Addis Ababa and the 'Rest' of Ethiopia is about 12 percentage points of which about 8 percentage points is due the difference in the characteristics while that due to the difference in coefficients is 21 percentage points.

Fig 7.2: Gap in fertility preference between Addis Ababa and the Rest of Ethiopia



It is worth noting here that although, the overall contribution of education ranks next to marital duration, much of the difference in the coefficients is attributable to education and could be identified as the most important factor in the fertility intention gap between the two regions. Parity and age follow with about 3% and 4% contribution respectively.

SECTION 7.4:
ACCOUNTING FOR THE DISPARITY OF NON-MARRIAGE BETWEEN ADDIS ABABA AND THE 'REST' OF ETHIOPIA

7.4.1 Introduction

Time to first marriage was investigated in chapter five in a comparative structure in order to identify the factors associated with marriage which in turn played a vital role in the fertility differential between Addis Ababa and the 'Rest' of Ethiopia. This section is a continuation of the effort to understand marriage but with a slight difference from chapter five that in this chapter the determinants and the gap in non-marriage between the two regions are examined.

As indicated in the research statement, following the study by Sibanda *et al* (2003) which suggested that marriage has played a vital role in the fertility decline in Addis Ababa, this study picked unanswered questions by the above authors such as: If delaying marriage played a role in the fertility decline in Addis Ababa, then what factors influence 'time to marriage'? And what factors influence 'non-marriage'? What is the extent of the gap in non-marriage between Addis Ababa and the 'Rest' of Ethiopia?

The gap in the outcome variable 'non-marriage' between the two major regions was evaluated using a logit model as shown in Table (7.3). Age was included in the decomposition as a control variable. As expected, age has a positive association with non-marriage in Addis Ababa and a negative association with non-marriage in the 'Rest' of Ethiopia. This justifies earlier claims that there is more delaying of marriage in the capital city than the 'Rest' of the country. The positive association of age and non-marriage in Addis Ababa is reflected in the detailed decomposition of as shown in Table (7.4) in which age explains the biggest gap, especially the difference in coefficients (58%).

Table 7.5: Decomposition using logistic regression of 'non-marriage' (ETDHS 2000)

	Parameter estimates	|t|	Parameter estimates	|t|	Difference in charac.	Difference in coeff.
Age	0.284***	-13.55	-0.377***	-23.71	0.055	0.575
Education						
1-3 years of education	0.394**	2.42	-1.184***	10.06	0.001	0.040
4-6 years of education	0.677***	3.99	-1.173***	10.12	0.077	0.020
7+ years of education	1.766***	12.02	-1.679***	15.65	0.005	0.195
Occupation						
Sales/services	-0.057	0.52	0.462***	4.77	-0.010	-0.072
Prof./technical/clerical	-1.339***	6.15	-0.722**	2.37	-0.006	-0.103
HH assets Index						
High HH asset	-0.277**	2.54	-0.065	1.14	-0.001	-0.091
Housing status						
no own/council house	0.147***	3.10	-0.039**	2.45	0.051	0.124
Migration status						
migrated ≥5yrs/lived always	-0.877***	5.08	0.079	0.64	-0.082	-0.245
Constant	-0.042	0.29	-1.792*	12.28		

Source: no educ, not workingl/, lower hh asset, lives in own/council hse, not migrated and migrated <5 yrs are reference categories not shown in the table; * signif. at 10%; ** signif at 5% * signif at ≤1%**

Yet again education has come out as the leading socioeconomic factor that influences non-marriage. After accounting for obvious and powerful factors such as age, the decomposition of non-marriage is carried out using only socioeconomic covariates. Besides the fact that being educated for at least 7+ years of education increases the odds of being non-married in Addis Ababa, education also contributes the most to the gap in non-marriage between the two regions with an overall contribution of about 34 percentage points (see Table 7.6), of which about 26% is due to the difference in coefficients (effects). On the other hand, education and non-marriage are negatively associated in the 'Rest' of Ethiopia, which is consistent with earlier finding that despite being in school, women are less likely to be single until they finish schooling due to family or community pressure.

Being engaged in a sales or professional occupation seems to be a precursor for getting married in both Addis Ababa and the 'Rest'. In other words, women with some form of paid work are more likely to be married evident from the negative association between non-marriage and occupation.. We recall that in earlier sections we found out a negative association between occupation and fertility particularly in Addis Ababa. Therefore, women in the capital city who are engaged in employment may get married but postpone the arrival of the first child or limit their fertility, which is one of the central reasons for the fertility gap between the two regions. The detailed decomposition of non-marriage shown in Table (7.4) also shows that of the categories of occupation, professional or technical occupation has contributed the most (about 10%) to the gap in non-marriage in terms of the difference in coefficients (effects).

As shown in Table (7.5), the odds of having higher household assets reduces the odds of non-marrying implying that a woman with higher household assets is more likely to get married in both regions of study. Household assets also contributes a part in explaining the gap in non-marriage between Addis Ababa and the 'Rest' of Ethiopia (about 9%) mainly through the differences in coefficients.

Table 7.6: Summary of the decomposition of non-marriage

Decomposing factor	Difference in characteristics	Difference in coefficients	Total contribution
Age	0.084	0.575	0.659
Education	0.083	0.255	0.338
Occupation	-0.016	-0.175	-0.191
HH assets Index	-0.091	-0.091	-0.182
Housing status	0.051	0.124	0.175
Migration status	-0.082	-0.245	-0.327
Overall gap	**0.029**	**0.443**	**0.472**

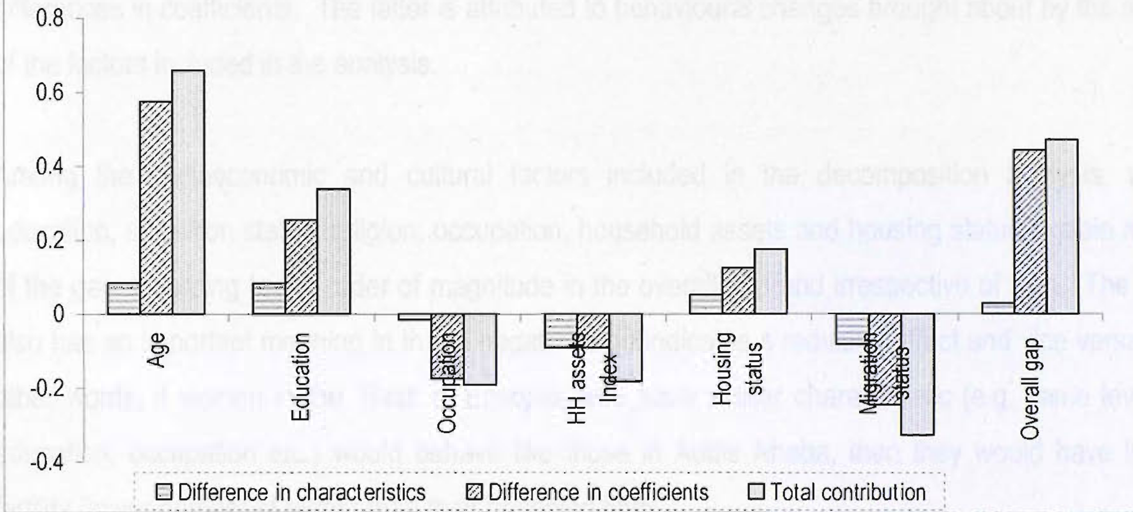
NB: * the 'overall gap' in the last row and 'total contribution' in the last column are sum totals of the individual values from the covariates used in the decomposition.

Housing status has been suggested as having played a vital role in delaying marriage in Addis Ababa. As expected, housing status is among the highly and positively significant socioeconomic covariates influencing non-marriage in Addis Ababa, but negatively associated in the 'Rest' of Ethiopia. This is reflected in the decomposition analysis that having no own or council house contributes to the gap in non-marriage by about 5% and 12% to the differences in characteristics and coefficients.

Migration status is identified as one of the leading factors that influence marriage and thereby fertility. In the decomposition analysis of nom-marriage, women who migrated to the capital city a long time a go or who have always lived in the current residence are less likely to be non-married, which is a reversal of the result obtained in the fertility analysis. This could be a result of the fact that women who have lived in the capital city for a long time may have settled well and get married but make informed decisions regarding their fertility. Table (7.4) displays that migration status explains the gap in non-marriage with the second highest contribution next to education, of -8% and -25% to the differences in characteristics and coefficients respectively.

Table (7.5) and Fig (7.3) display summary of the decomposition of the gap in non-marriage between Addis Ababa and the 'Rest' by major socioeconomic covariates. The overall gap in non-marriage between Addis Ababa and the 'Rest' by socioeconomic factors is about 47% with most of this gap being due to the differences in coefficients (44%). Also note the sign of the differences – that age, education and housing status have an overall positive effect while occupation, household assets and migration status have overall negative effect.

Fig 7.3: Decomposition of the gap in non-marriage between Addis Ababa and the Rest of Ethiopia



7.5.4 Conclusion

The main purpose of this chapter was to quantify the gap in births in the last five years and fertility intention and non-marriage between Addis Ababa and the 'Rest' of Ethiopia using a decomposition technique. Consequently, it was established that the overall gap in births in the last five years between Addis Ababa and the 'Rest' of Ethiopia in terms of the covariates used in the analysis is about -52% of which about 15% is due to differences in characteristics and about -67% is due to differences in coefficients. The latter is attributed to behavioural changes brought about by the some of the factors included in the analysis.

Among the socioeconomic and cultural factors included in the decomposition analysis, while education, migration status, religion, occupation, household assets and housing status explain much of the gap according to the order of magnitude in the overall gap and irrespective of sign. The sign also has an important meaning in that a negative sign indicates a reducing effect and vice versa. In other words, if women in the 'Rest' of Ethiopia, who have similar characteristic (e.g. same level of education, occupation etc.) would behave like those in Addis Ababa, then they would have lower fertility (lower number of births) than their observed level.

The decomposition analysis of fertility intention revealed that the overall gap between Addis Ababa and the 'Rest' of Ethiopia is about 28%, almost all of which is due to differences in coefficients attributable to the effects brought about by education (-27%), child loss experience (21%), parity (18%) and household assets index (-12%). Again the sign contrast, particularly the similarity between education and household assets index shows that the higher the education level or the higher the household wealth level the higher the desire to have more children. It is understandable to form a family and have children after spending many years in education. However, the desire to have more children when one has good household wealth triggers a question whether desire to have or not to have more children is associated with income.

Added to this, the decomposition analysis of the much publicized factor as having played a vital role in the dramatic fertility decline in Addis Ababa - marriage revealed that there is a 47% gap in non-marriage between Addis Ababa and the 'Rest' of Ethiopia, of which about 44% is due to differences in behavioural change. Among the factors included in the decomposition, education household assets, housing status and migration status explain much of the gap irrespective of the direction of effect (sign). There is one more analysis to carry out – hierarchical or multilevel analysis that helps disentangle individual and community level effects before making some generalization.

CHAPTER EIGHT
A MULTILEVEL ANALYSIS OF FACTORS INFLUENCING FERTILITY IN ETHIOPIA

8.1 Introduction

The analyses presented in the preceding chapters have so far been targeted at identifying factors that are closely associated with fertility by employing alternative modelling techniques at the individual level. However, existing demographic literature on Ethiopia indicates that little is known about the link among hierarchical structures, such as the link between individual childbearing decisions and the community in which the individual resides.

In this chapter, a multilevel perspective is considered to examine whether and how community and regional contexts influence 'births in the last 5 years' and 'fertility preference'. The first section deals with a discussion of the multilevel analysis of births in the last 5 years while the second section presents the multilevel analysis of desire for additional children using individual and community variables. The factors influencing births in the last 5 years are examined using multilevel negative binomial and Poisson regression models, while the second outcome - desire for additional children, is examined using multilevel multinomial logistic regression. Both analyses are divided into three parts one for national level, the second for Addis Ababa and the third for the 'Rest of Ethiopia' data sets. The chapter ends with a summarised review of the important findings.

8.1.1 Why Multilevel analysis?

Almost all kinds of social data have a hierarchical or clustered structure. A hierarchical data may be considered as consisting of units grouped at different levels and the existence of such data hierarchies is neither accidental nor ignorable. Once groupings are established, even if their formation is random, they will tend to become differentiated, and this implies that the group and its members can both influence and be influenced by the composition of the group (Goldstein, 1998). To ignore this relationship risks overlooking the importance of group effects.

