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Division of Social Statistics

School of Social Sciences

Three essays on fertility and contraceptive use in Egypt

by

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ABSTRACT

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THREE ESSAYS ON FERTILITY AND CONTRACEPTIVE USE IN EGYPT

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The thesis comprises three essays on fertility and reproductive health in Egypt. It provides unconventional applications of the Demographic and Health Survey (DHS) data both in the types of methods applied but also in the way the data themselves are used to answer questions on fertility and reproductive health. Notions and methods from the economics and geographical literatures are borrowed and are combined in the demographic literature. DHS calendar data, geographical and with environmental data are used as part of the DHS data set allowing the inclusion of another dimension of analysis. This thesis also provides alternative methods to analyze issues on fertility and reproductive health from the ones commonly used in demographic fields.

This thesis looks at the determinants of fertility and reproductive health in Egypt and uses the 2000 Egyptian Demographic and Health Survey data. Previous studies have identified the peculiar patterns regarding geographical differentials in fertility levels and contraceptive use in Egypt. Despite the reduction in fertility levels and increase in family planning use of the past 20 years, there remain a number of areas of concern. One is the large variation in fertility and contraceptive use by place of residence. This thesis looks at three aspects of the Egyptian demography, focusing on aspect of fertility, and reproductive health in its past, current and future trends. The first paper looks at the timing of fertility with a special emphasis to the second and third birth intervals and explores the effect of contraceptive use on the timing of fertility using retrospective information on the timing of contraceptive use, breastfeeding, and postpartum amenorrhea available in the DHS calendar. The second essay analyses the current use of modern contraception and explores the reasons for the regional gap in contraceptive use levels. The third essay looks at future fertility intentions by analyzing the determinants of desired fertility in Egypt.

Contents

List of tables

List of figures

Box

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Chapter 1

Introduction

1.1 Introduction

Malthus (1798) in his *Essay in the Principle of Population*, noted that the 'population, when unchecked, increased in a geometrical ratio, and subsistence for man in an arithmetical ratio' (Malthus 1798:opening of chapter 2). He based his theory on the population explosion that was already becoming evident in the eighteenth century, and argued that the number of people would increase faster than the food supply. The population would eventually reach a limit determined by the availability of food. Any further increase would result in a population crash, caused by famine, disease, or war or a combination of all three. Malthus was not optimistic about the outcome and suggested that only 'moral restraint' (birth control through delay in marriage and sexual abstinence) could prevent a crisis.

Since Malthus's *Essay in the Principle of Population*, there has been a steady increase in the understanding of ways to prevent the problem of excessive population growth. Demographic theory has developed, flourishing with improved demographic techniques and with improved understanding of the instruments through which fertility can be reduced in order to control population growth.

In the middle of the twentieth century, Davis and Blake (1956) introduced the concept of 'intermediate variables', which they defined as 'such factors through which, and only through which, cultural conditions can affect fertility'(1956:211). They inspired a more structured analysis of the proximate determinants, which have been subsequently defined as the factors through which fertility levels are determined within a population. The most important of these factors are explicitly listed as marriage, contraceptive use, breastfeeding, post-partum amenorrhea and abortion (Bongaarts 1978). Socio-economic variables only affect fertility through these proximate determinants. Instruments through which fertility levels can be modified have therefore been clearly laid out. However there is not yet a clear picture on how the socio-economic variables and community context affects the proximate determinants and ultimately the fertility levels. According to demographic theory the socio-economic variables affect fertility indirectly by acting upon the proximate determinants. In order to determine policies which are effective we need to understand how the proximate determinants affect fertility and how socio-economic factors affect those determinants. Only then, are we able to intervene to change behaviour in an effective way.

Shortly after the publication of Malthus's *Essay*, the first 'modern' life table was introduced for the analysis of mortality. Since then, demographic analytical techniques have moved on from the analysis of life tables, to regression modelling techniques for event-history analysis with which it is possible to analyse micro-level data in a more sophisticated way according to the types of event of interest.

However the rate of progress in theoretical knowledge has been influenced both by the lack of data available and the availability or non-availability of relevant demographic analytical techniques to provide empirical evidence to support or contradict the theoretical conceptual framework. The lack of demographic data is particularly noticeable in developing countries, where until recently the only data widely available were census data, only a limited amount of which concerned fertility and mortality, and the exploitation of even this required the use of indirect methods.

During the late 1970s and early 1980s there was a new project to collect data in developing countries called the World Fertility Survey (WFS). The surveys were of high-quality, comprising internationally comparable surveys of human fertility, conducted in 41 developing countries. These data represented an important addition to the stock of data on fertility for certain developing countries. They allowed production of higher quality fertility estimates (United Nations 1984). The WFS has been followed by the Demographic and Health Survey (DHS), which has collected data for a series of countries around the world and provided information about fertility and family planning. This information generally includes information about current use of contraception, knowledge of methods, and detailed fertility history including birth and death dates of children. The DHS data remains for most countries in the developing world the only information on the dynamics of fertility and reproductive health, and as such, the only data which can provide detailed estimates of the proximate determinants of fertility.

In the past decades, some DHSs have also included a so-called calendar which provides monthly information on the use of contraception, the timing of breastfeeding and post-partum amenorrhea for the five years preceding the survey. The DHS calendar has the potential to help answer important questions on fertility, notably those relating to the effects of each proximate determinant on the fertility process in each country studied.

In recent years there has been a growing body of evidence that the community where individuals live has a strong effect on shaping their fertility behaviour. However, only recently, have studies investigated these matters further to see which community characteristics affect fertility behaviour. For selected countries, DHSs have also collected Global Positioning System (GPS) locations for the primary sampling units of the survey. This GPS information allows the linking of contextual information to the survey data. However both the DHS calendar and GPS information of the primary sampling units have been rarely used.

This thesis aims to illustrate new ways to analyse DHS data. It intends to assess the reliability of the DHS calendar in capturing the variation in fertility, as well as illustrating how, by using information from the Global Positioning System locator of the primary sampling units, we are able to add another dimension of analysis to the DHS data. This thesis will focus on the special case of Egypt and will use the 2000 Egyptian Demographic and Health Survey data.

1.2 Content of the thesis

The thesis comprises three essays on fertility and contraceptive use in Egypt. It provides unconventional applications of the Demographic and Health Survey (DHS) data both in the types of method applied but also in the way the data themselves are used to answer questions on fertility and contraceptive use. Notions and methods from the economics and geographical literature are borrowed and are combined with those from the demographic literature. DHS calendar data, geographical data and more general environmental data are combined with the conventional DHS data set allowing the inclusion of another dimension of analysis. This thesis also provides methods of analysing issues relating to fertility and reproductive health which are different from the ones commonly used by demographers. For example the second essay provides an application of a decomposition technique normally used by labour economics, whereas in the third essay standard Geographical Information System (GIS) techniques commonly used by geographers and environmental planners are combined with multilevel modelling techniques which are widely used by demographers. Furthermore, the socio-economic variables as well as their geographical setting are given a main focus throughout the thesis. Hence, this thesis illustrates new ways to analyse DHS data.

As mentioned above, this thesis looks at the determinants of fertility and reproductive health in Egypt and uses the 2000 Egyptian Demographic and Health Survey (EDHS) data. Previous studies have identified geographical differentials in fertility levels and contraceptive use in Egypt. Despite the reduction in fertility levels and increase in family planning use over the past 20 years, there remain a number of areas of concern. One is the large variation in fertility and contraceptive use by place of residence. Another is the contraception users' discontinuation rate and reasons for discontinuation. This thesis looks at three aspects of Egyptian fertility focusing on fertility and reproductive health in its past, current and future dimensions. The first essay looks at the timing of fertility with a special emphasis on the second and third birth intervals and explores the effect of contraceptive use on the timing of fertility using retrospective information on the timing of contraceptive use, breastfeeding, and postpartum amenorrhea available in the DHS calendar. The second essay analyses current use of modern contraceptives and explores the reasons for regional gaps in contraceptive use levels. The third essay looks at future fertility intentions by analysing the determinants of desired fertility in Egypt.

Fertility behaviour differentials in Egypt have often been understood with reference to regional patterns of socio-economic development. However, there have been few studies which have assigned to the geographical and socio-economic environment a central role in the analytical framework. Hence, this research assigns the study of geographical differentials of fertility and contraceptive use a primary role. The regional patterns are covered throughout the thesis but most explicitly in the second and third essays, where the socio-economic determinants of fertility behaviour and contraceptive use are largely addressed in their local environments.

The thesis commences with a study of birth interval length using the 2000 EDHS calendar data. DHS calendar data, despite providing unusually detailed information on the proximate determinants of fertility (which are of primary interest for demographers), have been rarely used since their first introduction a decade ago in the DHS questionnaire. There are several reasons why there are few applications of these data but the two most important are that social scientists have been heavily sceptical of the accuracy of the information which they contain, and that they require a large investment of time in the data handling which has to precede any application of those data. In the first essay the DHS calendar, which provides monthly information on contraceptive use, breastfeeding, and postpartum amenorrhea, is used to analyse the influence of the proximate determinants and the results show that the DHS calendar data are capable of capturing almost all the variation in fertility. In other words the calendar data are detailed enough to permit an accurate application of the proximate determinants model of fertility. The results of this essay suggest that, where calendar data are available, studies which look at the determinants of fertility should be designed in two stages. First they should use the DHS calendar to clarify the effect of each proximate determinant on fertility, and allow the evaluation of the relative importance of the effect of each proximate determinant. Second, the results from the first stage should be used to discern the effect of the socio-economic factors on each proximate determinate and ultimately, thereby, their effect on fertility. Although the central research question of the first essay is largely methodological, in that the first essay shows that the 2000 EDHS calendar data can be used to gather an insight of the relative importance of each proximate determinant on the fertility processes, the results are of substantive interest, and provide an introduction of the patterns of fertility and reproductive health in Egypt.

The second essay examines the reasons for geographical differentials in contraceptive use in Egypt. As mentioned, several studies have found marked geographical differentials in contraceptive use levels within the country, particularly between Lower and Upper Egypt and between their rural and urban areas, though the reasons for these differentials so far have not been clearly identified. This paper explores the reasons for them using an Oaxaca decomposition of a logistic model. The Oaxaca-Blinder decomposition was originally used by labour economists to describe gender and race differentials in wages and subsequently extended to discrete variables (e.g. labour force status). The decomposition is applied here to look at geographical differentials in the use of modern methods of contraception and allows the determination of the proportion of the difference in the modern contraception between the main regions in Egypt that is due to different characteristics of the population of interest (the 'explained' components) and that caused by 'discrimination', which in the essay is represented by attitudinal or behavioural factors which vary by geographical region (that is 'residual' components, which are not accounted for in the model). The second essay, therefore, illustrates the application of this technique to a demographic question, and provides a relevant substantive contribution in exploring the geographical differentials in contraceptive use in Egypt. The results show that it is possible to evaluate the proportion of any given geographical differential that is due to behavioural aspects and how much is due to differences in the socio-economic characteristics of the two populations being compared.

The third paper approaches the analysis of geographical differentials in fertility behaviour in Egypt using a different approach which uses a recently developed methodology combining multilevel modelling and Geographical Information System (GIS) techniques. In recent years DHS data have included, for selected countries, information about the Global Positioning System locators for the primary sampling units in the survey. This new information allows the linking of other contextual data sources to the DHS data, and thereby permits us to add another dimension of analysis to the survey data. GIS techniques and up-to-date maps of land use and the road network are used to construct additional variables which refer to the socio-economic environment where women lived and which, in a demographic conceptual framework, are hypothesised to affect decisions about fertility and contraceptive use. The essay shows how the GIS techniques facilitate the addition of additional layers of information to the survey data, and allow the construction of several variables representing the level of economic modernization such as land use, road density and urbanization. Substantively, this essay aims to assess the relative importance of social and economic modernization at the individual and community level in explaining geographical differentials in desired fertility in Egypt.

Table 1.1 summarises the aims of the thesis, showing that each essay aims to make both a methodological and substantive contribution. The next section of this introduction provides some background information on past trends in fertility and contraceptive use in Egypt highlighting regional variations and introduces the current problem of population pressure. In section 1.4 Egypt's geography will be briefly illustrated in order to help the reader understand and appreciate the treatment of geographical differentials in the three essays. Section 1.5 introduces the data used in this thesis and Section 1.6 provides a brief outline of the thesis.

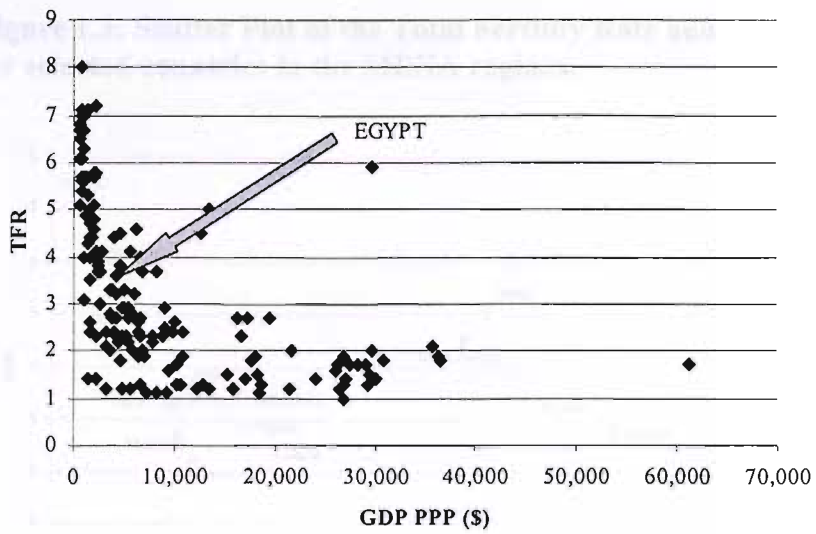
Table 1.1 Aims of the thesis.

Essay	*Methodological contributions*	*Substantive contributions*
First Essay: *The Proximate Determinants and Birth Intervals in Egypt: an application of Calendar Data*	DHS calendar data are capable of capturing almost all the variation in fertility	Effect of breastfeeding, contraceptive use and level of contraceptive failure in Egypt
Second Essay: *Explaining Geographical Differentials in Contraceptive Use in Egypt: a Decomposition Approach Using the 2000 Egyptian Demographic and Health Survey*	Application of Oaxaca decomposition to a demographic problem	How much of the geographical differential in contraceptive use in Egypt is due to behavioural aspect and how is due to differences in the socio-economic characteristics of the two populations being compared
Third Essay : *Effect of Modernization on Desired Fertility in Egypt*	Application of recently developed methodology which combines multilevel modelling and GIS techniques Show how GIS data can be used to add another dimension of analysis to the survey data	Importance of social and economic modernization at individual and community level in explaining geographical differentials in desired fertility in Egypt

1.3 Population pressure, fertility and contraceptive use differentials: an on-going policy challenge.

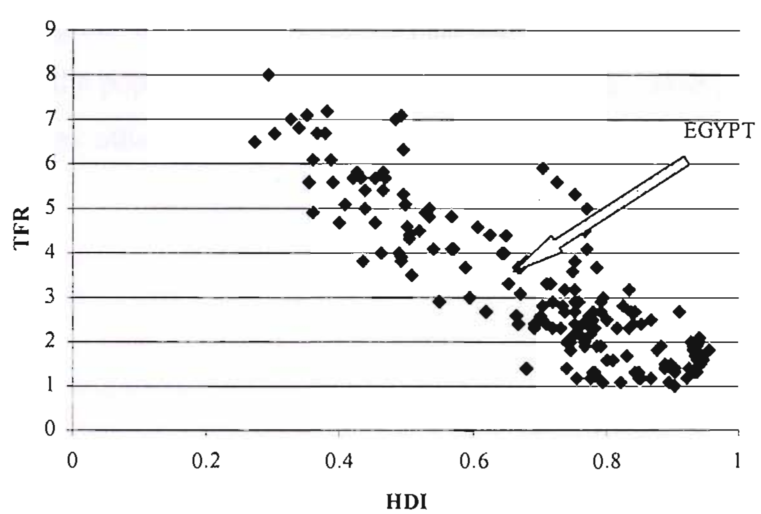
Egypt is ranked as a low-middle income country according to the World Bank classification with an average annual Gross Domestic Product (GDP) per capita of 3,810 (Purchasing Power Parity(PPP) US$) and as a middle human development country by the United Nations Development Programme (UNDP) classification with a value of 0.653 for the Human Development Index (HDR 2004). Despite this, fertility levels are still well above replacement level, and Egypt's fertility levels are high compared with countries with a similar level of development (Figure 1.1 and Figure 1.2).

Figure 1.1: Scatter plot of the Total Fertility Rate and GDP per capita (PPP$) for all countries in the world in 2002.



Source: *TFR*, UN (United Nations). 2003. World Population Prospects 1950-2050: The 2002 Revision. Database. Department of Economic and Social Affairs, Population Division. New York. *GDP PPP($),* calculated on the basis of GDP and population data from World Bank. 2004. World Development Indicators 2004. CD-ROM. Washington, DC.

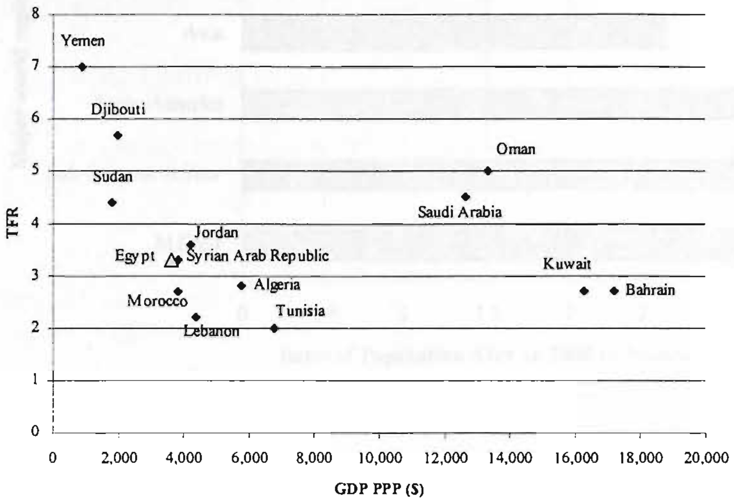
Figure 1.2: Scatter plot of the Total Fertility Rate and HDI for all countries in the world in 2002.



Source: *TFR*, UN (United Nations). 2003. World Population Prospects 1950-2050: The 2002 Revision. Database. Department of Economic and Social Affairs, Population Division. New York. *HDI is* calculated based on the life expectancy index, education index, and the GDP index.

Looking at the relationship between Total Fertility Rate (TFR) and GDP for the countries in the Middle East and North Africa (MENA) regions (Figure 1.3), Egypt is not exceptional in terms of the level of TFR expected from the level of development of countries within these regions.

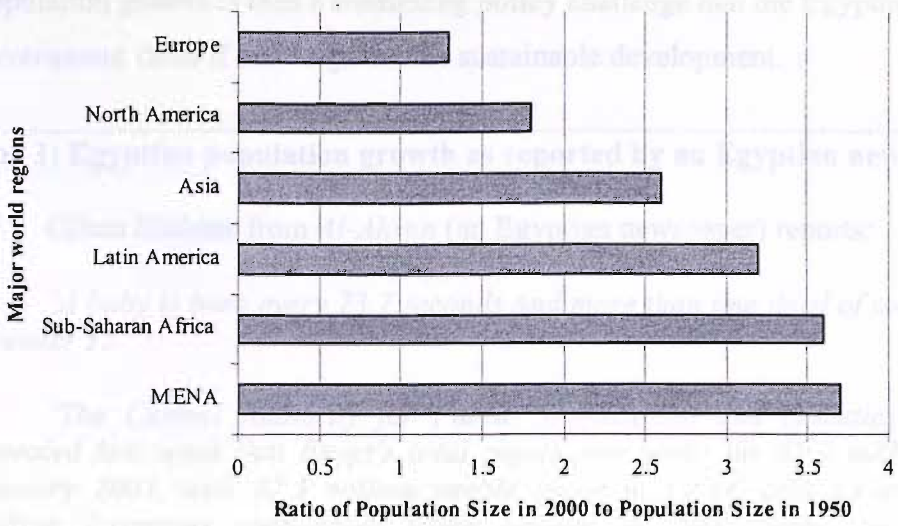
Figure 1.3: Scatter Plot of the Total Fertility Rate and GDP per capita (PPP$) for selected countries in the MENA regions.



Source: TFR, UN (United Nations). 2003. World Population Prospects 1950-2050: The 2002 Revision. Database. Department of Economic and Social Affairs, Population Division. New York. *GDP PPP($),* calculated on the basis of GDP and population data from World Bank. 2004. World Development Indicators 2004. CD-ROM. Washington, DC.

The MENA regions have experienced the highest rate of population growth of any regions in the world over the past century (Farzaneh 2001). During the past 50 years the population of the MENA regions has increased 3.7 times, which is more than any other world region (Figure 1.4)

Figure 1.4: Ratio of population size in 2000 to population size in 1950, by major world regions.



Source: United Nations, World Population Prospects: The 2000 Revision (New York: United Nations, 2001). Adapted from (Farzaneh 2001).

Recently, fertility has begun to decline in several countries in the region. Fertility in MENA countries declined on average from 7 children per women around 1960 to 3.6 children in 2001 (Farzaneh 2001). Although this fertility decline is expected to continue, the population will continue to grow rapidly for several more decades. The population is increasing at 2 per cent per annum, the second highest rate in the world after Sub-Saharan Africa. The MENA population is expected nearly to double in the next 50 years.

As Farzaneh (2001) suggested the MENA governments are increasingly challenged to provide basic needs for a growing numbers of citizens. According to Jalaleddin and Farzaneh (forthcoming) MENA economies will need to create half as many additional jobs as those that existed in 1996 in order to prevent the regions' unemployment from increasing further.

Egypt is the most heavily populated country in the MENA region (Figure 1.5). According to the United Nations (2002) projections, Egypt's population will grow from 67 million in 2000 to 82 million 2010 and 103 million in 2025. Between 2000 and 2015 there will be an increase in the number of women of reproductive age of 26 per cent and an increase of the number of 20-24 year olds of 53 per cent.

The Egyptian economy will need to create an additional 500,000 new jobs each year to absorb new entrants in the labour market (Farzaneh 2001). To control population growth is thus a continuing policy challenge that the Egyptian government faces if it is to guarantee sustainable development.