In a typical social survey, a multistage sampling such as a well-defined geographical unit randomly chosen in the first stage followed by random selection of households from which the final respondent individuals are selected. So individuals sampled from the same location cannot be considered to be independent. Moreover, a response to a given fertility related question may not only reflect the individual's own characteristics and preferences, but also that of the local community.

The importance of examining data on the basis of its hierarchy has now been recognised as individuals who share similar characteristics related to fertility behaviour, such as living in the same geographical area, are likely to act in a similar manner (Garner and Diamond, 1988). As described earlier, multilevel modelling is a technique used for investigating hierarchically structured data in which the units at one level are clustered within the units at a next higher level (Goldstein, 1987, 1995). In a simplified expression, multilevel or hierarchical modelling is a means by which one describes outcomes for an individual respondent as a sum of the effects of the individual and higher levels (e.g. cluster or district or zone etc.), which has advantages over single-level modelling (Garner and Diamond, 1988). Moreover, the multilevel modelling approach enables the estimation of fixed and random effects (Wiggins and others, 1991).

Two aspects are considered when analysing the relationship between individual characteristics and higher level contexts: (i) detecting the amount of higher level contribution and its effect in the total variation of individual behaviour and (ii) identifying which characteristics are mainly responsible for the higher level effect. From a theoretical point of view, this means introducing a multilevel approach in which individuals (the first level of analysis) are grouped in different levels, and variables from these levels can be jointly analysed in a unified framework. In this approach, individuals within contexts may be seen as a hierarchical structure, so that statistical tools developed for hierarchical data, such as multilevel models (Bryk and Raudenbash, 1992; Goldstein, 1993, Kreft and De Leeuw, 1998; Longford, 1993) can be used to establish effects and relationships.

Hence, the main aim of this chapter is to examine the hierarchical variation in fertility between different levels. Particularly, attempt is made to answer the following research questions: Are fertility variations influenced only by individual level characteristics alone? Do community level factors contribute in explaining the variations in fertility at national level and regional level (fertility variation between Addis Ababa and the 'Rest' of Ethiopia)?

8.1.2 Hierarchical structure

The sample design adopted for the 2000 ETDHS uses a nested structure with women being at the bottom of the hierarchy nested within households and households nested within clusters and clusters within zones. As Goldstein (1995) and Snidjers and Bosker (1999) argue, ignoring the sample design implies ignoring the hierarchical structure and may lead to standard errors that are smaller than the true errors and hence inefficient estimation of confidence intervals. It is therefore important to adopt a model that accounts for the hierarchical structure imposed by the sampling technique and allows for the correlation of outcomes at each level to be modelled and ensures that standard errors associated with estimated parameters in the model are correctly estimated.

A key characteristic of clusters or zones in the hierarchical structure is that households and individuals within a cluster are geographically close such that fertility outcomes may be related because of a shared cultural setting and similar health care access (Garner and Diamond). The DHS data follow a similar structure as the administrative area structure, 'clusters' nested in 'zones', zones nested in 'Federal regions. A total of 15,367 women within 540 clusters within 56 zones in 11 federal regions were included in the 2000 ETDHS. Of these Addis Ababa data set consists of 2005 respondents nested in 51 clusters within 6 zones, while the 'Rest of Ethiopia' data set is structured into 13362 respondents nested in 489 clusters within 50 zones.

8.1.3 Multilevel Poisson and Negative Binomial Regression Models

As mentioned earlier, one of the response variables - 'births in the last 5 years' is a count variable and is examined using the Poisson regression model, which allows for unrestricted heterogeneity across individuals but, for a given individual, there is still the restriction that dictates the equality of the mean of each count with its variance.

A three level multilevel Poisson model with an offset specification can be written as:

$$\log(\pi_{ijk}) = \log(M_{ijk}) + X_{ijk}\beta + W_{ijk}v_k + Z_{ijk}\mu_{ij} \qquad (8.1)$$

Where *i, j, k* identify first (individual), second (cluster) and third (zone) levels respectively for this study.

log(M_{ijk}) is an *offset* created to adjust for the measurement of the response variable as its count is measured over a variable time period. The term offset is a frequent feature of loglinear models for counts of events and often represents the log of some measure of exposure (e.g. duration of exposure as in the case of this study).

$X_{ijk}\beta$ represent matrices of the fixed parts with their coefficients respectively

W_{ijk} represents matrix of covariates (usually a subset X_{ijk}'s) that vary at level-three

Z_{ijk} represents matrix of covariates (usually a subset X_{ijk}'s) that vary at level-two

V_k is a vector of level-three random effects and

μ_{ij} is a vector of level-two random effects.

It is worth noting here that the 'offset' part enables to work with rates rather than counts because using raw counts may render larger counts of the units for larger sample sizes (Goldstein, 1995; Rasbash *et al*, 2004).

The negative binomial model has a similar structure as the Poisson but with a slight difference in the variance that includes an over-dispersion parameter and the mean count for level one unit has a gamma distribution (Goldstein, 1995). In other words, the negative binomial model derives by allowing for between individuals random variation of the expected number of events.

In Equation (8.1), the Poisson specification states that the mean and variance are equal:

$$E(Y_{ij}) = Var(Y_{ij}) = \mu_{ij} = (X_i + W_i + Z_i)\beta$$

Whereas in the Negative binomial case, the mean and variance are defined as:

$$E(Y_{ij}) = (X_i + W_i + Z_i)\beta \quad \text{and} \quad Var(Y_{ij}) = \lambda_{ij} + \alpha\lambda_{ij}^2$$

Where X_i, W_i & Z_i are as defined above, representatives of the fixed part covariates, level-3 varying covariates and level-2 varying covariates respectively; λ_{ij} is the random Poisson parameter and α is the over-dispersion parameter that distinguishes Poisson and Negative binomial models.

8.1.4 Multilevel Multinomial Models

Although a detailed description of multilevel multinomial models is given in chapter three, the following is a brief description of the mathematical form of a three-level model for a multinomial outcome variable with 't' response categories.

$$log\left(\frac{\pi_{ijk}^{(s)}}{\pi_{ijk}^{t}}\right) = X_{ijk}^{(s)\prime}\beta^{(s)} + W_{ijk}^{(s)\prime}v_k^{(s)} + Z_{ijk}^{(s)\prime}\mu_{jk}^{(s)}, \qquad s = 2,\ldots\ldots,t \qquad (8.2)$$

Where: $X_{ijk}^{(s)\prime}\beta^{(s)}$ are matrices of explanatory variables and their regression coefficients respectively,

$W_{ijk}^{(s)}$ is a matrix of covariates that vary at level-three,

$Z_{ijk}^{(s)}$ is a matrix of covariates that vary at level-two,

$\nu_{k}^{(s)}$ is a vector of level-three random effects with $\nu_{k}^{(s)} \sim N\left(0, \sigma_{(s)\nu}^{2}\right)$

$\mu_{jk}^{(s)}$ is a vector of level-two random effects with $\mu_{jk}^{(s)} \sim N(0, \sigma_{(s)u}^{2}$

π_{ijk} is the probability of occurrence of the outcome to a level-1 unit 'i' in level-2 'j' in level-3 'k'.

The probabilities $\pi_{ijk}^{(s)}$ are calculated using the expression;

$$\pi_{ijk}^{(s)} = exp(X\beta^{(s)} + W\nu_{k}^{(s)} + Z\mu_{jk}^{(s)})\left[1 + \sum_{s=1}^{t-1} exp(X\beta^{(s)} + W\nu_{k}^{(s)} + Z\mu_{jk}^{(s)})\right]^{-1} \qquad (8.3)$$

with the probability of the baseline category given by:

$$\pi_{ijk}^{(s)} = \left[1 + \sum_{s=1}^{t-1} exp(X\beta^{(s)} + W\nu_{k}^{(s)} + Z\mu_{jk}^{(s)})\right]^{-1} \qquad (8.4)$$

8.1.5 Estimation procedures

Both of the above models for discrete responses are run using quasilikelihood estimation due to the fact that maximum likelihood estimation for discrete response models is computationally intensive (Rasbash *et al*, 2003). Quasilikelihood procedure for estimation uses the mean and variance properties associated with binomial, multinomial and Poisson distributions to define the covariance structure.

The quasi-likelihood procedure for estimation is approximate and the degree of approximation can be controlled using either 'marginal quasi likelihood' (MQL) or 'penalised (predictive) quasilikelihood' (PQL) to choose whether or not to include estimated residuals in the iterative procedure, with a choice of 'first order' or 'second order' to control the degree of approximation (Goldstein, 2003). Basically, the MQL and PQL procedures use a linearization method, based on Taylor's series expansion which transforms a discrete response model into a continuous response model and then the model is estimated using iterative generalised least squares (IGLS), which is equivalent to maximum likelihood under normality or re-weighted or restrictive iterative generalised least squares (RIGLS), which is equivalent to residual maximum likelihood under normality (Goldstein, 2003). While IGLS is the default estimation procedure, RIGLS leads to unbiased estimates of random parameters. Generally, second order PQL provides the most accurate estimates but this may not always converge so that another combination can be used (Goldstein, 2003)

8.1.6 Variance partition coefficient

The variance partition coefficient (VPC) is the proportion of total residual variance of a random intercepts model fitted to a discrete response data which is attributable to a higher level in the hierarchy (Goldstein, 2003). This is equivalent to the 'intraclass correlation coefficient' in a random intercepts model for a continuous response, and is a measure of the degree of resemblance between lower-level units belonging to higher-level units.

Rasbash *et al* (2003) suggest the following estimating formula for a two-level normal regression intraclass correlation coefficient (ρ_u) as:

$$\rho_u = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + \sigma_e^2}$$

Where σ_{u0}^2 is the variance between groups and σ_e^2 is the variance between individuals.

However, Snijders and Bosker (1999) argue that there is no single measure of VPC for discrete response models and suggest that in a multilevel model with a logistic distribution, the level-one random variables μ_e's of a random intercepts model can be assumed to have a mean of 0 and a variance of $\pi^2/3$ =3.29, assuming that the model as a linear threshold model. Based on this assumption, the variance partition coefficient for level-three units (e.g. between zones) in a three-level multinomial logistic model can be estimated using:

$$\rho_\upsilon = \frac{\sigma_\upsilon^2}{\sigma_\upsilon^2 + \sigma_u^2 + \pi^2/3} \qquad (8.5)$$

Similarly, Variance partition coefficient for level-two units (e.g. between cluster) can be estimated as:

$$\rho_u = \frac{\sigma_\upsilon^2 + \sigma_u^2}{\sigma_\upsilon^2 + \sigma_u^2 + \pi^2/3} \qquad (8.6)$$

Where ρ_v and ρ_u are proportions of the total residual variance attributable to level-3 and level-2 respectively; σ_v^2 is the level-three variance for the random intercept model and σ_u^2 is the level-two variance for the random intercept model.

8.1.7 Response and explanatory variables

Two response variables are considered for the multilevel analysis. The response variable used for the negative and Poisson regression analysis of fertility is 'births in the last 5 years', which is the number of children a woman had borne in the five years before the survey. On the other hand, 'desire for a/another child' is selected to measure fertility intention and is categorised into *'want no more'*, *'undecided'* and *'want more children'*.

The explanatory variables used for the multilevel multinomial logistic regression analysis of fertility intention include: Individual variables: parity, age, women's education, women's work experience, contraceptive use, religion, migration status; Household variables: partner's education, partner's occupation, child loss experience; Contextual variables: living standard, kinship network, urban/rural residence, region of residence. In order to examine whether hierarchical fertility variations exist and at the same time to identify the key factors responsible for the fertility variations, modelling is carried out for country level, Addis Ababa and 'Rest' of Ethiopia data separately.

8.2 Discussion of results

The following two sections present a three-level Poisson regression model for the analysis of births in the last 5 years and a three-level multinomial regression model for the analysis of fertility preference. As mentioned at the beginning, the main aim in this chapter is to examine the community effects in the variation of fertility at national level, in Addis Ababa and in the 'Rest' of Ethiopia. Three models are discussed in each section - the first model for country level, the second model for Addis Ababa and the third model for the 'Rest' of Ethiopia data sets.

8.2.1 Results of a three-level Poisson regression model of births in the last 5 years

The results of the multilevel Poisson regression model of births in the last 5 years are presented in Table (8.2.1.1). The second and third columns of the same table show the fixed effects parameter estimates with their standard errors for the final model. As the multivariate analyses of the fixed effects of the covariates on the response variable are discussed in earlier chapters, the main focus in this chapter is on hierarchical effects.

A glance at the country model of births in the last 5 years shown in Table (8.2.1.1) indicates that most of the results of the fixed effects concur with the results obtained in earlier chapters. Among the explanatory variables used in the model, having had at least 7+ years of education, being engaged in sales or professional occupation, living in own/council house and having lived in or migrated a long time a go to current residence were found to have a reducing effect on the rate of births in the last five years before the 2000 Demographic and Health Survey.

On the other hand, having had 1-6 years of education, having higher household assets, being a Muslim or Protestant Christian and being from SNNP or Tigriyan ethnic or regional background were found to have increasing effect on the rate of childbearing in the last five years before the survey. Particular attention is given to the effect of migration status on births in the last 5 years at national level where the relative risk of having larger births in the last 5 years is higher for women who migrated to current residence less than five years. Whether this holds in the case of the two major regions – Addis Ababa and 'Rest' of Ethiopia will be examined in subsequent sections.

The random effects particularly the variance partitioning coefficients for the final model are shown in Table (8.2.1.1b). The random estimates help to see how much of the variance is reduced after including individual and community variables into the step-by-step model building process. The same table also shows the pattern of changes in the variation at zone and cluster levels after the inclusion of individual and community explanatory variables.

The results of the multilevel model of fertility at national level reveal that there is evidence of both zonal variation and clustering of fertility in Ethiopia with more variation observed at the zone level than at the cluster level. However, as will be shown in subsequent sections, this pattern changes when the country data is spilt into Addis Ababa and the 'Rest' of Ethiopia sub-populations. About 57% of the total unexplained variation in births in the last 5 years is attributable to zone factors. Similarly, in the all women data about 43% of the unexplained variation in births in the last 5 years is attributable to cluster factors within zones.

Table 8.2.1.1: Three-level Poisson model Results of 'births in the last 5 years' (Ethiopia Total)

Factor	Ethiopia Total (N = 9473)	
	Parameter estimates	S.E(U)
INDIVIDUAL FACTORS		
Education		
1-3 years of education	0.489	0.040
4-6 years of education	0.438	0.045
7+ years of education	-0.713	0.047
Occupation		
Sales/services	-0.199	0.029
Prof./technical/clerical	-0.674	0.092
HH assets Index		
High HH asset	0.389	0.023
Housing status		
no own/council hse	-0.068	0.029
Migration status		
migrated ≥5yrs/lived always	-0.363	0.244
COMMUNITY FACTORS		
Religion		
Moslem	0.235	0.035
Protestant	0.249	0.039
Ethnic background		
Amhara	-0.210	0.037
SNNP	0.114	0.045
Tigray	0.051	0.016
Constant	**-2.769**	**0.043**

NB: all covariates were significant at the 5% level

For the purpose of this study, only two community level covariates, religion and ethnic or regional background were included. As shown in Table (8.2.1.1b), inclusion of religion into the model increases zone variation by about 4% and reduces cluster variation by a similar margin (4%). Similarly, inclusion of ethnic/regional background into the model has a similar effect as religion compared with individual level covariates. This indicates that religion and ethnic background have both zonal and clustering effect on fertility in Ethiopia.

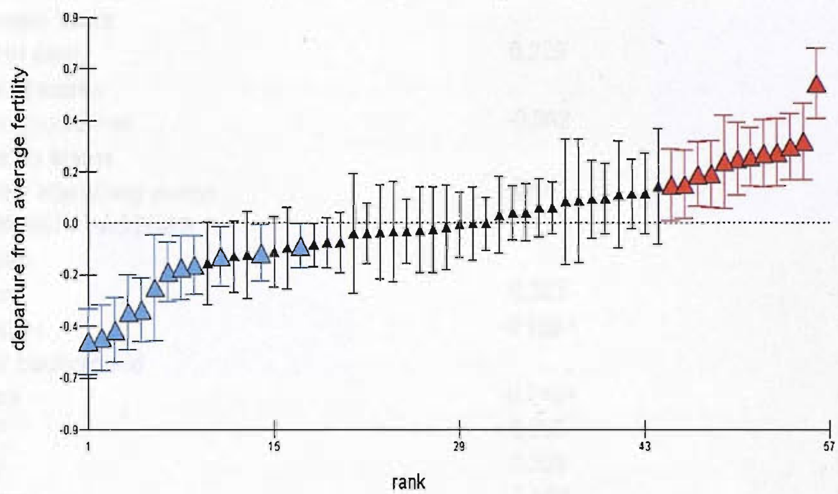
Table 8.2.1.1b: Random effects of the 3-level Poisson model of 'births in the last 5 years' (Eth total)

Factors included in model	Zone variance (SE)	Cluster variance (SE)	zone vpc	Cluster vpc
Individual only	0.0645(0.0153)	0.0570(0.0071)	0.531	0.469
Individual + religion	0.0635(0.0149)	0.0487(0.0065)	0.566	0.434
Individual + religion + ethnofed	0.0612(0.0144)	0.0471(0.0065)	0.565	0.435

Key: vpc ≡ variance partition coefficient, ethnofed ≡ ethnic/regional background, (SE) ≡ Standard Errors in bracket.

The caterpillar plot shown in Fig (8.2.1.1) displays the residuals corresponding to the zones included in the survey ranked in ascending order with their 95% confidence limit. Looking at the confidence intervals around them, we can see a group of about 11 zones at the lower end and about 9 zones at the upper end of the plot where the confidence intervals for their residuals do not overlap with zero.

Fig 8.2.1.1: Fertility variation by zone using last 5 year births (Ethiopia)



(a) List of zones with significant variation at the lower & upper ends of the caterpillar plot in order of rank

(i) Lower end (blue colour)	(ii) Upper end (red colour):
Addis_Z2	North Omo
Addis_Z4	Jijiga
Addis_Z5	Arsi
Addis_Z1	East Shewa
Addis_Z3	Sidama
Addis_Z6	Borena
Affar_Z1	West Shewa
South Wello	West Tigray
Affar_Z3	Central Tigray
Dire Dawa	Shinile
Affar_Z5	East Tigray
Gambela_ Z4	E.Gojjam

b) List of zones with NO significant variation in order of rank

Bench Maji	North Gonder
North Wello	Keficho_Shcho
Oromiya_inA	Agew Awi
Jimma	West Gojam
South Omo	Metekel
S. Gonder	East Gojam
Gurage	Kamashi
South Tigray	Gedeo
Gambella_Z1	Dirashe SW
Harari	Bale
Asosa	West Wellega
Gambella_Z2	Hadiya
Illubabor	Yem
East Harerge	KAT
East Wellega	Burji
Wag Hamra	

These residuals represent zone departures from the overall average predicted by the fixed parameter β_0, which means that these zones differ significantly from the average at the 5% significance level. The list of zones corresponding to each line in the graph is shown above with zones in similar colour. When viewed at national level, all zones of Addis Ababa except are among the zones on the lower side of the plot, which indicate lower rate of birth. Yet another interesting result is that those with larger (positive) residuals at the above end are among areas with traditionally higher fertility levels such as Borena, North Omo and Sidama.

Table 8.2.1.2: Three-level Negative Binomial model results of 'births in the last 5 years'

Factor	Addis Ababa (N=668)	
	Parameter estimates	S.E(U)
INDIVIDUAL FACTORS		
Education		
1-3 years of education	0.022[a]	0.17
4-6 years of education	-0.217	0.017
7+ years of education	-0.929	0.117
Occupation		
Sales/services	-0.071[a]	0.099
Prof./technical/clerical	-0.855	0.176
HH assets Index		
High HH asset	0.229	0.099
Housing status		
no own/council hse	-0.362	0.122
Migration status		
migrated ≥5yrs/lived always	-0.461	0.108
COMMUNITY FACTORS		
Religion		
Moslem	0.323	0.112
Protestant	-0.159[a]	0.193
Ethnic background		
Amhara	-0.219[a]	0.176
SNNP	0.265	0.104
Tigray	0.309	0.036
Constant	-0.962	0.152
Dispersion param.		
Alpha	-0.657	0.098

NB: [a] not significant at the 5% level

We have so far seen the results for country level data. Turning to the focus of this study - Addis Ababa and the 'Rest' of Ethiopia samples, the picture is different as is evidenced by the results shown in Tables (8.2.1.2 and 8.2.1.3). Unlike the case for the national level result in which variation is observed mainly across zones but also at cluster level, births in the last 5 years in Addis Ababa is observed to vary across cluster level only. This is a very interesting but a true picture of the capital city's residential setup for the following reasons.

The delineation of zone boundaries in Addis Ababa is done more on the basis of proxy clusters and may not reflect other social and cultural ties among the dwellers. However, some of Addis Ababa's residential areas have a pattern of clustering of those who migrate from areas of similar origin (zones) in the 'Rest' of Ethiopia thereby bringing their social and cultural norms with them including their community's value towards children and fertility behaviour.

Table 8.2.1.2b: Summary of variation of the 3-level model of 'births in the last 5 yrs' (Addis Ababa)

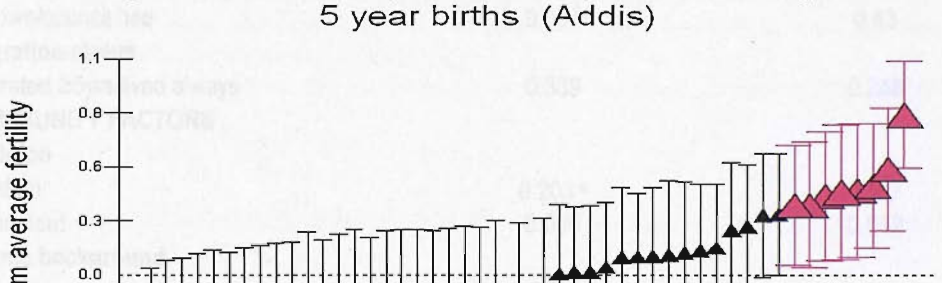
Factors included in model	Zone variance (SE)	Cluster variance (SE)	zone vpc	cluster vpc
Individual only	0.00939(0.0181)[a]	0.0774(0.0381)		
Individual + religion	0.00802(0.0173)[a]	0.0772(0.0381)		
Individual + religion + ethnofed	0.0084(0.0173)[a]	0.0747(0.0375)	0.101	0.899

Key: [a] ≡ not significant at the 5% level; vpc ≡ variance partition coefficient, ethnofed ≡ ethnic/regional background, (SE) ≡ Standard Errors in bracket

Summary of the random effects is given in Table (8.2.2.2b). The results indicate that there is a significant evidence for clustering of fertility in Addis Ababa, but no significant variation at zone level. After including individual and community variables into the model, the variance partitioning indicate that about 0.899 (90%) of the unexplained variation in births in the last 5 years in Addis Ababa can be attributed to clustering of women by religion and ethnic background. This variation is observed in particular clusters shown in the Figure (8.2.1.2).

There is a distinct difference between the model for Addis Ababa discussed above and the 'Rest' of Ethiopia shown in Table (8.2.1.3) below. While most of the variation in Addis Ababa is observed across clusters, the variation of births in the last 5 years in the 'Rest' is observed at zone level. Moreover, while education, housing status, migration status play a vital role in the downward variation of fertility in Addis Ababa, these factors have a positive (upward) effect in the 'Rest' of Ethiopia.

Fig 8.2.1.2: Fertility variation by cluster using last 5 year births (Addis)



(a) **List of clusters in Addis Ababa with significant variation at the lower end of the caterpillar plot in order of rank**
Blue colour: C486, C457

(b) **List of clusters in Addis Ababa with significant variation at the upper ends of the caterpillar plot in order of rank**
Pink colour: C502, C461, C470, C478, C454, C492, C504, C455

Summary of the zone level variation of births in the last 5 years in the rest is shown in Table (8.2.1.3b) and in the caterpillar plot in Figure (8.2.1.3). Overall, about 71% of the total unexplained variation in births in the last 5 years in the 'Rest' of Ethiopia is attributable to zone factors. Similarly, about 29% of the total unexplained variation in fertility in the 'Rest' is attributable to clustering factors.