Box 1: Egyptian population growth as reported by an Egyptian newspaper

Gihan Shahine from *Al-Ahran* (an Egyptian newspaper) reports:

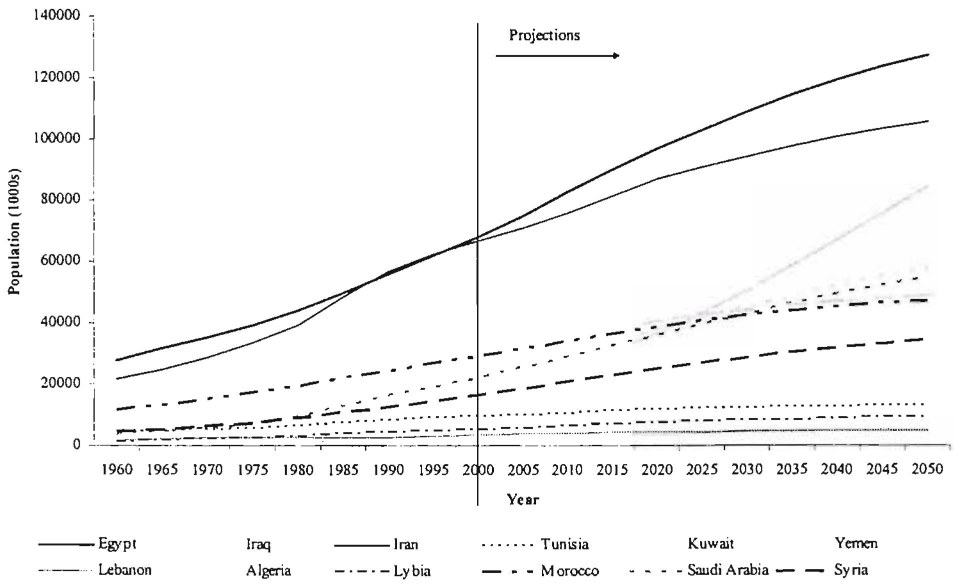
'A baby is born every 23.7 seconds and more than one third of the population is under 15.'

'The Central Authority for Public Mobilisation and Statistics (CAPMAS) revealed last week that Egypt's total population broke the 69.2 million mark in January 2003, with 67.3 million people living in Egypt, plus an estimated 1.9 million Egyptians temporarily living abroad. In 2002 alone, the population increased by more than 1.3 million at a rate of 110,600 new births a month. That means 3,636 newborns a day, or a baby born every 23.7 seconds.'

Looking beyond contraception Al-Ahram

Al-Ahram Weekly Online: 27 Feb. - 5 March 2003 (Issue No. 627)

Figure 1.5 Population projections of selected countries in the Middle East and North Africa regions.



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2002 Revision and World Urbanization Prospects: The 2001 Revision, http://esa.un.org/unpp, 16 April 2003; 8:29:30 AM. Medium variant population projection.

Egypt was one of the first countries in the Arab region to introduce a national population policy. As early as the 1930 Egypt's demographers and social scientists noted the country's population problem: 'an exponential population growth at rates outstripping the country's ability to expand its resource base' (Ibrahim 1995:57). After a few decades of concern, following the abolition of the monarchy in the 1960s, the Egyptian state adopted a population policy. However, according to some scholars, despite early institutional efforts to cope with population pressure, only in the past two decades under the Mubarak presidency did the Egyptian government develop a "clear policy with a clear object" (Ibrahim 1995:61).

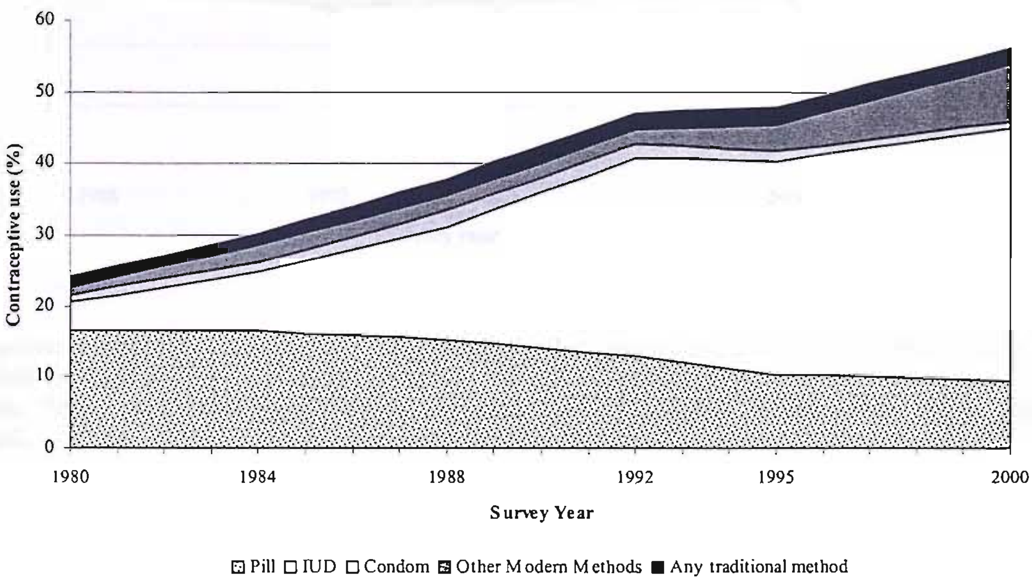
In the past twenty years major changes have occurred in several other socio-economic indicators, notably the expansion of educational opportunities, the improvement of health and sanitation, the transformation of the economy from an almost exclusively agricultural base toward mixed industry and agriculture, the spread of urbanization, the electrification of most rural areas, the expansion of networks of transportation and access to the mass media (Hallouda, Farid and Cochrane 1988).

Contraceptive use levels have more than doubled in Egypt since 1980 (El-Zanaty and Way 2001). At the time of 1980 Egyptian Fertility Survey (EFS) the percentage of currently married women using a modern method of contraception was 22.8 per cent; at the time of the 2000 EDHS the percentage had risen to 53.9 per cent (see Figure 3.1 Chapter 3). The total fertility rate (TFR) decreased by almost two births from 5.3 births to 3.5 births over this period. This decline in fertility has been clearly associated with these increasing levels of contraceptive use (Govindasamy and Malhotra 1996).

Family planning programme efforts have contributed to a shift in method mix toward the Intra Uterine Device (IUD). The change in the percentage of women relying on the IUD has been especially noticeable, rising from only 4 per cent at the time of 1980 EFS to 35.5 per cent at the time of 2000 EDHS. During the same period, there was a decrease in the percentage of women using the pill from 17 per cent to 10 per cent.

The increase in contraceptive use has been evident in all regions, although the rate of increase varies. Between 1980 and 2000 the prevalence of contraceptive use increased by 43 percentage points in rural Lower Egypt, by 36 percentage points in rural Upper Egypt and by 30 percentage points in urban Upper Egypt. The overall increase in the four entirely urban governorates was 19 percentage points, due to the rate already being high in these governorates at the time of 1980 EFS. Sayed *et al.* (1993) found that the level of contraceptive use in Lower Egypt was approaching that of the urban governorates, whereas the level in Upper Egypt lagged behind that of other areas.

Figure 1.6: Trend in Contraceptive use by methods between 1980 and 2000.

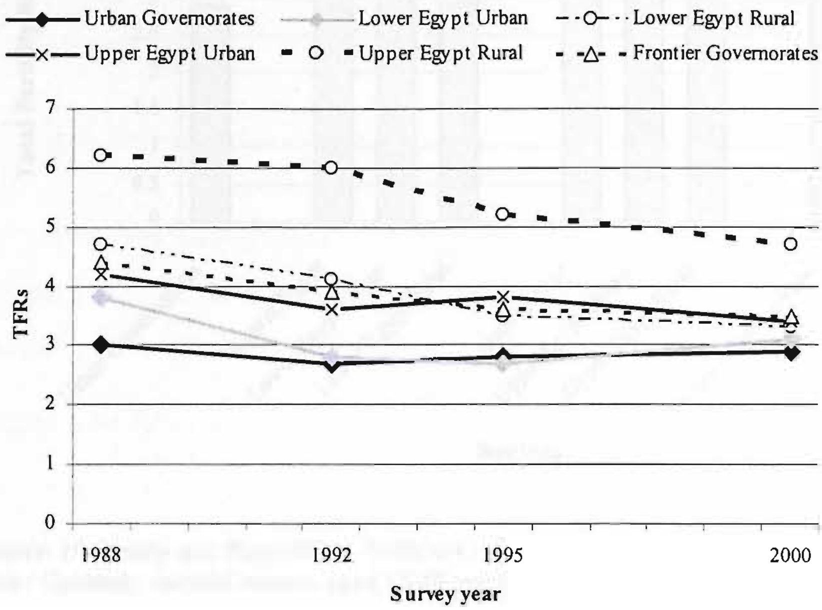


Sources: Mayer, El-Zanaty and Way (1995), El-Zanaty et al.(1996), El-Zanaty and Way (2001).

To consider recent trends in fertility levels, in the past 20 years we have witnessed a decline in fertility. Urban fertility declined between the 1988 and 1992 surveys from 3.5 to 2.9 births. The decline levelled off early in the 1990s, with the urban Total Fertility Rate (TFR) fluctuating around three births throughout the rest of the 1990s. In rural areas, however, fertility levels declined continuously, from 5.4 births per woman at the time of the 1988 EDHS to 3.9 births per woman at the time of the 2000 EDHS.

Place of residence was related to the pattern of fertility decline. Women in rural Upper Egypt experienced the greatest absolute changes in fertility levels during the period, with a TFR dropping from 6.2 to 4.7 births per women. The TFR in rural Lower Egypt was 4.7 at the time of the 1988 survey (the level reached in 2000 in rural Upper Egypt) and dropped to 3.3 births at the time of the 2000 EDHS.

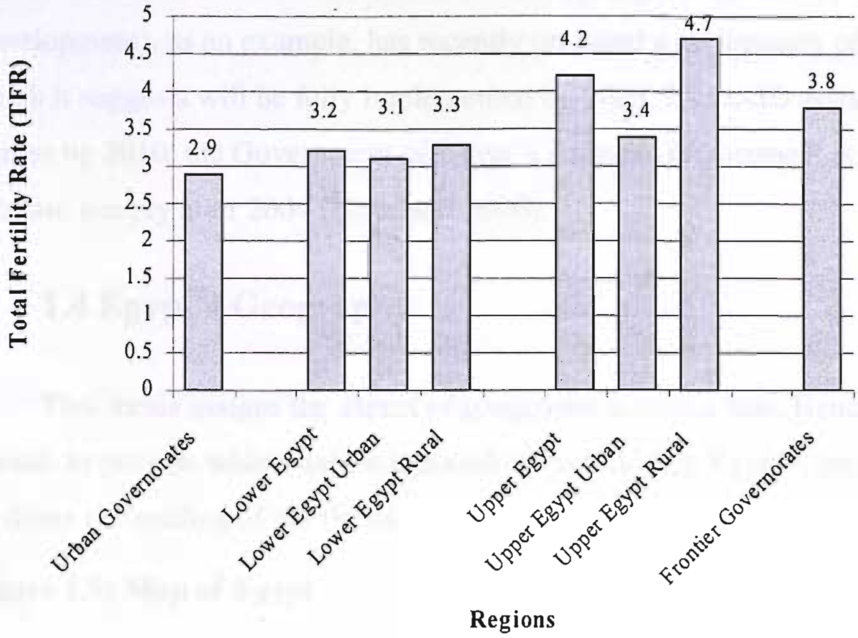
Figure 1.7: Trends in fertility by place of residence.



Sources: Adapted from El-Zanaty *et al.* (1996) Table 3.4, page 42 and El-Zanaty and Way (2001) Table 4.4, page 48.
Note: Total fertility rates for three years preceding the survey, by place of residence, Egypt 1986-2000.

Despite the recent findings from the 2000 EDHS showing progress in lowering fertility and increasing use of family planning, fertility and contraceptive use levels are characterized by a large variation by place of residence, and not much improvement has been recorded in some areas of the country. Figure 1.8 shows the current fertility level by place of residence, and shows that Urban Governorates have the lowest level of fertility with 2.9 births per woman, whereas rural Upper Egypt show the highest level with 4.7 births per women.

Figure 1.8: Total fertility rates by place of residence, 2000 EDHS.



Source: El-Zanaty and Way (2001), Table 4.1, p. 45
Note: Currently married women aged 15-49 years.