While the introduction of religion into the multilevel model as a community level factor resulted in the increase of zonal variation by about 10% (from 0.648 to 0.732) and inclusion of ethnic/regional background factor into the model slightly reversed the above increase in variation by about 2% (from 0.732 to 0.708). However, ethnic background has a clustering effect as it increases the cluster variation by about 2% (from 0.268 to 0.292). Although only two community level factors were included into the model, the results have shown the existence of community level variation which supports the argument put forward in chapter one for the importance of hierarchical analysis.

Table 8.2.1.3: A three-level Poisson model of 'births in the last 5 years' in the 'Rest' of Ethiopia (N= 8803)

Factor	Rest of Ethiopia (N=8796)	
	Parameter estimates	S.E(U)
INDIVIDUAL FACTORS		
Education		
1-3 years of education	0.414	0.043
4-6 years of education	0.473 [a]	0.257
7+ years of education	0.588	0.061
Occupation		
Sales/services	-0.213	0.031
Prof./technical/clerical	-0.356	0.133
HH assets Index		
High HH asset	0.403	0.024
Housing status		
no own/council hse	0.087	0.43
Migration status		
migrated ≥5yrs/lived always	0.339	0.248
COMMUNITY FACTORS		
Religion		
Moslem	0.203 [a]	0.137
Protestant	0.096	0.042
Ethnic background		
Amhara	-0.215	0.041
SNNP	0.157	0.018
Tigray	0.093	0.028
Constant	-2.823	0.038

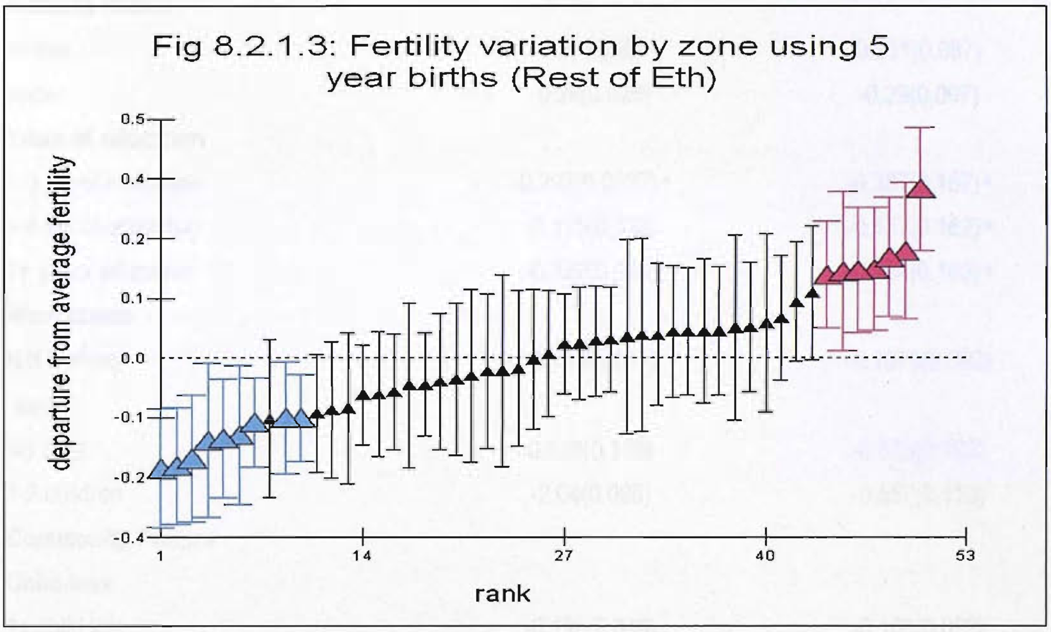
NB: [a] Not significant at the 5% level

As shown in Fig (8.2.1.3), about 7 zones (see list next to the graph) in the upper end and about 9 zones in the lower end show significant difference in the variation of births in the last 5 years in the 'Rest' of Ethiopia. The caterpillar plot also identifies that East Gojjam zone (on the upper end) was identified as a distinctive 'outlier' and 'South Wollo', from an area with recurrent famine problem is in the lower end of the plot, raising for further and closer examination.

Table 8.2.1.3b: Random effects of the 3-level Poisson model of 'births in the last 5 years' (Rest of Eth

Factors included in model	Zone variance (SE)	Cluster variance (SE)	zone vpc	cluster vpc
Individual only	0.0138(0.0042)	0.0075(0.0034)	0.648	0.352
Individual + religion	0.0164(0.0048)	0.006(0.0028)	0.732	0.268
Individual + religion + ethnofed	0.015(0.0045)	0.0062(0.0027)	0.708	0.292

Key: vpc ≡ variance partition coefficient, ethnofed ≡ ethnic/regional background, (SE) ≡ Standard Errors in bracket.



NB: the following is the list of labels corresponding to the caterpillar plot shown in colours. Refer to the list next to Fig (8.2.1.1) above for the list of zones whose fertility does not significantly vary.

1. **Labels for the lower part of the plot (Blue colour): Affar_Z1, South Wello, Affar_Z3, Harari, Gambela zone4, Dire Dawa, Affar zone5, Jimma and Affar Z5**
2. **Labels for the upper part of the plot (Pink colour): N.Omo, Shinile, E.Shewa, Borena, Arsi, Jijiga, E. Gojam,**

8.2.2 Results of a three-level multilevel multinomial logistic regression model of desire for additional children

Among measures of fertility intention desire for a/another child is the most common variable used in demographic surveys. Although this measure has shortcomings such as inability to reflect changes over time and assumes that all births preceding the survey are wanted, it is less biased compared to other fertility intention measures. It is believed that women are less likely to misreport their future fertility preference (Bongaarts, 1990, 1997). In this section, a multilevel approach of the analysis of fertility preference is carried out on country level data and also on Addis Ababa and the 'Rest' of Ethiopia data.

Table 8.2.2.1: Three-level Multinomial Logistic Results of 'desire for additional children' (all women)

Factor	Fixed Effects	
	Parameter est. with S.E.	Parameter est. with S. E.
	No More	Undecided
Individual Factors		
Age at 1st sexual activity		
Began at <15 age	-0.1881(0.073)	-0.146(0.124)
Began at 1st union	-0.271(0.071)	0.0171(0.118)
Own house		
no ownhse	0.057(0.026)	0.063(0.092) [a]
Assets index		
middle	0.3(0.055)	0.251(0.087)
upper	-0.28(0.025)	-0.29(0.097)
Years of education		
1-3 yrs of education	-0.293(0.0937) [a]	-0.387(0.157) [a]
4-6 yrs of education	-0.175(0.098)	-0.157(0.162) [a]
7+ yrs of education	-0.122(0.060)	-0.154(0.163) [a]
Work status		
Not working	-0.169(0.051)	-0.1978(0.083)
parity		
No child	0.636(0.109)	-0.573(0.103)
1-2 children	-2.04(0.098)	-0.557(0.113)
Community Factors		
Child loss		
1+ child lost	-0.198(0.049)	-0.188(0.092)
Religion		
Muslim	-0.688(0.073)	-0.223(0.106)
Protestant Christian	-0.375(0.085)	-0.085(0.134)
Reproductive rights		
Unaware	-0.351(0.128)	-0.576(0.177)
Constant	-1.664(0.147)	-1.519(0.164)

NB: [a] ≡ not significant. at 5%

Table (8.2.2.1) presents the multilevel multinomial model of the outcome variable for fertility preference (desire for additional children) at national level. The dependent variable has three categories and two (no more and undecided) are contrasted against the reference category 'want more'.

Most of the dummy variables used in the fixed effects model are significant at the 5% level. Whilst child loss experience, own house and reproductive rights awareness are positively associated with desire for additional children, work status, years of education, and parity are negatively associated with the response variable.

Table 8.2.2.1b displays summary of the random effects variance of the three-level multilevel multinomial model of desire for additional children. The probability of nomore versus wantmore and undecided versus wantmore vary between zones and clusters. Accordingly, the between-zone variance for the 'nomore' category is estimated to be 0.314, while the between-zone variance for the 'undecided' category is 0.203 with the covariance of the two categories at zone level being 0.102. Similarly, the between-cluster variance for 'nomore' is 0.329 and that of ''undecided' is 0.314 with a covariance of both being 0.137.

Table 8.2.2.1b: Random effects of the 3-level multinomial logistic reg of 'desire for additional children'

Random Effects	Nomore vs want more	Undecided vs want more[a]
Zone level variation		
nomore	0.251(0.059)	
undecided	-0.033(0.036)	0.122(0.045)
zone variance partitioning coeff.	0.0676	0.0101
Cluster level variation		
nomore	0.174(0.027)	
undecided	0.016(0.029)	0.269(0.062)
cluster variance partitioning coeff	0.1144	0.1062

NB: [a] want more is the reference category; [b] figures in bracket are the standard errors of the parameter estimates.

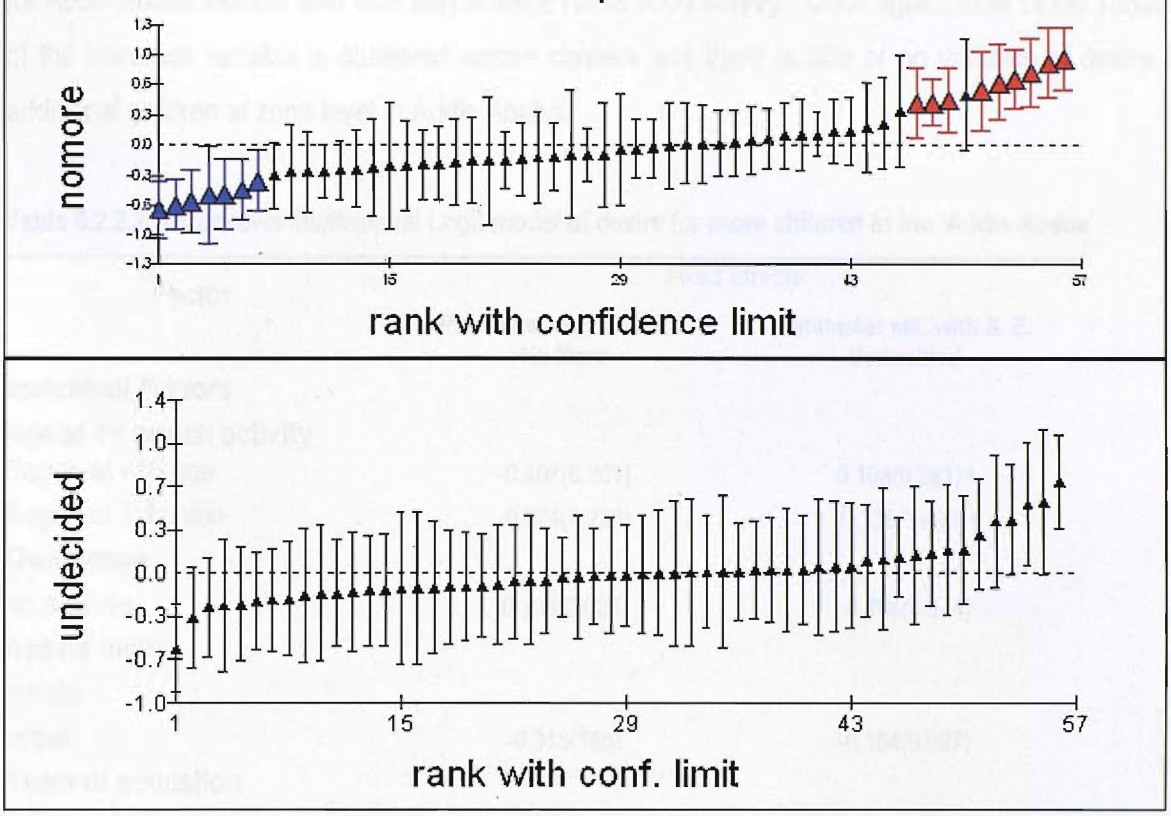
The zone and cluster level variances can be used to estimate intra-zone and intra-cluster correlation (variance partition) coefficients (Goldstein, 2003). Using expressions (8.5) and (8.6) given above and assuming that there is no extra-multinomial variation, the intra-zone correlation (variance partition) coefficient for 'nomore' is $(0.251)/(0.251+0.174+\pi^2/3)=0.0676$. This can be interpreted as 8% of the unexplained variation in the probabilities of 'nomore' versus 'wantmore' can be attributed to unobserved zone factors. In other words, about 8% of the total variance in 'nomore' versus 'wantmore' can be attributed to differences between zones. Similarly, the intra-cluster variance partition coefficient for 'nomore' versus 'wantmore' is $(0.251+0.174)/(0.251+0.174+\pi^2/3)=0.1144$, which implies that about 16% of the unexplained variation in 'nomore' versus 'wantmore' is attributable to unobserved cluster factors. Similarly, the intra-zone and intra-cluster variance partition coefficients for 'undecided' versus 'wantmore' are $(-0.033)/(-0.033+0.016+\pi^2/3)=0.0101$ and $(0.122+0.269)/(0.122+0.269+\pi^2/3)=0.1062$ respectively showing little homogeneity in being 'undecided'. This means that about 1% and 11% of the unexplained variation in 'undecided' versus 'wantmore' can be attributed to unobserved zone and cluster factors respectively at national level showing cluster variation is more prevalent than zone variation.

The zone level variation is also shown pictorially in Fig (8.2.2.1) for 'want nomore' and 'undecided' categories of the outcome variable respectively. Both figures present the plots of variance in the outcome variable (residual estimates) by rank points (top) and with 95% confidence limits (bottom) respectively. The categories (zones) that are significantly different from the rest are shown in different colours at the lower and upper end of each plot. For instance, the lower and upper ends of the 'want nomore' graph are shown in pink and green colour respectively (if printed in colour) and the lower and upper ends of the 'undecided' graph are shown in blue and brown colour respectively. The lists following Fig (8.2.2.1) presents the rank orders of the variation of 'want nomore children' and 'undecided categories of the outcome variable and not the dummy code for zone as included in the model. For instance, 'South Wello' is the 11th category/zone of the variable 'zone' as included in the model, but the same zone ('South Wello') is ranked 56th in the ascending order of the variation of 'want nomore' category. A similar graph can be produced for cluster level but it would be too dense to identify each cluster on the graph if presented on this page.

According to Fig (8.2.2.1) 'South Wello' zone is identified to have the highest desire for 'no more children' and appears to be distinctively positioned from the rest. On the other hand, 'Borena' zone is observed to have the lowest ranking in terms of desire for nomore children, while 'North Gondar' zone is in the middle of the rank order.

Again looking at the lower (caterpillar) graph of Fig (8.2.2.1) for 'want nomore', we observe that zones whose residual estimates lie above the average (zero) line and zones with rank order whose residual estimates lie below the average line are significant compared with those in the middle whose confidence interval overlap with the zero line. The same interpretation holds for the 'undecided' category (see list under Figs 8.2.2.1). This is an important revelation in that it helps the decision/policy maker or program manager to devise specific programs that suit particular zones with similar tendency.

Fig 8.2.2.1: Variation of fertility preference by zone in Ethiopia



NB: The following list is presented according to rank order and should be read in reference with the key below for zone's name

Nomore: **Lower end with CI error bar below dotted average line**: z49, z3, z39, z4, z2, Z22, Z46, Z55

Upper end with CI error bar above dotted average line: z24, z36, Z31, z19, Z30, z29, z11

Undecided: **Lower end with CI error bar below dotted average line**: Z55;

Upper end with CI error bar above dotted average line: Z21, Z46

Half way (middle ranked zone is Z14, though not significant

NB: Note also that the plot does not include never married respondents

Key: 'zone' categories used in the model

1 'East Tigray'	15 'Affa_Z5'	29 'Addis_Z4'	43 'Yem'
2 'Central Tigray'	16 'East Gojam'	30 'Addis_Z3'	44 'Hadiya'
3 'West Tigray'	17 'Affar_Z3'	31 'Addis_Z5'	45 'KAT'
4 'South Tigray'	18 'Kamashi'	32 'Addis_Z2'	46 'North Omo'
5 'North Gonder'	19 'N. Shewa_inO'	33 'Addis_Z1'	47 'Bench Maji'
6 'Wag Hamra'	20 'East Wellega'	34 'Illubabor'	48 'Sidama'
7 'S. Gonder'	21 'West Wellega'	35 'Addis_Z6'	49 'Borena'
8 'North Wello'	22 'Shinile'	36 'Jimma'	50 'Gedeo'
9 'Affar_Z1'	23 'West Shewa'	37 'Arsi'	51 'Dirashe SW'
10 'West Gojam'	24 'Dire Dawa'	38 'Gambella_Z1'	52 'Burji'
11 'South Wello'	25 'East Harerge'	39 'Gurage'	53 'Asosa'
12 'Agew Awi'	26 'West Haraerge'	40 'Bale'	54 'South Omo'
13 'Metekel'	27 'Harari'	41 'Keficho_Sh'cho'	55 'Jijiga'
14 'Oromiya_inA'	28 'East Shewa'	42 'Gambella_Z2'	56 'Gambela_ Z4'

Table (8.2.2.2) presents a three-level multinomial logistic regression of desire for additional children for Addis Ababa women who took part in the ETDHS 2000 survey. Once again, most of the variation of the response variable is observed across clusters and there is little or no variation of desire for additional children at zone level in Addis Ababa.

Table 8.2.2.2: Three-level Multinomial Logit model of desire for more children in the 'Addis Ababa'

Factor	Fixed Effects	
	Parameter est. with S.E. No More	Parameter est. with S. E. Undecided
Individual Factors		
Age at 1st sexual activity		
Began at <15 age	-0.407(0.201)	0.108(0.381) [a]
Began at 1st union	-0.574(0.228)	-0.139(0.403) [a]
Own house		
no ownhse	0.166(0.020)	-0.301(0.074)
Assets index		
middle		
upper	-0.315(163)	-0.164(0.027)
Years of education		
1-3 yrs of education	0.229(0.281)	0.097(0.44)
4-6 yrs of education	0.434(0.123)	-0.259(0.353)
7+ yrs of education	-0.718(0.212)	-1.79(0.415)
Work status		
Not working	-0.138(0.074)	0.208(0.622) [a]
parity		
No child	-2.99(0.289)	1.136(0.433)
1-2 children	1.93(0.185)	0.039(0.401) [a]
Community Factors		
Child loss		
1+ child lost	-0.147(0.024)	-0.079 (0.012)
Religion		
Muslim	-1.331(0.25)	-0.237(0.036)
Protestant Christian	-0.219(0.032)	0.366(0.552) [a]
Reproductive rights		
Unaware	0.374 (0.32)	-0.494 (0.581) [a]
Constant	2.356(0.288)	-1.352(0.509)

NB: [a] ≡ not significant. at 5%

Table (8.2.2.2a) reveals that fertility preference is significantly influenced by age at first sexual activity, parity and religion. Child loss experience, awareness of reproductive rights, years of education and work status are negatively associated with nomore response, while own house is positively associated with no more choice.

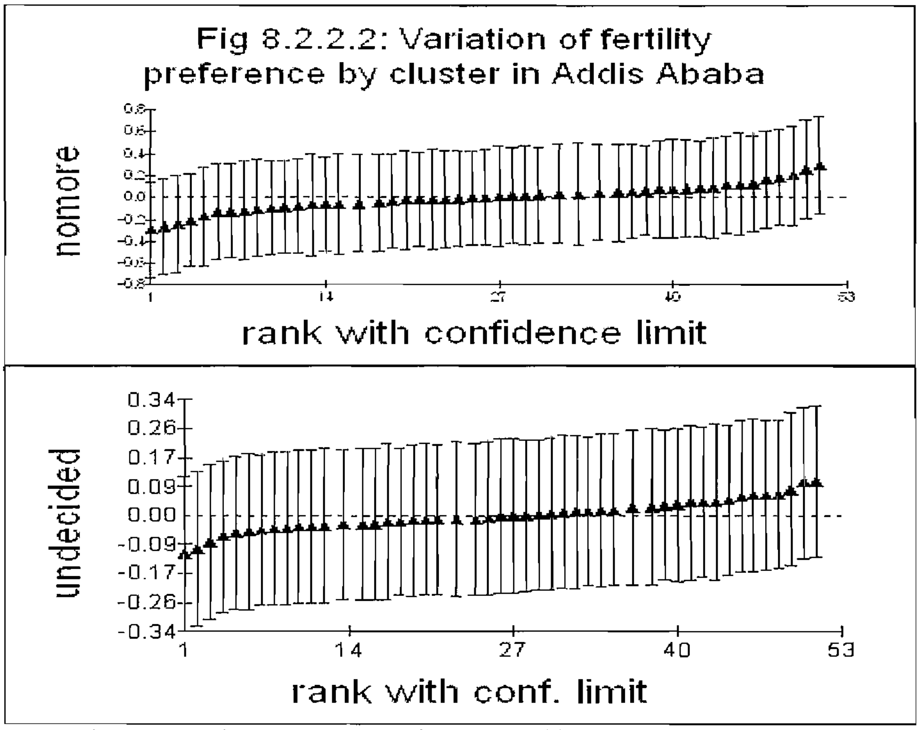


Fig 8.2.2.2: Variation of fertility preference by cluster in Addis Ababa

NB: There are no significant zones or clusters to be identified.
Note also that the plot does not include never married respondents

Figure (8.2.2.2) gives the variation in Addis Ababa along cluster level. An important result observed from the graph of fertility preference in Addis Ababa is that there is no variation at zone and cluster level in terms of desiring no more. Very little variation (about 2%) is observed at cluster level for being undecided.

The summary of community level variation in Addis Ababa is presented in Table (8.2.2.2b). We observe that desire to have no more children does not vary across Addis Ababa zones and clusters. There is little variation about 2% of being undecided at cluster level.

Table 8.2.2.2b: Random effects of a 3-level multinomial logit model of desire for additional children (Addis Ababa)

Random Effects	Nomore vs want more	Undecided vs want more[a]
Zone level variation		
Nomore	0.000 (0.000)	
Undecided	0.000 (0.000)	0.000 (0.000)
Zone variance partitioning coeff.	0.000	0.000
Cluster level variation		
Nomore	0.000 (0.000)	
Undecided	0.000 (0.000)	0.069(0.015)[b]
Cluster variance partitioning coeff.	0.000	0.0215

NB: [a] want more is the reference category; [b] figures in bracket are the standard errors of the parameter estimates.

The analysis of fertility preference in the 'Rest' of Ethiopia is shown in Table (8.2.2.3). A quick glance at the table reveals that all explanatory variables included in the model are significantly associated with the response nomore with the exception of reproductive rights awareness, which is not significant.

Table 8.2.2.3: Three-level Multinomial Logistic model of desire for more children in the 'Rest' of Ethiopia

Factor	Fixed Effects	
	Parameter est. with S.E. No More	Parameter est. with S. E. Undecided
Individual Factors		
Age at 1st sexual activity		
Began at <15 age	-0.127(0.076) [a]	-0.0645(0.131)
Began at 1st union	-0.264(0.076)	0.103(0.126) [a]
Own house		
no ownhse	0.106(0.075)	0.095(0.122) [a]
Assets index		
middle	-0.036(0.015)	0.085(0.091) [a]
upper	-0.087(0.012)	-0.179(0.022)
Years of education		
1-3 yrs of education	-0.287(0.101)	-0.222(0.157) [a]
4-6 yrs of education	-0.158(0.110)	-0.046(0.182) [a]
7+ yrs of education	-0.113(0.011)	-0.066(0.171) [a]
Work status		
Not working	0.157(0.053)	0.197(0.086)
parity		
No child	-1.91(0.103)	0.389(0.115)
1-2 children	-1.346(0.060)	-0.072(0.092) [a]
Community Factors		
Child loss		
1+ child lost	-0.276(0.051)	0.176(0.091)
Religion		
Muslim	-0.645(0.076)	-0.225(0.110)
Protestant Christian	-0.38(0.089) [a]	-0.149(0.135) [a]
Reproductive rights		
Unaware	-0.038 (0.048)	-0.147(0.071) [a]
Constant	0.268(0.114)	-2.131(0.165)

NB: [a] ≡ not significant. at 5%

The random part of the model, summarised in Table (8.2.2.3b) indicates that there is significant variation at both zone and cluster levels unlike the case in the Addis Ababa, where variation is observed across cluster level only. About 6% of the total unexplained variation desiring no more children and about 1% of the total unexplained variation of being undecided are attributable to zone factors in the 'Rest' of Ethiopia. Similarly, about 11% of the unexplained variation desiring no more children and about 21% of the variation being undecided is attributable to clusters in the 'Rest' of Ethiopia.