According to the 2000 EDHS, the current use of any modern contraceptive method among currently married women aged 15 to 49, ranges from 60 per cent in the urban governorates and Lower Egypt to around 40 per cent in Upper Egypt and the frontier governorates (see Figure 3.2 in Chapter 3). A gap in contraceptive use between Upper Egypt and Lower Egypt exists both in rural and urban areas. As far as urban areas are concerned there is a similar method mix in the Urban Governorates, urban Lower Egypt and urban Upper Egypt, but the level of contraceptive use in urban Upper Egypt is almost 10 per cent lower than in other urban areas.

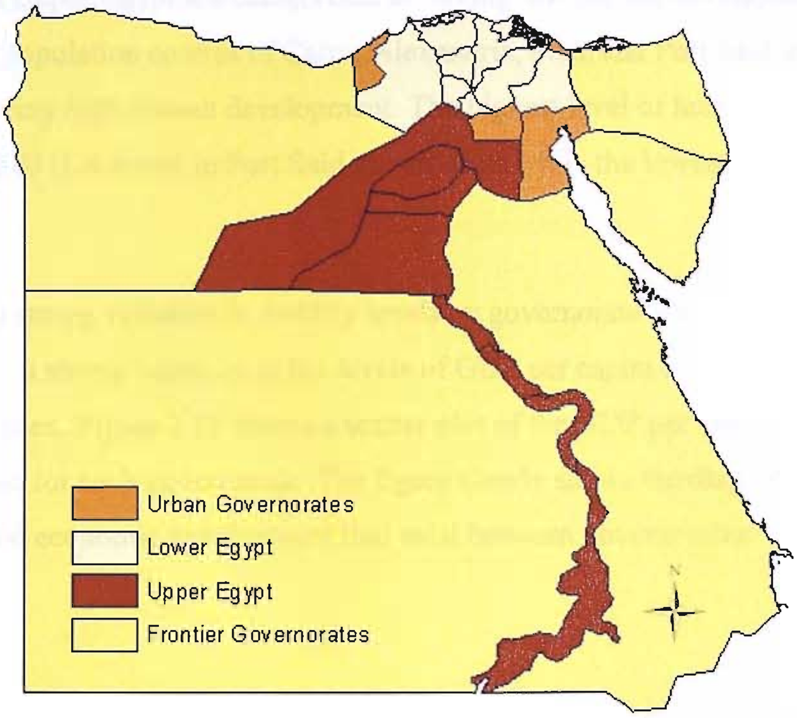
The gaps in contraceptive use need to be properly addressed if the government's goal of replacement levels of fertility by 2016 is to be considered a realistic target. Furthermore, in recent years there has been rising concern about the sustainability of the whole family planning programme. The fact is that in spite of the decline in fertility levels of the last decade, population growth in Egypt is still a problem. The population program has historically been dependent on donor support. Moreland (2000) calculated that in 1997-98 the government of Egypt financed only

53 per cent of the cost of family planning services with the remaining 47 per cent coming from donors. Recently many donors have suggested that fewer funds will be available in the future. USAID (United State Agency for International Development), as an example, has recently prepared a preliminary phase-out plan, which it suggests will be fully implemented by 2009. If USAID assistance declines to zero by 2010, the Government of Egypt's financial requirement is estimated to increase steeply after 2004 (Moreland 2000).

1.4 Egypt's Geography

This thesis assigns the aspect of geography a central role. Hence, this section intends to provide additional background information on Egypt's geography to facilitate the reading of the thesis.

Figure 1.9: Map of Egypt

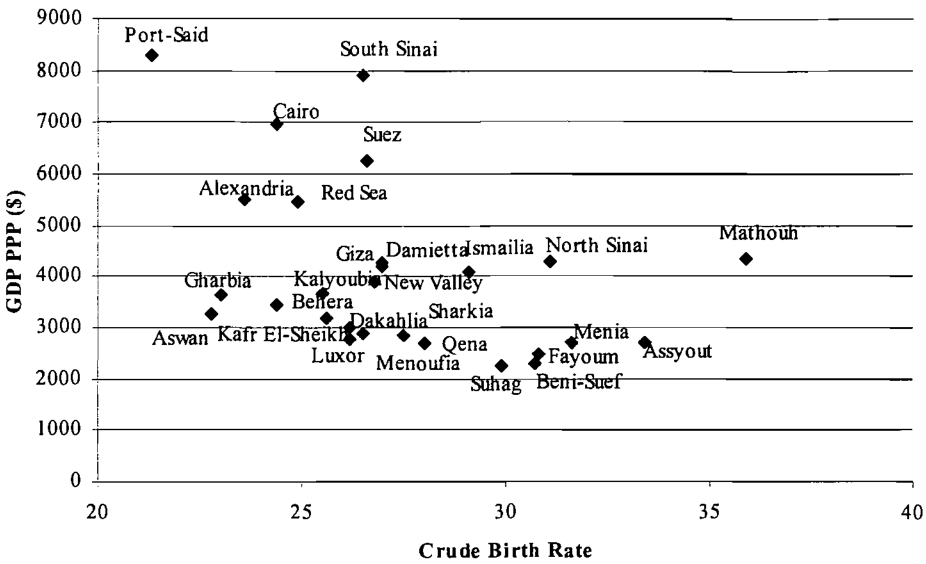


Administratively, Egypt's population is divided into 26 governorates, which are commonly grouped into four main areas. The *Urban Governorates* comprise the four governorates of Cairo, Alexandria, Port Said and Suez, all of which are completely urban. These represent 19 per cent of the total population, according to estimates for 2000 made by the Central Agency for Public Mobilization and Statistics (CAPMAS). The *Frontier Governorates* consist of 5 governorates: New Valley, Mathouh, North and South Sinai and Red Sea. These governorates are located on the eastern and western boundaries of Egypt, and only 2 per cent of the population live there as they are mainly desert areas. Each of the other governorates includes both urban and rural areas. *Lower Egypt* consists of nine governorates located in the north in the Nile delta and includes 43 per cent of the total population. Eight governorates located in the narrow Nile Valley south of Cairo governorates represent *Upper Egypt*, which has 36 per cent of the population.

According to the data from the 2003 Egyptian Human Development Report (EHDR), that there are significant disparities in the level of development among governorates and within them, showing the extent to which 'development disparities coincide with the north-south divide' (EHDR 2003:2). The majority of governorates in Upper Egypt are categorized as having low human development, while the main population centres of Cairo, Alexandria, Suez and Port Said are classified as having high human development. The highest level of human development (0.831) is found in Port Said governorate while the lowest in Suhag governorate.

There is a strong variation in fertility levels by governorate which is accompanied by a strong variation in the levels of GDP per capita or Human Development Index. Figure 1.10 shows a scatter plot of the GDP per capita and Crude Birth Rate for each governorate. The figure clearly shows the disparities in fertility level and economic development that exist between governorates.

Figure 1.10: Scatter plot of the GDP per capita (PPP $) and Crude Birth Rate by governorates in 2002.



Source: 2004 Egypt Human Development Report
Note: the crude birth rate is the number of births in a given population during a given time period divided by the total population and multiplied by one thousand.

1.5 Egyptian Demographic and Health Survey

The 2000 Egyptian Demographic and Health Survey (2000 EDHS) is the fourth full-scale Demographic and Health survey to be implemented in Egypt. The earlier surveys were conducted in 1988, 1992, and 1995. Two additional interim surveys were carried out in 1997 and 1998. The survey was conducted under the auspices of the Ministry of Health and Population and national Population Council. The technical support for the 2000 EDHS was provided by ORC Macro through MEASURE DHS+, a project sponsored by the USAID designed to assist countries worldwide in conducting surveys to obtain information on key population and health indicators.

The 2000 EDHS included an individual and a household questionnaire, and was carried out between February and April 2000. The 2000 EDHS is a nationally representative sample of 15,573 ever-married women aged 15-49 years. It contains information about fertility, contraceptive use, infant and child mortality, immunization levels, coverage of antenatal and delivery care, and maternal and child health and nutrition. These types of information are the core part of the

Demographic and Health survey dataset. In addition to this information the 2000 EDHS included two special modules, one including questions on female circumcision and the other collecting data on children's education. The EDHS, as previously mentioned, also collected the so called calendar data, which provide monthly information about contraceptive use, breastfeeding and post-partum amenorrhea.

Despite the fact that DHS surveys do not collect information about income or consumption, they do provide extensive information on the assets owned by each household. There is a growing body of literature which has designed and assessed the suitability of alternative methods for deriving proxy measures of living standards from such data. A number of studies have applied a principal components analysis to construct an index using information on household ownership of goods. Studies have shown that an asset index constructed with this method can provide a good proxy for long run household wealth. In this thesis data from the household questionnaire are used to construct this asset indicator (see Appendix A for details).

The EDHS sample was designed to provide estimates of key indicators at the national level, for urban and rural areas, as well as for the four main regions (and for both Upper and Lower Egypt it is also possible to have estimates for their rural and urban areas separately). The sample design also allows estimates of contraceptive prevalence and other basic health indicators (but not fertility and mortality rates) for each governorate[1]. El-Zanaty and Way (2001) report that to achieve these estimates a three stage probability sample was designed.

The response rate of the 2000 EDHS was high, both for households and among eligible women. El-Zanaty and Way (2001:11) report that during the fieldwork activity, 'out of 17521 households selected for the 2000 DHS, 17,103 households were found, and 16,957 households were successfully interviewed which represent a response rate of 99 percent. A total 15,649 women were identified as eligible to be interviewed. Questionnaires were completed for 15,573 of those women, which represents a response rate of 99.5 percent'.

[1] With the exception of the five Frontier Governorates (due to the relatively small population in this region) and Luxor, which for the purpose of the sampling frame was combined with Qena governorate.

1.6 Outline of the thesis

The thesis comprises three essays on fertility and reproductive health in Egypt. In Chapter 2 of this thesis we will present the first essay '*The proximate Determinants and Birth Interval in Egypt: an application of Calendar Data*' which analyse the use of DHS calendar data in birth interval analysis. In Chapter 3 the second essay '*Explaining Geographical Differentials in Contraceptive Use in Egypt: a Decomposition Approach using the 2000 Egyptian Demographic and Health Survey*' analyses geographical differentials in contraceptive use levels. In Chapter 4 we will present the third and last essay of this thesis on the '*Effect of Modernization on Desired Fertility in Egypt*'. The second and third essays use an Household Economic Index constructed using ownership of household assets as a proxy of household wealth and the details of the methods and analysis used in the construction of this index are presented in Appendix A of this thesis. The final Chapter 5 discusses the principal findings, the data limitations and the areas for further research.

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Chapter 2

The Proximate Determinants and Birth Intervals in Egypt: an application of Calendar Data

ABSTRACT

Using Bongaarts's conceptual framework of the proximate determinants of fertility, the paper shows that calendar data provides important information to enable demographers to identify the pathways by which the proximate determinants influence fertility. The paper applies a discrete time hazard model to study birth intervals using data from the Egyptian Demographic and Health Survey 2000 (EDHS), and the month by month information on contraceptive use, breastfeeding, and postpartum amenorrhea available in the EDHS calendar. The paper shows the importance of accounting for unobserved heterogeneity in birth interval analysis and with special reference to Egypt suggests a degree of failure of contraceptive use, which varies considerably by method.

2.1 Introduction

Studies which have looked at fertility changes over time tend to look at the direct impact of socio-economic variables on fertility. Bongaarts (1978:105) suggested that 'substantial insight can be gained if in addition to the socio-economic factors influencing fertility, the specific mechanisms through which these factors operate are identified'. Bongaarts (1978) observed that socio-economic variables operate through what he called 'proximate determinants' and that changes in fertility are dictated by changes in these intermediate variables. The concept of intermediate variables was originally laid out by Davis and Blake(1956), where it was pointed out that, as Bongaarts (1982:179) puts it, the intermediate variables are 'the factors through which and only through which, social, economic, and cultural conditions can affect fertility'.