Table 8.2.2.3b: Random effects of the 3-level model of desire for additional children (Rest of Ethiopia)

Random Effects	Nomore *vs* want more		Undecided *vs* want more [a]	
Zone level variation				
Nomore	0.203(0.053) [b]			
Undecided	-0.031(0.013)		0.136(0.049)	
Zone variance partitioning coeff.		0.055		0.011
Cluster level variation				
Nomore	0.217(0.031)			
Undecided	0.149(0.038)		0.28(0.061)	
Cluster variance partitioning coeff.		0.1132		0.212

NB: [a] want more is the reference category; [b] figures in bracket are the standard errors of the parameter estimates.

Figure (8.2.2.3) shows a caterpillar of residuals plot for the 56 zones within the 'Rest of Ethiopia data set. The residual estimates represent zone departures from the overall average predicted by the fixed parameter β_0, this means that these are the zones that differ significantly from the average at the 5% level in the 'Rest' of Ethiopia. The zones with significant variation where the confidence intervals for their residuals do not overlap zero are highlighted using different colours. We observe that a group of about 11 zones below and 9 zones of the 'nomore' versus rank plot are above the average line and 9 zones below and 8 zones above the average line of the 'undecided' versus rank plot are significantly different from the rest of zones. Z11 ('South Wello') in the upper end of the 'nomore' versus rank plot tends to be in an outlying position, implying that women residing in 'South Wello' are more likely to say nomore children than those living in the other zones in the 'Rest' of Ethiopia. This is an area with a history of recurring famine often forcing the residents to migrate to resource areas. On the other hand, at the lower end of the same plot, Z49 ('Borena') is less likely to say nomore children. This area is part of the 'Oromia' region known for its high fertility. Interestingly, except 'East Tigray' all the zones in Tigray region (Z4 - 'S.Tigray', Z3 - 'W.Tigray', and Z2 - 'C.Tigray') are more likely to desire to have more children.

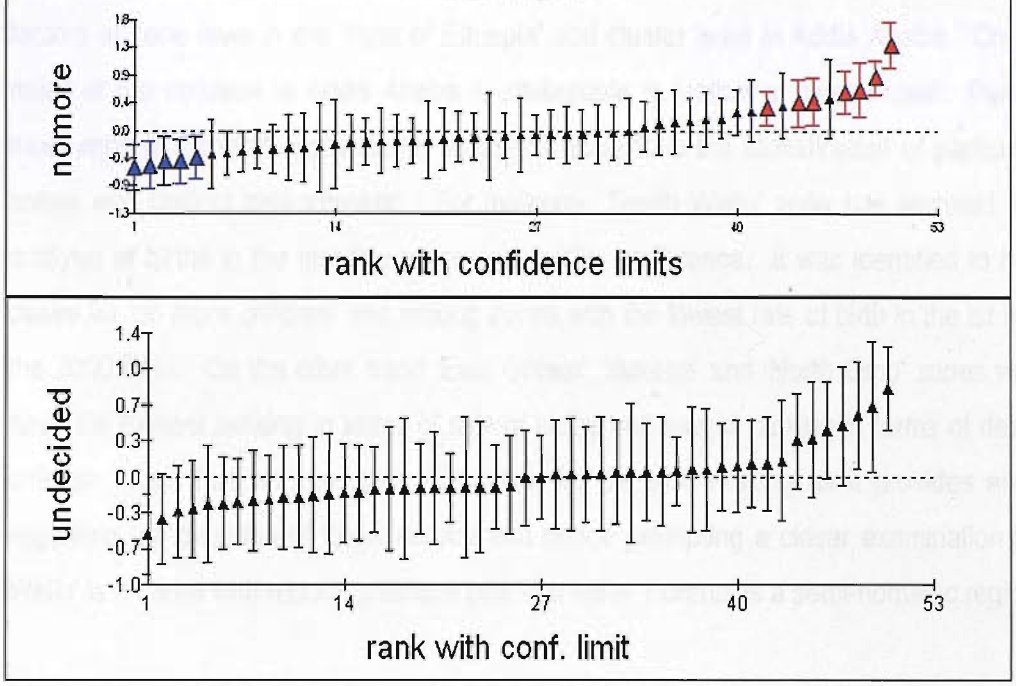


Fig 8.2.2.3: Variation of fertility preference by zone in the Rest of Ethiopia

NB: The following list is presented according to rank order and can be linked with the key below for zone's name

Nomore: **Lower end with CI error bar below dotted average line**: z49, z3, z39, z4, z2;

Upper end with CI error bar above dotted average line: z24, z36, z56, z19, z8, z27, z11

Undecided: **Lower end with CI error bar below dotted average line**: Z55;

Upper end with CI error bar above dotted average line: Z21, Z54, Z46

Half way (middle ranked zone is Z26, though not significant

Note also that the plot does not include never married respondents

Key: 'zone' categories used in the model

1 'East Tigray'	15 'Affa_Z5'	29 'Addis_Z4'	43 'Yem'
2 'Central Tigray'	16 'East Gojam'	30 'Addis_Z3'	44 'Hadiya'
3 'West Tigray'	17 'Affar_Z3'	31 'Addis_Z5'	45 'KAT'
4 'South Tigray'	18 'Kamashi'	32 'Addis_Z2'	46 'North Omo'
5 'North Gonder'	19 'N. Shewa_inO'	33 'Addis_Z1'	47 'Bench Maji'
6 'Wag Hamra'	20 'East Wellega'	34 'Illubabor'	48 'Sidama'
7 'S. Gonder'	21 'West Wellega'	35 'Addis_Z6'	49 'Borena'
8 'North Wello'	22 'Shinile'	36 'Jimma'	50 'Gedeo'
9 'Affar_Z1'	23 'West Shewa'	37 'Arsi'	51 'Dirashe SW'
10 'West Gojam'	24 'Dire Dawa'	38 'Gambella_Z1'	52 'Burji'
11 'South Wello'	25 'East Harerge'	39 'Gurage'	53 'Asosa'
12 'Agew Awi'	26 'West Haraerge'	40 'Bale'	54 'South Omo'
13 'Metekel'	27 'Harari'	41 'Keficho_Sh'cho'	55 'Jijiga'
14 'Oromiya_inA'	28 'East Shewa'	42 'Gambella_Z2'	56 'Gambela_ Z4'

8.3 Summary and conclusion

The main aim in this chapter was to address the research question: Do individual level factors completely explain variation of fertility? Do community level factors contribute in explaining the variations in fertility at national level, in Addis Ababa and the 'Rest' of Ethiopia? Besides highlighting a number of community factors influencing fertility at national level and in the two major comparison regions, this study also demonstrated the importance of methodological issues in the analysis of hierarchical data.

Overall, much of the variation in births in the last 5 years and fertility preference are attributable to factors at zone level in the 'Rest of Ethiopia' and cluster level in Addis Ababa. On the other hand, much of the variation in Addis Ababa is attributable to factors at cluster level. Perhaps one of the most important contributions of the multilevel analysis is the identification of particular clusters and zones with distinct characteristic. For instance, 'South Wello' zone has featured in the multilevel analysis of births in the last five years and fertility preference. It was identified to have the highest desire for 'no more children' and among zones with the lowest rate of birth in the lst five years before the 2000 DHS. On the other hand 'East Gojam', 'Borena' and 'North Omo' zones were identified to have the highest ranking in terms of rate of births and lowest ranking in terms of desire for no more children. This has an important implication for decision making as it provides an important clue regarding the direction of future fertility and hence prompting a closer examination because 'South Wello' is an area with recurring famine problem while 'Borena' is a semi-nomadic region.

The existence of significant community effects and variations among the two major regions of Ethiopia also points to the need to decentralize policy making in fertility. For instance, the preceding analyses revealed evidence of fertility clustering by specific characteristics such as religion, ethnic/regional background in both Addis Ababa and the 'Rest' of Ethiopia. Policies need to take into account the particular social and cultural environment in which fertility decisions are made.

CHAPTER NINE
SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

9.1 Introduction

The study of fertility dynamics requires documenting past, present and future fertility trends and their determinants. Ethiopia has been relatively under represented in the demographic and health literature until recently. Except the capital city where much of the demographic data collection and documentation effort has been concentrated, not much had been documented about the demographic and health transitions and socio-economic conditions prevailing in the 'Rest' of the country, particularly prior to 1990 due to insecurity that prevented effective field work. The lack of information on population and health characteristics has been the main impediment not only to researchers to make comparative studies but also to international agencies that base their development and monetary cooperation on the population situation and its momentum.

This situation is changing now because of the availability of various databases that provide a wealth of information on population and health characteristics in Ethiopia. The 2000 Demographic and Health Survey data provide a comprehensive and nationally representative demographic data that permit the analysis of aspects of Ethiopian demography that have never been investigated before.

This study was prompted by Ethiopia's first ever Demographic and Health Survey (ETDHS) conducted in 2000 and some of the demographic revelations it uncovered, particularly regarding fertility transition the survey revealed. The study was further prompted by findings of recent studies Kinfu (2001) and Sibanda *et* al (2003) both concurring on the factors that might have contributed to the fertility decline Addis Ababa especially emphasizing of marriage and housing issues. Moreover, the new administrative and geographical structure which is in place since 1991 and the need to document for subsequent comparative study also contributed to the coining of this study.

The study began with a trend analysis using time series and descriptive techniques to determine whether the fertility transition to lower level has begun in the rest of Ethiopia other than that observed in Addis Ababa. The next task was to examine the factors that influence fertility at national level and the two major regions by applying various statistical modelling techniques. The main findings are summarised in the following sections followed by suggestions for decision makers and future investigation.

Presentation of the summary findings is arranged with a statement of purpose of the analyses carried out in each chapter with a reminder of the main research questions tackled followed by summary of the main findings.

9.2 Summary of results of the trend analysis

The main aim of the trend analysis discussed in chapter four was to document fertility trends and differentials using various descriptive and time-series graphical techniques. The total fertility rate of Addis Ababa began branching out in the 1980s, after which the gap grew wider and wider until it reached below-replacement level around 1995.

Moreover, the gap grew wider between 1984 and 1985, which coincided with the 1984/85 famine that engulfed the whole country. A sudden leap occurred in the fertility rate of the 'Rest' of Ethiopia which was also reflected at national level. This is perhaps due to the fact that crisis-induced falls in fertility are usually followed by a rebound as the severity of the conditions that prompted the decline diminishes (Bongaarts and Cain 1981; Caldwell and Caldwell 1992).

However, the gap between the fertility level of the capital city and that of the 'Rest' of Ethiopia became more pronounced after the 1984 famine and particularly after 1990/91, which also coincides with a change in the political system along with all the changes in policy such as population policy and structural adjustment programme.

Using cohort analysis and graphical techniques, it was also shown in the trend analysis chapter that the proportions of married women had decreased in the 10 years before ETDHS 2000 with only 15% of the 25-29 cohort in Addis Ababa were married in 1991 compared to more than half of the same cohort in the 'Rest'. Moreover, at the time of the 2000 DHS, that is, when the 25-29 cohorts become 35-39 only about half of Addis Ababa women are married while more than nine out of ten women in 'Rest' were married. This is a significant indicator of marriage postponement in Addis Ababa.

Moreover, the median age at marriage was estimated using the SMAM technique as 26.6 years for Addis Ababa, which is much higher than most Sub-Saharan African cities where as many as two-thirds of young women in some of these countries get married before age 20 (Westoff et al, 1994).

In general, given all the evidences presented in the trend analysis sections, it can be claimed that the fertility level of Addis Ababa has reached the post transition stage (below-replacement level) and that the fertility transition has been underway in the 'Rest' of Ethiopia since 1984 but in a consistent trend since the early 1990s and can be classified can be classified to be in the 'Early-to-mid' stage of the transition. What remains is to identify, through multivariate analyses, the factors for such a dramatic fertility decline and factors that account for the gap between the capital city and the 'Rest' of Ethiopia.