Using aggregate analysis with countries as unit of analysis, Bongaarts (1982) demonstrated that virtually all important variation in fertility is captured by differences in the proximate determinants. Against this background, individual level analyses of birth intervals have been reaching different results, and many authors have still found direct effects of socio-economic variables on the dynamics of birth intervals. Reasons for those discrepancies have been related to the accuracy of the measurement of the intermediate variables.

The most common set of data which are used to study fertility differentials in developing countries come from Demographic and Health Surveys (DHSs). These are large, nationally representative sample surveys collected for a series of countries around the world which provide information about fertility and family planning, knowledge and current use of contraceptive methods, knowledge, and detailed fertility histories with records the birth and death dates of all children. Recent DHSs have also collected monthly calendar data which are a longitudinal record of contraceptive use, breastfeeding and postpartum amenorrhea for countries with relatively high contraceptive use. Although these calendar data provides unusually detail information on contraceptive use, breastfeeding duration and amenorrhea few studies have hitherto used these data (Curtis 1997; Magnani, Rutenberg and McCann

1996; Steele and Curtis 2001; Steele, Curtis and Choe 1999; Zhang, Tsui and Suchindran 1999).

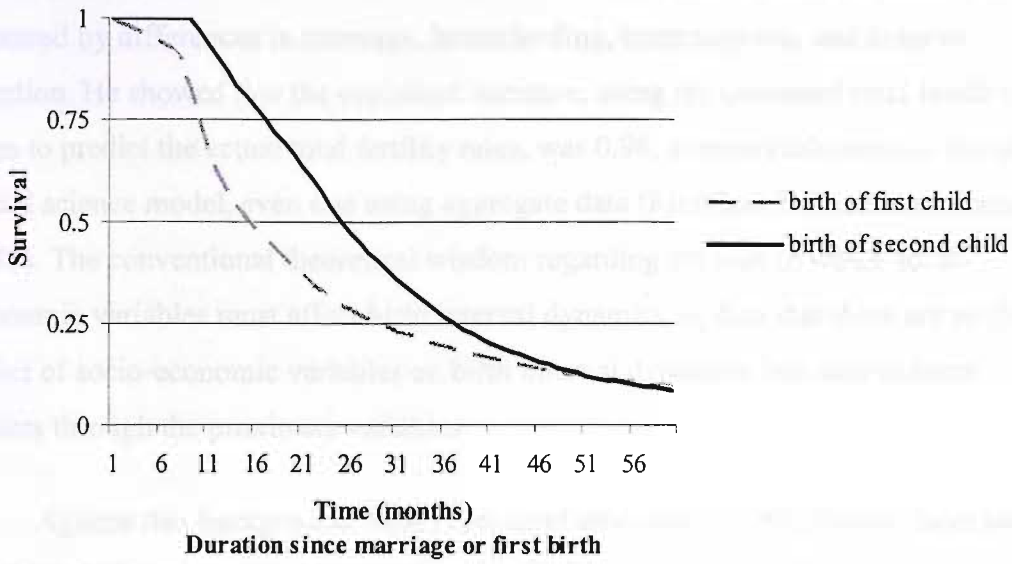
Studies of the quality of the DHS calendar data on contraception have shown that they are fairly reliable. Curtis (1997) using DHS data from a selected number of countries, compares the percentage of currently married women using contraception using both current status data from an earlier survey and calendar data for corresponding time point. She found that calendar data quality is likely to vary across countries but that 'generally the estimates of prevalence obtained retrospectively from calendar are in very close agreement with the corresponding current status estimates obtained from the earlier survey'(Curtis 1997:12). Leone (2002) performed a similar analysis using 1991 DHS data on current contraceptive use for Northeast Brazil and data 1996 from the Brazilian DHS calendar on current use at the time of the 1991 DHS and found similarly reassuring results. Furthermore Strickler et al. (1997) had the unique opportunity to use data from 1995 Morocco Panel Survey to evaluate the reliability of the contraceptive history data collected in the calendar of the 1992 DHS. The Panel Survey consisted of a sub-sample of respondents from the DHS calendar. Both surveys included a five-year calendar, and the two calendars overlap for the period 1990-92. Strickler et al. (1997) found that the reporting of contraceptive use was fairly reliable, though they found that data on contraceptive discontinuation and on complex histories were less unreliable. Overall, their results suggest that contraceptive use information is fairly robust, although estimates of contraceptive failure rates are likely to be less accurate than estimates of prevalence.

According to Bongaarts's (1982) framework of the proximate determinants of fertility, all the important variation in fertility is captured by variation by the proximate determinants of fertility. Therefore if calendar data on contraceptive use, breastfeeding and postpartum amenorrhea are good enough measures of the proximate determinates they should be able to confirm Bongaarts's (1982) model, in other words to capture all variation in fertility. Previous studies have assessed the reliability of those data using aggregate techniques, whereas this study will make use of individual level data. The question we pose here is not whether individual level responses of calendar data are reliable or not, but rather whether the calendar data are good enough in capturing all the variation in fertility. If they are, then the calendar data can be used to study the effect of each proximate determinant on fertility in each country for which the calendar is available. Hence, they will provide an insight on the specific mechanisms through which the proximate determinants affect fertility and ultimately the effect of the socio-economic factors on fertility.

Using Egypt as a case study this paper first analyses the effect of the proximate determinants on the second birth interval with special reference to the effect of contraceptive use on birth interval length. Having focused initially on the second birth interval, and we then extend the analysis to the third birth interval to show how the effect of the proximate determinates changes with birth order.

We are limiting the analysis to the second and third birth intervals as, according to the 2000 Egyptian Demographic and Health Survey (EDHS), few women who approve of family planning think that a newly married couple should use contraception to delay the first birth and only 0.3 percent of currently married women use modern methods of contraception before their first birth (El-Zanaty and Way 2001). More than 50 percent of married women conceive their first child in less than six months from the marriage date and in just over a year and half 75 percent do so. Among those women in the EDHS who had a first child, 50 percent conceived the second child within a year and half of the birth of the first child, and it took almost two years and a half for 75 percent of them to conceive their second child (Figure 2.1), the first birth interval is shorter than the second and contraceptive use appears not to play a role in determining its length. Women start using contraception after the first birth.

Figure 2.1: Kaplan-Meier estimate of the survival function(S(t)) for duration from marriage to the birth of the first child and for duration from the birth of the first child to the birth of second child for all ever married women, 2000 EDHS.



Note: The Kaplan-Meier estimate for the first birth is based on all ever married women aged 15-49 included in the 2000 EDHS (15,573 women), whereas the Kaplan-Meier estimate for the birth of second child is based on all the ever-married women who had had a first birth (14,164 women). For estimating the number of months by which 50 percent or 75 percent of women conceived a first or second child we subtract nine months from the number of months by which 50 or 75 percent of women give birth to the first or to the second child.
Source: 2000 EDHS.

The DHS calendar offers the possibility of assessing the effect over time of contraceptive use on birth interval length. A discrete-time survival model has been applied, introducing information on breastfeeding, postpartum amenorrhea and types of contraceptive use in the form of time-varying covariates, which allow the detection of changes in the discrete-time hazard rate because of the timing of the use of contraception, breastfeeding behaviour and postpartum amenorrhea.

In section 2.2 of this paper I present the background of the study and introduce the problem of model specification and the conceptual framework. Section 2.3 presents the data and considers issues of sample selection. Section 2.4 presents the method, and section 2.5 presents the major results.

2.2 Background and conceptual framework

As I pointed out earlier Bongaarts (1982), using aggregate analysis with countries as units, demonstrated that virtually all important variation in fertility is captured by differences in marriage, breastfeeding, contraception, and induced abortion. He showed that the explained variance, using the estimated total fertility rates to predict the actual total fertility rates, was 0.96, a remarkable success for any social science model, even one using aggregate data (Rindfuss, Palmore and Bumpass 1987). The conventional theoretical wisdom regarding the way in which socio-economic variables must affect birth interval dynamics is, then that there are no direct effect of socio-economic variables on birth interval dynamics, but only indirect effects through the proximate variables.

Against this background, individual-level analyses of birth intervals have been reaching different results. Many authors have still found direct effects of socio-economic variables on the dynamics of birth interval after controlling for proximate variables (Bumpass, Rindfuss and James 1986; Palloni 1984; Trussell et al. 1985). Rindfuss et al. (1987) argue that there could be three possible explanations for the discrepancy between theory and empirical micro-level analysis. One is that the conventionally-used measures of the four proximate determinants of fertility are inadequate operationalizations of the theoretical constructs. For example, as Rindfuss et al. (1987: 820) suggest 'if a substantial proportion of all contraceptive use were not reported, observed contraceptive use patterns would miss much of contraception's mediating role'. Second, it is possible that there could be specification errors due to the omission of important intermediate variables (Kallan and Udry 1986). Third, the effects of some of the intermediate variables or the socioeconomic variables might be curvilinear rather than linear.

In the analysis of birth intervals several authors have pointed out the problem of limited availability of time to event data, as well as the problem of misspecification due to important variables being omitted from the model. So far as data availability is concerned, the problem arises not just because information is not being collected, but also because the information that is collected is not accurate enough. For example, to study the determinants of birth interval length one would ideally need information about fecundability, intensity of breastfeeding, and contraceptive use over time, as well as detailed information about such socio-economic variables as are likely to affect the risk of conception over time (for example respondent's work status and educational level at each time point). Unfortunately, only rarely does a study designed to look at fertility and family planning in developing countries collect information in longitudinal format. For these reasons researchers are often constrained to study the dynamics of fertility and family planning using cross-sectional surveys.

As far as the problem of model specification in duration analysis is concerned, several authors (Blossfeld and Rohwer 1995; Rindfuss et al. 1987) have stressed the fact that the exclusion of important covariates is likely to create misspecification in the model and provide an incorrect estimate for the shape of the hazard with respect to time. For example, duration of breastfeeding was commonly omitted until recently, and it might be that there are still other important intermediate variables which are presently unnoticed. Researchers have tried to cope with this problem of important omitted variables in the model by introducing an error term, and in duration analysis the residual becomes an important part of the model specification. Despite this theoretical rationale for introducing error terms in duration models, in the literature there are still opposing views about the appropriateness of their use (see section 2.4 for further discussion).

This paper will use data from the Egyptian Demographic and Health Survey (DHS), and although DHS data are collected in a cross sectional format, for countries with high contraceptive use recent DHSs have collected retrospective monthly information about contraception, breastfeeding and postpartum amenorrhea for the five years before the survey date. This study therefore makes use of the most detailed information available in DHS for countries with high contraceptive use. The introduction of month by month information on contraception will allow us to detect changes in the discrete time hazard rate because of the timing of use of contraception by types, breastfeeding behaviour and post partum amenorrhea. The study uses a discrete-time hazard model accounting for unobserved heterogeneity that is gamma distributed, and discusses the implications for the shape of the hazard and survival functions because of the introduction of the error term.

Furthermore, the present study offers the possibility of assessing whether there is any direct effect of the observed socio-economic variables on the second birth interval in Egypt after controlling for the main proximate determinants. In this study the intermediate variables are better collected than those of previous studies as, not only are data on breastfeeding and postpartum amenorrhea collected month by month, but also those on contraceptive use. The information on contraceptive use was collected by method of contraception, and this allows a better assessment of the effect of contraception on birth interval lengths as the efficacy of contraceptive methods varies by method. Therefore the aim of the present analysis is to see if, with improved measurement of intermediate variables, such as contraceptive use, breastfeeding and postpartum amenorrhea, we can eliminate the direct effect of the socio-economic variables. This analysis will allow to assess the quality of DHS calendar data on contraceptive use, breastfeeding and postpartum amenorrhea, and in principle, to measure the relative contribution of the main proximate determinants.