9.3 Summary of the survival and design-based analyses of marriage and fertility

Based on the trend analysis and issues raised by recent studies on the fertility decline in Addis Ababa, the next challenge was to examine factors influencing marriage and fertility comparing Addis Ababa and the 'Rest' of Ethiopia. While the analysis of marriage was carried out using survival analysis in chapter five, a design-based analysis of births in the last five year and fertility preference were carried out (see chapter three and five for details on these methods). The following are some of the main findings the analyses of marriage and fertility.

9.3.1 Summary of the discrete time survival analysis of time to first marriage

Marriage has been increasingly featuring in recent studies of fertility as having played a leading role the transition to lower fertility. Despite, using only Bongaarts model in their analysis, Sibanda *et al* (2003) strongly argued that the change in marriage is the answer to the fertility decline in Addis Ababa. This study picked where the above authors left and examined marriage using advanced statistical analysis and the following are among the findings worth noting.

1. Education is identified as the most important factor influencing marriage distinguishing Addis Ababa from the 'Rest' of Ethiopia as far as delayed marriage is concerned. Addis Ababa women with 7+ years of education have twice higher survival rate of delaying marriage than women with the same educational level in the 'Rest' of Ethiopia.
2. In terms of fertility, again education was found to be the principal factor that distinguishes Addis Ababa from the 'Rest' of Ethiopia. Addis Ababa women with at least 7+ years of education have about 6 times lower 'births in the last 5 years' than women with the same level in the 'Rest' of Ethiopia, which could be attributed to the fact that most women in the vast rural areas succumb to family and community pressure to get married even if it means they still have to attend school.

3. Another interesting finding is the association between shorter survival time to marriage and professional occupation, while the 'sales and services occupation' is positively associated with 'time to marriage' in both Addis Ababa and the 'Rest'. The reason that Addis Ababa

women who are in the professional or technical occupation have shorter survival time to marriage may be due to the fact that this group of women may have reached a stage where they have attained a certain level of education and secured employment thus time to start a family. Similarly, the reason for the observed positive effect of sales/services and time to marriage in the 'Rest' of Ethiopia may be in part due to the fact that 'peasant traders' spend much of their time travelling between the countryside and cities to sell agricultural produce and may opt to enjoy temporal relationships in the new exposure areas particularly in the city hence taking a little longer time to marry.

4. However, despite the finding in (No. 3) above, engagement in professional occupation was found to lower rate of births in Addis Ababa indicating that although these group of women may want to marry after reaching the desired educational level and securing employment, but delay childbearing as it competes with their career.

5. The study on 'time to marriage' also found that Addis Ababa women who don't own houses or who don't live in council houses (as it is assumed as a perpetual residence) are more likely to delay marriage while on the other hand, owning or not owning a house does not have any effect in the 'Rest' of Ethiopia as marriage is early and almost universal. Similarly, women who don't live in own or council houses have lower rate of births and hence lower fertility in Addis Ababa, while this odes not affect the rate of birth in the 'Rest' of Ethiopia.

6. Also among the findings is that of the unusual direction of association between women with Tigriyan ethnic background living in Addis Ababa and the 'Rest' of Ethiopia. Women with Tigriyan ethnic background living in Addis Ababa were found to have lower survival time to marriage compared to the same group in the 'Rest' of Ethiopia. This could be related to either a difference in the economic status of members of the Tigriyan ethnic group living in Addis Ababa and those living in the 'Rest' or an effort to compensate for elapsed time as most members of this ethnic group had been engaged in 'gorilla fighting' for a long time and most are past their marriage age, hence the marriage boom. This is also reflected in the rate of births in the last five years before the survey.

7. Education, household wealth status and housing status are identified as the most important factors influencing 'time to marriage' that distinguishes Addis Ababa from the 'Rest' of Ethiopia as far as late marriage is concerned. Addis Ababa women with 4-6 and 7+ years

9.3.2 Summary of the design-based analysis of births in the last 5 years

1. The important role played by women's education in influencing births in the last five years in Addis Ababa compared to the 'Rest' of the regions draws particular attention. The upward trend in women's education is associated with a downward trend in fertility level in Addis Ababa. Education equips women with renewed belief about their own life as well as skills that enable for participating in the labour force. A rise in the level of women's education also leads to a rise in age at first birth and consequently to a decline in fertility making it a vital issue for policy setting.
2. There are also differing results - the marked drop in fertility with the participation in the labour force, which has strongly featured in the Addis Ababa sample and an increase in fertility with increasing household wealth in both areas and raises a prospective importance for a closer investigation.
3. Following the suggestions by recent studies that housing might have played a role in the fertility decline in the capital city, data on 'housing status' was analysed and this study found that having no own or council house is negatively associated with fertility only in Addis Ababa but not in the 'Rest' of Ethiopia.
4. Migration status also featured in the analysis conforming results by earlier studies that women who migrated before a long time or who have lived in the current residence always have lower rate of birth in Addis Ababa whereas migration and fertility are positively related in the 'Rest' of Ethiopia. Finally, and one of the surprising results, the analysis of births in the last five years found that among the ethnic/regional categories, women with Tigriyan background living in Addis Ababa were found to have up to 11% higher births in the last five years than their counterparts in the 'Rest' of Ethiopia.

9.3.3 Summary of the design-based analysis of fertility intention

The analysis of fertility intention discussed in chapter six was carried on the outcome variable - 'desire for additional children' comparing the capital city – Addis Ababa with the 'Rest' of Ethiopia using multinomial logistic regression modelling technique that accounts for the survey design. The analysis was carried out excluding never married women for the purpose of simplifying interpretation of fertility preference against period factors.

The analysis revealed the following main findings. While Addis Ababa women have less desire for additional children despite longer duration of marriage, perhaps due to relatively high rate of union instability, or relatively high prevalence of contraceptive use and exposure to mass media. The opposite is true in the 'Rest' of the regions that marital duration has positive effect on desire for additional children.

Among the interesting findings is that Addis Ababa women with at least 7+ years of education have higher probability of being undecided to have a/another child. Higher household asset is also associated with higher probability of 'desire for more children in Addis Ababa.

Addis Ababa women have higher preference for daughters as they are needed to help in the domestic work such as baby sitting while the mother is at work, women in the 'Rest' have higher preference for sons as most of the respondents depend on agricultural production and more hands are needed to help in the farm and sons are preferred as they do most of the farming work.

9.4 Summary of results of the decomposition analysis of fertility

The main aim of the decomposition approach discussed in chapter seven was to quantify the gap in marriage and fertility between Addis Ababa and the 'Rest' of Ethiopia and to identify the contribution of each explanatory variable to the gap. An important departure of chapter seven from chapter five and chapter six - which dealt with the factors influencing 'time to marriage', 'births in the last 5 years' and 'fertility intention', is that the modelling carried out in chapter seven is carried out with the main aim of quantifying the 'gap' in marriage and fertility' while at the same time examine their correlates. The following are the main findings of the three decomposition analyses.

The decomposition was made by taking the data set for Addis Ababa as the standard population and quantifying the gap and assuming as if women in the 'Rest' of Ethiopia were to behave like those in Addis Ababa. Accordingly, the overall gap in births in the last 5 years between Addis Ababa and the 'Rest' of Ethiopia is about -0.519. When this overall gap is broken down in to the two major differentials, most of the difference appears to be due differences in coefficients (about -0.674) while that due to the differences in characteristic is about 0.155. The negative sign implies that if women in the 'Rest' of Ethiopia were to behave like those in Addis Ababa (the standard population) then many more of them would have lesser rate of childbearing than their current pace.

Regarding the contribution of each explanatory variable, most of the covariates were found to have contributed more to the difference in coefficients (behavioural effect) than to the difference in characteristic. Education, migration and occupation have relatively bigger contribution to the difference in coefficients (behavioural effect).

The second part of chapter seven dealt with the decomposition of the gap in fertility intention between Addis Ababa and the 'Rest'. The overall gap in fertility intention between Addis Ababa and the 'Rest' of Ethiopia is about 0.284. Of this, about 0.269 is due to differences in coefficients while only 0.155 (1 percentage point) is due to differences in the characteristics. Much of the difference in coefficients is attributable to the effects brought about by education, marital duration and parity.

The third section of chapter seven dealt with the decomposition of marriage which revealed that there is a 47% gap in non-marriage between Addis Ababa and the 'Rest' of Ethiopia, of which about 44% is due to differences in behavioural change.

9.5 Summary of results of the multilevel analysis of fertility

The main aim of the multilevel analysis discussed in chapter eight was as an alternative to conventional approaches which ignore either individual or group effects in modelling responses and to address the research question:

- Are fertility variations influenced only by individual level characteristics?
- Do community level factors contribute in explaining the variations in fertility at national level, in Addis Ababa and the 'Rest' of Ethiopia?

The results indicate that there is a significant evidence for clustering of fertility in Addis Ababa by religion and ethnic background. The study found that about 90% of the unexplained variation in births in the last 5 years in Addis Ababa is attributable to clustering of women by religion and ethnic background.

On the other hand, much of the variation in births in the last 5 years and fertility preference are attributable to factors at zone level in the 'Rest of Ethiopia'. Overall, about 71% of the total unexplained variation in births in the last 5 years in the 'Rest' of Ethiopia is attributable to zone factors and about 29% of the total unexplained variation in fertility in the 'Rest' is attributable to clustering factors.

Perhaps one of the most important contributions of the multilevel analysis is the identification of particular clusters and zones with distinct characteristic. For instance, South Wello' zone is identified to have the highest desire for 'no more children' and 'Borena' zone is observed to have the lowest ranking in terms of desire for no more children. This has an important implication for decision making as it provides an important clue regarding the direction of future fertility and hence prompting a closer examination because 'South Wello' is an area with recurring famine problem while 'Borena' is a semi-nomadic region.

The existence of significant community effects and variations among the two major regions of Ethiopia also points to the need to decentralize policy making in fertility. Policies need to take into account the particular social and cultural environment in which fertility decisions are made.

9.6 Suggestion for policy and further research

Results of the preceding analyses suggest that there may be indirect effects through other proxy factors indicating that there is clearly much additional work to be done. Particularly, given the rise in mortality indices due to HIV/AIDS raises the issue of further investigation of the relationship between HIV/AIDS and fertility.

The important roles played by women's education influencing births in the last five years in Addis Ababa compared to the 'Rest' of the regions draws particular attention. Education equips with renewed belief about one's own life as well as skills that enable for participating in the labour force. Furthermore, it was observed that a rise in the level of women's education also leads to a rise in age at first birth and consequently to a decline in fertility. Therefore, provision of free universal education at least up to primary level is still the key to modernization as urbanization.

Some may argue that childbearing is a deeply personal matter that should be left entirely to the individuals involved and that it is not up to a government or policy makers to tell people how many children they should have. However, reproductive policy is about identifying relevant issues, setting priorities, and targeting the right sub-groups within the population through information, education and communication (IEC) using the mass media that will eventually prepare them to make their own decision whether to have any children and how many to have.

The national goal of attaining replacement level fertility by the year 2005 that was set out in the first population policy of the country (although ambitious) can only be achieved if the rate of use of contraception could be increased to 70 per cent requiring a concerted effort to increase the prevalence of contraceptive use, particularly condom use which has dual advantage as both fertility inhibiting and protecting from HIV infection.

In the hierarchical analysis, 'South Wello' zone, which has gone through that has gone through recurring famine is identified to have the highest desire for 'no more children' appeals for further investigation possibly through a qualitative approach.

9.7 Conclusion

This study has attempted to provide partial answers to the pre-set research questions in chapter one. Besides attempting to identify a number of factors influencing fertility at national level, in Addis Ababa and in the 'Rest' of the regions, this study also demonstrated the importance of methodological issues in the analysis of fertility by employing various methodologies in tackling the research questions.

The study has not only confirmed that on the one hand, the fertility transition in the capital city (Addis Ababa) has reached the post-transitional stage making it unique compared with other capital cities in Sub-Saharan Africa has begun, but also identified that the transition to lower fertility level has begun in the 'Rest' of Ethiopia but in the early-mid stage. The unique fertility transition to below replacement level that took place in Addis Ababa has caught many researchers by surprise because it happened in an African city and in a country with wide spread poverty.

Other African capital cities have also experienced considerable demographic change, but Addis Ababa's case is unique due to a cultural context that dictates marriage. In the Ethiopian context, getting married involves several factors but housing is the most important among them because children are expected to be borne immediately after marriage. For this reason, prospective couples have to prepare their homes in advance. In the vast rural areas preparing one's own house is relatively easier where a prospective groom gathers his peer group and constructs his future home (often thatched houses) within a short period. However, to construct one's own house or to rent a council house in Addis Ababa is very hard due to the high prevalence of unemployment and poverty.

Among the important findings, education, household wealth status and housing status are identified as the most important factors influencing 'time to marriage', 'desire for additional children' and 'actual fertility'. The depressing effect of education on fertility and its strong positive effect on marriage in

Addis Ababa in contrast to that in the 'Rest' raises the question why it operates differently. First, the effect of education on fertility has not always been uniform due to the contextual nature of its association and the influence of external factors such as culture and kinship network (Cleland, 2002). Therefore, the strong negative influence of education on fertility in Addis Ababa could be a result of the interplay of other modernization factors in the capital city, whereas in the 'Rest' deep embedded cultural forces may resist the expected behavioural change induced by education.

Like education, there have been conflicting views on the association between poverty and fertility. For instance, World Bank (1984) claimed that high fertility is a rational response to poverty. Aassve et al (2005) also noted that the persistence of high levels of fertility and poverty in Ethiopia is driven by lack of economic growth and poor access to family planning.

On the other hand, the ideational and diffusion approach views fertility decline to be a result of the spread of ideas and information to the population (Casterline, 2001, Cleland, 2001). The evidence for the view is the remarkable demographic transition achieved by Bangladesh and Nepal both of when both are classified among the poorest countries in the world.

One of the main findings of this study is that some of the poverty indicators such as lower household assets index and not having own house were consistently related to shorter time to first marriage, less desire for additional children and fewer number of children born in Addis Ababa. This study employed various techniques – from trend analysis to multivariate, design-based and multilevel modelling to arrive at such finding and it is fair to suggest that the fertility decline in Addis Ababa has likely been poverty induced, which needs further attention.

Another important contribution of this study is quantifying the gap in actual fertility, marriage and fertility preference between Addis Ababa and the 'Rest' of Ethiopia by accounting for the disparity into a part due to the respondents own characteristics and another part due to behavioural change attributable to the effects of socio-demographic, attitudinal and modernization factors. This study has found that there is a 67 percent gap in the rate of child bearing, 47 percent gap in non-marriage and a 28 percent gap in fertility intention between Addis Ababa and the 'Rest' of Ethiopia attributable to education, occupation and housing status among others.

Finally, one of the important findings of this study is the identification of particular clusters and zones that behave distinctly from the rest of the clusters and zones using a hierarchical or multilevel analysis. For instance, South Wello' zone is identified to have the highest desire for 'no more children' and 'Borena' zone is observed to have the lowest ranking in terms of desire for no more children. This has an important implication for decision making as it provides a vital clue regarding the direction of future fertility and hence prompting a closer examination because 'South Wello' is an area that has gone through recurring famine problem while 'Borena' is a semi-nomadic region.

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APPENDICES

APPENDIX – PC: Principal Components Analysis

Estimation of 'household assets index' using Principal Components Analysis

The principal components analysis technique was used to estimate the assets index in this study. The principal component analysis (PCA) is a procedure that transforms a number of correlated variables into a smaller number of uncorrelated variables called principal components. PCA is similar to the factor analysis and is used to extract from a large number of variables, a principal component which is the linear index of variables with the largest amount of information common to all of the variables (Filmer and Pritchett, 2001).

The main advantage of a principal component analysis is that it enables us to reduce the number of variables of the data set while retaining most of the original variability in the data. The first principal component accounts for as much of the variability and each succeeding component accounts for as much of the remaining variability as possible.

Filmer and Pritchett (2001) based their principal components analysis of the assets index on the assumption that household long-run wealth explains the maximum variance (and covariance) in the asset variables. In general, for a set of N variables, a_{1j} to a_{Nj}, representing N assets each household (j) owns. The first step in the PCA is to normalize each variable by its mean and standard deviation using:

$$a^*_{Ij} = \frac{(a_{Ij} - \bar{a}_I)}{s^*_I}$$

where a^*_{1j} is the normalized variable $\bar{a}_I$ is the mean of a_{1j} across households and s^*_1 is its standard deviation. These selected variables are expressed as linear combinations of a set of underlying components for each household j:

$$\begin{aligned} a^*_{1j} &= v_{11} \cdot A_{1j} + \ldots + v_{1N} \cdot A_{Nj} \\ \ldots & \qquad\qquad\qquad j = 1,\ldots J \qquad\qquad (1) \\ a^*_{Nj} &= v_{N1} \cdot A_{1j} + \ldots + v_{NN} \cdot A_{Nj}, \end{aligned}$$

where the A_s are the components and the v_s are the coefficients on each component for each variable. Although the only known parameter in equation (1) are the a^*_{1j} *to* $a^*_{Nj,}$ PCA finds the linear combination of the variables with maximum variance (i.e. the first principal component, A_{1j}) and then finds a second linear combination of the variables, orthogonal to the first, with maximal remaining variance, etc. (Filmer and Pritchett, 2001). The resulting principal component (i.e. assets index) for each household (A_{1j}) is based on the formula:

$$A_{1j} = \frac{f_{11}(a_{1j} - \bar{a}_1)}{s_1^*} + ... + \frac{f_{1N}(a_{NJ} - \bar{a}_N)}{s_N^*}$$

where f_1 is the 'scoring factor' for the first asset as determined by the procedure. Scoring factor is the 'weight' assigned to each variable (normalized by its mean and standard deviation) in the linear combination of the variables that constitute the first principal component. a_{1j} is the J^{th} household's value for the first asset and $\bar{a}_1$ and s^*_1 are the mean and standard deviation of the first asset variable respectively.

Table PC 1: Results of the principal components analysis

Variable	Mean	Std. Dev.	Eigenvalue[a]	Factor scores[b]	Weight in assets index	lower 51%	middle 36%	upper 13%
Has electricity	0.270	0.444	7.380	0.882	1.988	0.001	0.392	0.999
Owns radio	0.308	0.462	1.934	0.660	1.431	0.087	0.383	0.983
Owns TV	0.067	0.251	1.193	0.595	2.373	0.000	0.017	0.484
Owns a Car	0.011	0.102	1.109	0.277	2.715	0.000	0.001	0.079
Has telephone	0.043	0.202	1.058	0.504	2.496	0.000	0.004	0.324
Has electric 'Mitad' ‡	0.066	0.249	0.911	0.600	2.412	0.000	0.011	0.490
Has lamp (kerosene/gas)	0.187	0.390	0.803	0.078	0.201	0.131	0.271	0.174
Owns cropland	0.621	0.485	0.785	-0.763	-1.572	0.962	0.355	0.011
Owns cattle	0.496	0.500	0.673	-0.602	-1.204	0.748	0.307	0.023
Goats	0.307	0.461	0.609	-0.386	-0.837	0.454	0.194	0.041
Uses pond water	0.029	0.169	0.563	-0.071	-0.421	0.028	0.041	0.000
Uses Well water	0.637	0.481	0.517	-0.803	-1.670	0.972	0.389	0.001
Uses piped water	0.333	0.471	0.435	0.844	1.791	0.000	0.569	0.999
Has no toilet	0.676	0.468	0.394	-0.814	-1.739	1.000	0.455	0.008
Has pit latrine	0.314	0.464	0.377	0.771	1.661	0.000	0.543	0.923
Has flush toilet	0.009	0.097	0.209	0.237	2.453	0.000	0.002	0.070
Uses firewood for cooking	0.797	0.402	0.049	-0.834	-2.072	0.999	0.781	0.029
Uses charcoal for cooking	0.038	0.190	0.0044	0.259	1.362	0.000	0.080	0.067
Uses electr/gas for cooking	0.149	0.356	0.0013	0.764	2.149	0.000	0.099	0.889

Source: Estimated using ETDHS 2000; ‡ electric 'mitad' is a type of oven used for making 'Injera' (staple food)

NB: [a] **Eigenvalue**: An eigenvalue is the variance of the factor. In PC, the first factor will account for the most variance, the second will account for the next highest amount of variance, etc (see Fig. PC1).

[b] **Factor scores**: show how the variables are weighted but also the correlation between the variables and the factor.

The PCA procedure begins with the construction of the mean, standard deviation and covariance matrix using the variables of interest. Each variable (or its dummy) takes the value 0 or 1 (for 'not having' or 'having') a particular household item. The next step is to create eigenvectors from the covariance matrix and then reorder them by eigenvalue, highest to lowest (see Col. of Table PC_1).

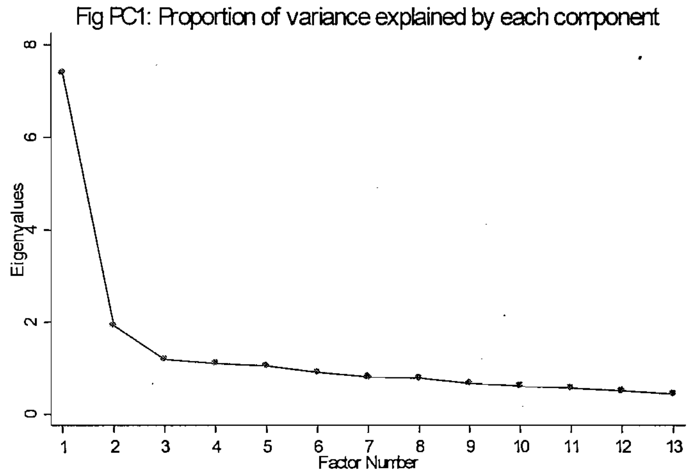
The ETDHS survey covers about 901 households and about 15367 respondents. The survey collected information on household items such as ownership of consumer durables (bicycle, radio, television, bicycle, refrigerator, car), services in the household (toilet facilities, source of drinking water, electricity, type of cooking fuel, telephone, source of lighting), shelter, crop land, and livestock (see Table (PC1)).

Table (PC1) presents the results of the principal components analysis of the 20 variables. According to the results in Table (PC1), owning a car has the highest weight raising the assets index by about 2.71 units while using fire wood for cooking has the lowest weight lowering the assets index by about 2.1 units. Similarly, a household that has electric 'Mitad' (a type of electric oven used to make the staple food 'Injera') raises the assets index by about 2.4 points and having no toilet facility lowers the assets index by about 1.7 units.

Once the assets index was constructed, respondents were arbitrarily classified into three categories (the lowest 51% as 'poor', the next 36% as 'middle' and the upper 13% as 'rich'), but not in the conventional meaning and classification of 'poverty' (Filmer and Pritchett, 2001). Moreover, in the Ethiopian case the (40, 40, 20) classification could not implemented due to the fact that about 50% of the respondents fall on to a single cutoff point when trying to classify using the Filmer and Pritchett (2001) technique. Therefore, the classification was done using (51%, 36%, 13%) in stead of (40%, 40%, 20%) for 'poor', 'middle' and 'rich' categories respectively.

Reliability and consistency of the Assets Index

The consistency of the assets index and the average correlation of items were checked using Cronbach's alpha with a value of 0.898. Generally, a reliability/consistency coefficient of 0.70 to 0.80 or higher is considered as 'acceptable' (Hays, W. L. 1981). As shown in the last three columns of Table (PC1), considerable differences of average ownership of each asset are observed. For instance, only 8% of the 'poor' own radio compared to 39% for the 'middle' and almost 100% for the 'rich. Similarly, none of the respondents in the 'poor' category seem to own electric 'mitad' used to make the staple food 'injera' meaning they exclusively use firewood for cooking compared to, about half (49%) of the 'rich' using electric 'mitad' and about 90% of the same use electricity/gas for cooking.



Scree plot

A scree plot is a graphical technique by which the eigenvalues are plotted against the corresponding factor numbers to get a clue on the maximum number of factors to extract (Gorsuch, 1983). It illustrates the rate of change in the magnitude of the eigenvalues for the factors. As can be seen from Fig (pc1), the rate of decline tends to be fast for the first few factors but then levels off.

The 'elbow' or the point at which the curve bends is considered to indicate the maximum number of factors to extract. The figure above illustrates the proportion of variance explained by each component. A clear 'elbow' occurred at the third factor, which has an eigenvalue of about 1. Fig (PC1) also shows that the eigenvalues for the first few variables drop rapidly and after the third factor the decline in the eigenvalues gradually levels off, suggesting that a maximum of three factors might be (Loehlin, 1992).