Figure 2.2 Conceptual framework.

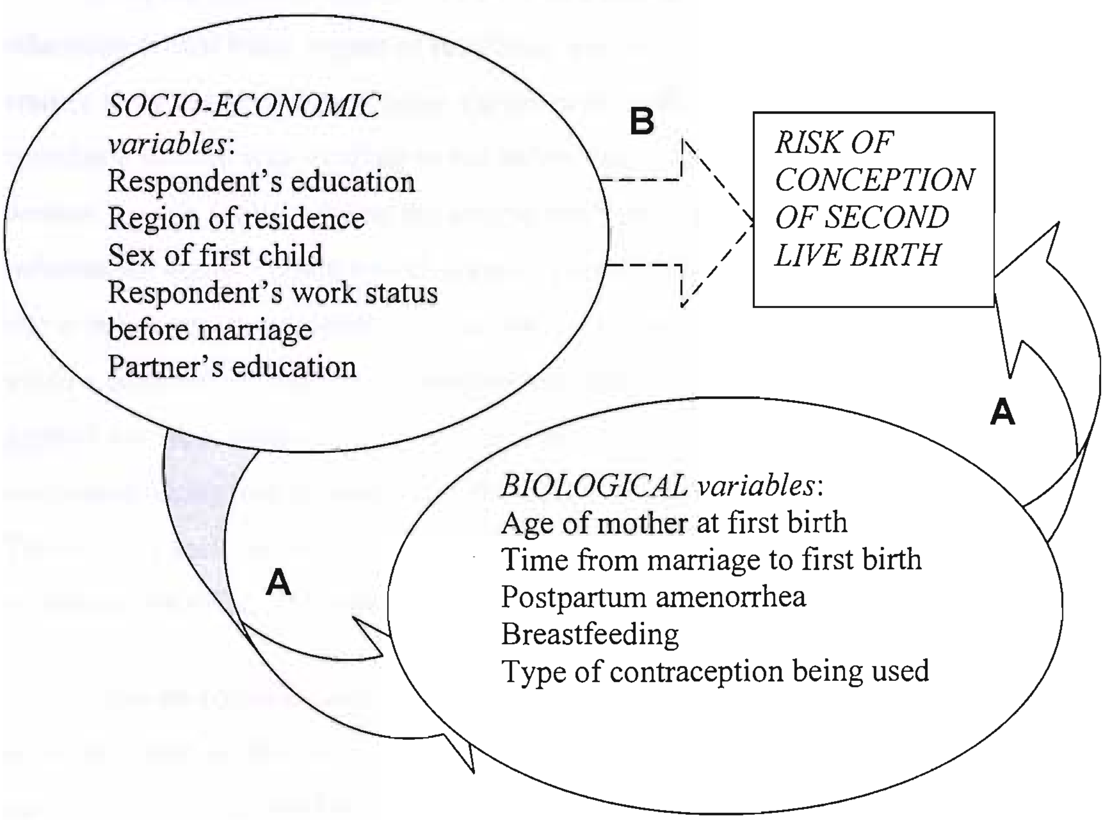


Figure 2.2 shows the conceptual framework of the present analysis. The biological variables listed in Figure 2.2 consist of those variables that in Bongaarts's (1982) conceptual framework were defined as proximate variables. Among the proximate variables I did not include abortion as abortion in Egypt is only allowed if it considered necessary to save the life of mother and in no other circumstances. Therefore abortion cannot be considered in Egypt as a measure of birth control. The proximate variables include both breastfeeding and postpartum amenorrhea. The contraceptive effect of breastfeeding changes over time. It is greatest in the period of postpartum amenorrhea but can continue at lower intensity even after the period of amenorrhea has finished. Among the proximate set of variables we also include month by month information on contraceptive use by method and information on the length of time elapsing between marriage and the first birth. Only 0.3 percent of married women in the EDHS used contraception before the birth of their first child, so the length of the first birth interval is likely to be largely determined by a couple's fecundity. Finally amongst the proximate variables we include age at first birth, for its interacting effects with the other proximate variables.

In the list of socio-economic variables I include the respondent's level of education at first birth, region of residence, and the sex of the first child, as previous studies have found effects of those variables on birth interval length. I also included whether a woman was working or not before marriage for its possible correlation with women's work activity during the second birth interval. Not having longitudinal information about women's work status, I prefer to include in the analysis the work status before marriage rather than current work status (at the time of the survey) to avoid a problem of endogeneity relating to current work status. A similar rationale is applied for the respondent's level of education at first birth, which has been calculated taking into consideration the Egyptian educational system (see note to Table 2.1). I include husband's educational level at the time of respondent's first birth to capture the effect of husband's socio-economic level.

Separate consideration is needed of the effect of duration dependence or time since first birth on the risk of conception of the second child. Intuitively the risk of conception will be very low for the first month or two from conception and increase and decrease thereafter. However, it is not clear exactly what status duration dependence has in this conceptual framework and, whether indeed, its effect still exists after controlling for other socio-economic and biological variables. We will include duration in our analysis in order to see the shape of the baseline hazard after controlling for intermediate variables and unobserved heterogeneity. However, we will bear in mind that duration is also likely to capture both unobservables as well as representing a measure of misspecification (Lancaster 1979).

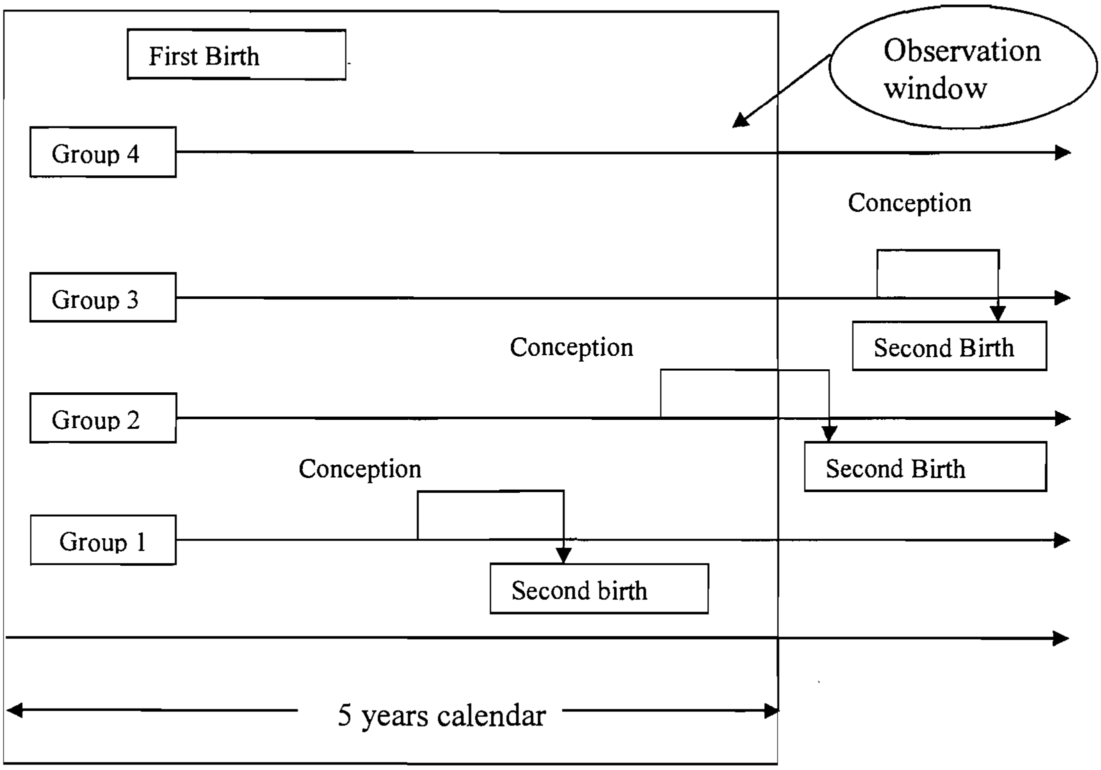
2.3 Data and sample selection

The data used in this study come from the individual and household questionnaire of the 2000 Egyptian Demographic and Health Survey (EDHS). As discussed in section 1.5 in the introduction of this thesis, the 2000 EDHS contains not only the usual information about current fertility and family planning but it also contains detailed information (on fertility and family planning) month by month for the five years prior to the survey date. This latter information makes use of a calendar table to help respondents recall the information for the five years preceding the survey date. The DHS calendar consists of a matrix of rows and columns. Each row represents a particular month with the first row usually representing January of the fifth calendar year before the survey (for the 2000 EDHS, it represents January 1995). The columns are used to record different types of information for each month. In the 2000 EDHS calendar there are six columns. The first column contains month by month information about births, pregnancies and contraception, the second contains information about the reasons for discontinuation of contraceptive methods, the third about marriages and unions, the fourth about sources of family planning methods, the fifth about postpartum amenorrhea and the sixth about breastfeeding.

In the present analysis I selected all women who had their first birth after the beginning of the calendar (January 1995), a total of 2,899 women. I excluded information for the last three months of the calendar to allow for underreporting of the first trimester pregnancies at the time of the survey and to avoid including pregnancies that will end in termination shortly after the end of the calendar.

The event of interest is the conception leading to the second live birth. There are four possibilities (Figure 2.3): (1) the second birth occurs within the calendar period, (2) the second birth is after the survey date but conception happened before the survey date, (3) the second birth is conceived after the survey date, (4) there was no second conception even after the survey date. For the first group of women (who had a second birth within the calendar period) the time to conception is the time between the birth of first child and the birth of the second minus nine months. The event variable takes the value of 1 in the month that the second conception leading to a live birth occurs. The second group consists of women that conceived the second child before the end of the calendar but the birth happened after the survey date. For these women I use the information on pregnancy history in order to time the conception leading to the live birth. I assume that if a woman is pregnant for at least three months before the end of her calendar then the pregnancy will lead to the second live birth and the event variable takes the value of 1 in the month of conception. In this way we will also allow for miscarriage, since most miscarriages are in the first three months of pregnancy. For women who conceived their second child after the survey date (group 3) the duration is calculated between the birth of first child and a point three months before the survey date. In this case the event variable takes the value of 0 as the conception leading to a live birth did not occur within the period of observation. The same applies for those women that will never conceive a second child (group 4). In our sample, out of 2,899 women, 1,684 conceived their second child during the study period.

Figure 2.3 Selection procedures.



Note: In Group 1 there are 1,442 women, in Group 2 there are 242. As we do not experience the second birth for Group 3, we cannot distinguish between women that belong to Groups 3 or 4, though we know that the total number of women for Groups 3 and 4 is 1,215 women.

Table 2.1 shows descriptive statistics for the variables included in the model with the categorization used. Column 1 shows the percentage distribution of women in the sample by background characteristics. Columns 2, 3 and 4 show, respectively, the 25^{th}, 50^{th}, and 75^{th} percentiles of the second birth interval in months by selected background characteristics derived from K-M estimates. In other words column 2 shows the number of months by which 25 per cent of the relevant subgroup of women had their second birth, column 3 shows the number of months by which the 50 per cent of the same women had their second birth, column 4 the number of months by which 75 per cent had their second birth.

Table 2.1 Percentage distribution, and 25th, 50th, 75th percentiles of interval between first birth and conception of second birth by selected background characteristics of women that had a first birth after 1 January 1995.

	Percentage	*Percentiles of second birth interval (months)*		
		25th	*50th*	*75th*
Age Group				
Less than 18	10.4	13	22	32
18-22	42.7	13	20	29
22-27	35.6	14	23	34
Over 27	11.3	13	23	39
Respondent education at first birth				
No education	25.9	12	19	30
Primary	12.6	13	20	32
Secondary	50.0	15	24	34
Higher	11.5	13	22	32
Region of residence				
Urban Governorates	20.0	15	25	39
Urban Lower Egypt	13.0	17	25	36
Rural Lower Egypt	28.7	14	21	30
Urban Upper Egypt	10.1	13	23	36
Rural Upper Egypt	22.7	11	18	28
Frontier Governorates	5.5	12	21	28
Gender of first child				
Male	51.5	13	23	34
Female	48.5	13	21	30
Respondent worked before marriage				
Yes	18.9	14	24	35
No	81.1	13	21	32
Partner's education				
No education	15.9	12	20	33
Some education	84.1	14	22	32
First child alive				
Yes	96.1	14	22	33
No	3.9	5	9	18
Length of time from marriage to first birth (mean=19 months, median =12 months)				
Less than 19 months	72.0	14	23	32
More than 19 months	28.0	12	20	32
Less than 12 months	51.2	14	24	33
More than 12 months	48.8	12	20	30

Note: The total number of women is 2,899. Information about educational attainment at the time of the first birth has been derived from the mothers' age at first birth using the Higher Education System database (http://usc.edu/dept/education/globaled/wwcu/background/Egypt.htm) and assuming that all the women that had some level of education entered schooling at the official entry age for primary education (6 years), and proceeded to further levels of education at the usual ages (14 years for secondary and 19 years for higher education). For example, suppose a mother of age 22 is reported to have 'higher education' at the time of the survey. If she had her first child at age 18, then because the entry age for higher education in Egypt is at least 19 years of age, the educational level of this woman

when she had her first birth was 'secondary'. In fact, the educational level at the time of the first birth is different from that reported at the time of the survey for only four women who had higher education level at the time of the survey and secondary education at the time of their first birth. This is probably due to the fact that our sample relates only to women that had their first child after 1 January 1995, leaving a maximum of five years gap between the first birth and survey date. Moreover, most women in Egypt complete their education before they have their first child.
Source: 2000 EDHS.

Looking at Table 2.1, for example, the duration by which 50 per cent of women with no education had conceived their second child is 19 months and with an increasing level of education the birth interval is longer, but this trend reverses for women with higher education, so that the number of months by which 50 per cent of women with higher education had conceived their second child is lower than the corresponding duration for women with secondary education. The same result is confirmed for other percentiles. As far as the region of residence is concerned, women living in rural Upper Egypt have the shortest birth intervals, followed by women living in Frontier Governorates and rural Lower Egypt. There appears to be a sex-of-first-child effect: if the first child was female the number of months by which 50 per cent of women had the second birth is shorter (21 months) than if the first child was male (23 months). Amongst respondents who worked before marriage the number of months by which 25, 50 or 75 per cent had a second birth is longer than for those women who did not work before marriage. Moreover, women who had a partner with no education seem to have shorter intervals than those who had a partner with some level of education. A quite substantial difference appears by survival status of first child. If the first child dies the number of months by which 25, 50 and 75 per cent of women had a second birth is considerably shorter (five, nine and 18 months respectively) than if the first child remains alive (14, 22, and 33 months respectively).

The mean length of time from marriage to the birth of the first child is 19 months for the women with the completed spell in our sample. Among women for whom the length of time from marriage to the first child is less than the mean length, the second birth-conception interval is longer. The same applies if instead of the mean we use the median first birth interval (12 months). I return to this issue later.

2.4 Method

In the present analysis I apply a discrete time hazard model of the length of time between first birth and the conception leading to the second live birth. This model specification will allow for a flexible baseline hazard, so there is no need to assume a functional form of the effect of duration. The duration will be broken into k categories (say 0-2 months, 3-5 months, etc...) during each of which the risk of pregnancy is assumed constant for individuals with the same values of the covariates. The degree of flexibility of the baseline hazard will depend on the number of duration dummies in the model.

The discrete time hazard rate is defined as:

$$h_{it} = prob[T_i = t \mid T_i \geq t, x_{it}] \ , \tag{1}$$

where x_{it} is a vector of regressor variables (covariates), some of which can be fixed covariates, and others can be time-varying. T_i is a discrete random variable representing the time at which the end of the spell occurs.

I chose to estimate the hazard by applying a discrete time hazard model using a logistic functional form. As Jenkins (1995) suggested, if we reorganize the data in a person-months format, the model likelihood has exactly the same form as that for a standard binary logit regression model. Furthermore this model specification will facilitate the introduction of time-varying covariates in the model. This type of model also allows for censoring in the data.

The hazard rate is defined as follows:

$$h_{it} = 1/\{1 + \exp[-\theta(t) - \beta' x_{it}]\} \Leftrightarrow \log[h_{it}/(1 - h_{it})] = \theta(t) + \beta' x_{it} \ , \tag{2}$$

where $\theta(t)$ allows the hazard to vary with time. As has been previously mentioned this specification facilitates the inclusion of time-varying covariates, since x_{it} can include both time-varying and fixed covariates. Furthermore the time varying covariates and fixed covariates can have fixed effects as well as time-varying effects.

In the present analysis I treated breastfeeding practices, postpartum amenorrhea, and contraception as time-varying covariates with fixed effects, and all the other variables as fixed covariates with fixed effects. During the analysis several interactions of fixed-effect variables and time-varying variables with duration dummies were tried, and none of those interactions was significant. In all the models I partitioned the interval between the birth of the first child and the pregnancy leading to the birth of the second into several categories: 0-2, 3-5, 6-9, 10-12, 13-15, 16-18, 19-23, 24-29, 30-36, 37-42, and 43-60 months[1]. Rodriguez (1984) has shown that the estimated effects of covariates are quite insensitive to the choice of partition. We chose the duration categories to be narrow at the beginning of the interval as other studies (Hobcraft and McDonald 1984) have shown that the hazards change quickly at the beginning of the interval, mainly because the effect of lactation changes vary rapidly after birth.

As previously mentioned, in the literature there is diverging opinion about the value of including unobserved heterogeneity in the model. Some authors argue (Jenkins 1997; Lancaster 1979) that failing to account for unobserved heterogeneity in the model will result in an over-estimation of the degree of negative duration dependence in the (true) baseline hazard, and an under-estimate of the degree of positive dependence. This is because women whose unobservable characteristics render them 'high-risk', and likely to experience the event of interest have short durations and leave the sample, so that at higher durations the risk set is increasingly composed of women whose unobservable characteristics make them unlikely to experience the event of interest. The result is that failure to account for unobserved heterogeneity will lead the analyst to overestimate the hazard at short durations and underestimate the hazard at longer durations. Moreover, failing to account for unobserved heterogeneity will bias the parameter estimates of regressors as well.

Although there are strong positive arguments for the inclusion of unobserved heterogeneity in the model, some authors (Blossfeld and Rohwer 1995) have argued that a drawback of accounting for unobserved heterogeneity in the model is that the

[1] Despite we partitioned the intervals between the birth of the first child and the pregnancy leading to the birth of the second into several categories (0-2, 3-5, etc.), the information on the proximate variables was considered as monthly information.

parameter estimates can be highly sensitive to the assumed parametric form of the error term. As an example Heckman and Singer (1982) estimated four different unobserved heterogeneity models: one with a normal, one with a log-normal, and one with a gamma distribution of the error term, as well a model with a non-parametric specification of the disturbance. They found that the parameter estimates provided by these models were surprisingly different. In other words, as Blossfeld and Rohwer (1995) suggest, the identification problem might only be shifted to another level. The misspecification of the duration variables caused by neglecting the error term might be replaced by misspecification of the parametric distribution of the error term.

On the other hand others suggest that with a flexible specification of the duration dependence, i.e. in our case the 10 duration dummies, the misspecification can be avoided. McDonald and Egger (1990) have suggested that the unobserved heterogeneity in the analysis of birth intervals could allow us to measure individual fecundity. As individual fecundity varies from couple to couple and it is inherently not observable or reportable, including unobserved heterogeneity in the model will avoid us having to assume that there are no omitted covariates in the model, and will also allow measurement of individual unobserved fecundity.

In the present paper I present the results both of models without accounting for unobserved heterogeneity and models accounting for unobserved heterogeneity for the purposes of comparison and I discuss the implications of the introduction of unobserved heterogeneity in the model.

In the model which accounts for unobserved heterogeneity, the hazard rate being is specified:

$$\log[h_{it}/(1-h_{it})] = \theta(t) + \beta' X_{it} + \varepsilon_i \quad (3)$$

where ε_i is the unobserved heterogeneity term.

The models are estimated using the **pgmhaz** command in STATA developed by Jenkins (1997). This command estimates, by maximum likelihood, two discrete time grouped duration data proportional hazard models one of which incorporates a gamma mixture distribution to summarize individual unobserved heterogeneity (or 'frailty'). The two models estimated are : (1) the Prentice and Gloeckler (1978) model ; and (2) the Prentice and Gloeckler (1978) model incorporating a gamma mixture distribution to summarize unobserved individual heterogeneity, as proposed by Meyer (1990). The Prentice-Gloeckler-Meyer models estimated are described by Stewart (1996).

2.5 Results

As previously stated I estimate four different models. Model 1 includes only duration, and tests whether the raw hazard varies with duration since the first birth. Model 2 includes only the proximate variables that have been shown to affect fertility (age of mother at first birth, breastfeeding, amenorrhoea, use of types of contraception, and the length of the interval between marriage and first birth). Model 3 includes only socio-economic variables (region of residence, respondent's education, husband's education, whether or not the respondent worked before marriage and sex and survival status of the first child). Model 4 includes both the socio-economic variables and proximate variables. In this way I can compare the 'socio-economic' model to the 'proximate' model, determining which one performs better after having accounted for contraception as a time-varying covariate in the 'proximate' model. This also allows to see if the socio-economic covariates became insignificant when the proximate determinants are also in the model.

In the presentation of the results I shall use two statistics employed by Rodriguez and Hobcraft (1983) in their illustrative analysis of life tables. As originally defined, the *quintum* is the proportion of women that have their next birth within five years (60 months). The *trimean* is a measure of the average birth interval among those women who have their next child within five years (measured by the quintum). The trimean, originally developed by Tukey (1977), contains more information about the shape of the distribution than the median as it includes in its formula the first and third quartiles, thus allowing the detection of asymmetries in the distribution. It is defined as:

$$T = (q_1 + 2q_2 + q_3)/4 ,$$

where T is the trimean and q_1, q_2, and q_3 are the durations by which 25, 50 and 75 per cent respectively of those women who go on to have their next child within five years have had their next child. When the right tail is long, as is true for the distribution of pregnancies in a birth interval, the trimean will be higher (slightly) than the median. Rodriguez and Hobcraft (1983) considered the birth interval length and calculated the quintum and trimean for each parity.

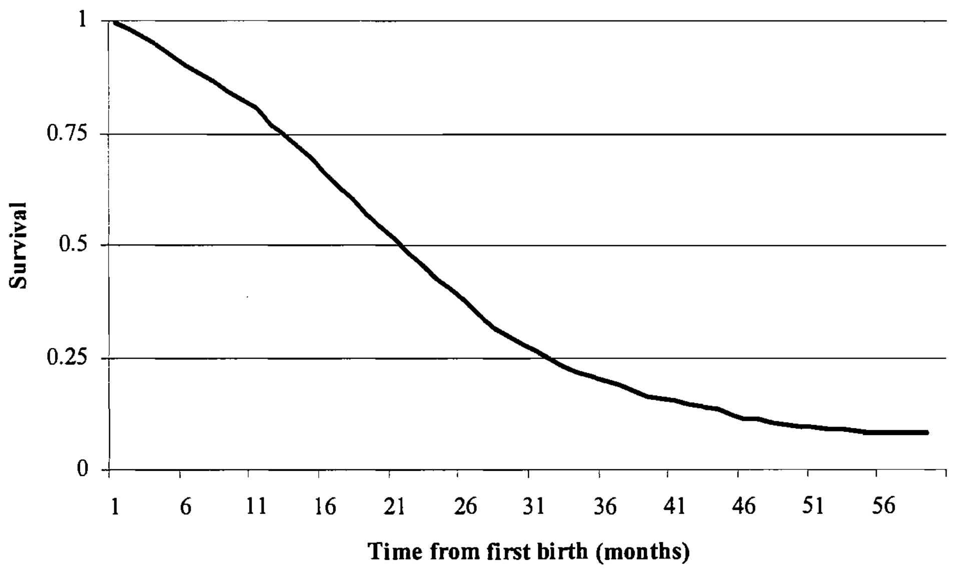
In the present study I shall modify the definition, following Trussell, Vaughan and Farid (1988). In their work on birth intervals in Egypt using the 1980 Egyptian Fertility Survey, they considered the birth-pregnancy interval (from the birth of a child to the conception of the following one) instead of the inter-birth interval (from birth of a child to the birth of the following one). Hence, the quintum is the estimated proportion becoming pregnant within 51 months and is a direct estimate of the proportion giving birth within five years, and the trimean is a measure of the average birth-pregnancy interval of those women who conceived their second child within 51 months of giving birth to their first. Other measurements that could be calculated to report the dispersion of the data include the spread (or inter-quartile range). The spread, in this case, is the difference between the duration by which 25 per cent of women conceive their second child and the duration by which 75 per cent of women conceive their second child.

Figure 2.4 shows the Kaplan-Meier estimate of the survival function from first birth to conception of the second birth for the whole sample. From the Kaplan-Meier estimate the quantum, trimean and spread may be calculated, and these are shown for the whole sample in Table 2.2, column 1. The quintum is 0.91, which means that 91 per cent of women in our sample that had conceived a first birth conceived the second child within 51 months, with an average first birth-pregnancy interval of almost 20 months. Furthermore 25 per cent of women conceive their second child within a year (11.9 months) and 50 per cent of women in just over a year and a half (19.6 months).

Table 2.2: Quintum, median, trimean, and spread from Kaplan-Meier estimate and duration-only model.

	Kaplan-Meier estimate	*Duration only model*
Quintum (Q)	0.91	0.89
q_1	11.9	12.8
q_2 Median	19.6	21.7
q_3	27.9	29.9
Trimean (T)	19.7	21.5
Spread (S)	15.9	17.1

Figure 2.4: Kaplan-Meier estimate of the survival function for the interval between first birth and second conception for women that had a first child after 1 January 1995.



Source: 2000 EDHS.

2.5.1 'Proximate' and socio-economic models

The results from Models 1 to 4 are shown in Table 2.3. Consider first Model 1, with only duration as a covariate. Figure 2.5 shows the shape of the hazard of conception for this model, and demonstrates that the risk of conceiving the second child increases almost monotonically until two years after the birth of the first child, and then decreases. The quintum of this 'duration-only' model is 0.89 (89 per cent of women became pregnant within 51 months) and the trimean is 21.6.

Figure 2.5: Estimated hazard of conception of second birth (duration-only model).

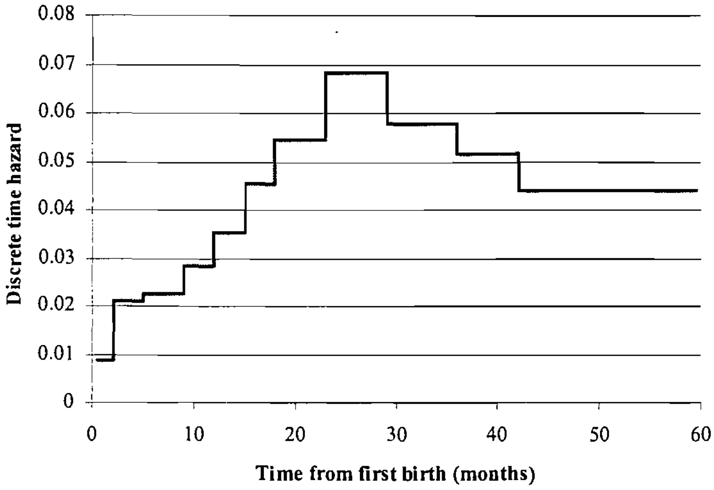


Table 2.3: Parameter estimates of discrete time hazard models for duration to conception of second child.

Covariates	*Model 1* *Duration only*	*Model 2* *Proximate variables only*	*Model 3* *Socio-economic variables only*	*Model 4* *Both proximate and socio-economic variables*
Duration (months)				
1-2	0	0	0	0
3-5	0.908 (5.55)***	0.935 (5.17)***	0.919 (5.62)***	0.943 (5.21)***
6-9	0.981 (6.14)***	0.998 (5.56)***	1.006 (6.28)***	1.006 (5.60)***
10-12	1.220 (7.45)***	1.218 (6.61)***	1.258 (7.67)***	1.223 (6.62)***
13-15	1.440 (8.84)***	1.414 (7.64)***	1.486 (9.11)***	1.420 (7.65)***
16-18	1.708 (10.55)***	1.612 (8.70)***	1.769 (10.89)***	1.613 (8.67)***
19-23	1.903 (12.17)***	1.582 (8.65)***	1.984 (12.66)***	1.580 (8.57)***
24-29	2.139 (13.56)***	1.529 (8.14)***	2.247 (14.20)***	1.535 (8.07)***
30-36	1.961 (11.54)***	1.202 (6.04)***	2.086 (12.23)***	1.226 (6.08)***
37-42	1.843 (9.12)***	0.914 (4.01)***	1.983 (9.76)***	0.943 (4.09)***
43-60	1.674 (7.51)***	0.725 (2.94)***	1.863 (8.31)***	0.771 (3.09)***
Age group				
Less than 18 years		-0.207 (2.40)**	-0.171 (1.98)**	-0.167 (1.90)*
18-22 years		0	0	0
22-27 years		0.072 (1.23)	-0.085 (1.42)	0.054 (0.87)
Over 27 years		-0.068 (0.73)	-0.195 (2.12)**	-0.125 (1.25)
Time (months) from marriage to first birth		-0.013 (8.30)***		-0.012 (7.67)***
Amenorrheic		-1.226 (11.66)***		-1.237 (11.72)***

Covariates	*Model 1* *Duration only*	*Model 2* *Proximate variables only*	*Model 3* *Socio-economic variables only*	*Model 4* *Both proximate and socio-economic variables*
Breastfeeding		-0.477 (7.15)***		-0.504 (7.10)***
Types of contraceptive used				
None		0		0
PILL		-2.147 (14.58)***		-2.190 (14.80)***
IUD		-3.373 (27.10)***		-3.427 (27.32)***
Other modern methods		-1.786 (7.44)***		-1.861 (7.71)***
Education level at first child				
No education			0	0
Primary			-0.051 (0.59)	0.036 (0.40)
Secondary			-0.191 (2.78)***	-0.080 (1.12)
Higher			0.039 (0.38)	0.366 (3.36)***
Region of residence				
Urban Governorates			0	0
Urban Lower Egypt			0.045 (0.48)	0.115 (1.19)
Rural Lower Egypt			0.271 (3.53)***	0.170 (2.13)**
Urban Upper Egypt			0.118 (1.17)	-0.008 (0.08)
Rural Upper Egypt			0.435 (5.17)***	0.003 (0.03)
Frontier Governorates			0.366 (3.09)***	0.107 (0.88)
Respondent's work status before marriage				
Working			-0.096 (1.37)	-0.165 (2.26)**
Not working			0	0
Sex of first child				
Male			-0.172 (3.41)***	-0.105 (2.02)**
Female			0	0
Survival status of first child				
Alive			-0.968 (7.97)***	0.184 (1.39)
Dead			0	0
Partner's education				
No education			0	0
Some education			0.128 (1.71)*	0.258 (3.33)***
Constant	-4.753 (33.13)***	-3.061 (17.00)***	-3.922 (19.11)***	-3.422 (14.83)***
Pseudo R square	0.0318	0.1791	0.0415	0.1827
Log-Likelihood	-7147.0	-6031.0	-7075.6	-6004.3

Note: Absolute value of *z* statistics in parentheses.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

Comparing Model 2 with Model 1 we see that the proximate variables dramatically improve the fit of the model. The effect of duration also changes, because the estimated duration effect in Model 1 relates to all women, whereas that in Model 2 relates to a 'baseline' group of women who are aged 18-22 years at the time of the first birth and who are not using contraception, not breastfeeding and not amenhorreic. Because breastfeeding, amenhorrea and contraceptive use vary with duration, the proportion of the risk-set who are in the 'baseline' group also varies with duration. The results of Model 2 clearly justify the inclusion in the model of both the information on breastfeeding and amenorrhea, in that breastfeeding significantly reduces the risk of conception even among non-amenorrhic women. The use of contraception greatly decreases the hazard of conception, with the intra-uterine device (IUD) being slightly more effective in this respect than the pill or other methods.

Model 3, which includes only socio-economic variables, has a much lower explanatory power than Model 2. Although several socio-economic variables significantly affect the hazard in Model 3, their effect is significantly reduced in Model 4, which includes both proximate and socio-economic variables. However, Model 4 does mark a significant improvement on the 'proximate variables-only' model (Model 2). Performing a likelihood-ratio test we have:

(2{Log-Likelihood (full model) - Log-Likelihood (biological only model)}

= 2 x (-6031)-(-6004) = 54

with 12 degrees of freedom ($p < 0.0005$). Model 4 with both socio-economic variables and proximate variables thus performs better than the 'proximate only' model.

Looking at the effect of socio-economic variables in Model 4 on the risk of conception we can see that the respondent's and husband's education, whether or not the respondent worked before marriage, the sex of the first child, and region of residence have a significant effect on hazard of conception after controlling for proximate variables, though only respondent's and husband's education are significant at the 1 per cent level. Women with higher education have shorter birth intervals than uneducated women, the relative risk of conception being 42 per cent higher[2]. If the first child is male the relative risk of conception decreases by 10 per cent, resulting in a longer second birth interval than if the first child was female. If the respondent worked before marriage the relative risk of conception of second child is 15 per cent lower, resulting in a longer birth interval. If the partner of the respondent has some level of education the relative risk of conception is 28 per cent higher, resulting in a shorter birth interval.

One possible explanation of the continued significance of some socio-economic variables in the model after the proximate variables have been included is that, although the framework of Bongaarts (1982) still holds in general, including the socio-economic variables improves our measurement of the impact of intermediate variables. For example, if the first child is a boy, one would expect more contraceptive use because of a reduced need to have a second child quickly compared to the situation when the first child is a girl. However the 'sex-of-first-child' effect is still significant *after* accounting for contraceptive use and duration of breastfeeding. This might be because, for example, boys are breastfed more intensely than girls, or that contraception is used more carefully after a boy than a girl. Furthermore, higher educated women appear to have a higher risk of conception compare to women with no education. This could be explained by the fact that higher educated women are those who rely more on traditional methods. Similar finding are also found for Tunisia (Esseghairi 2003).

The effect of the survival status of the first child on the monthly hazard of conception differs across the models[3]. In Model 4 the monthly risk of conception increase by 17% where the first child is alive compared with the case where the first child is dead. However, in the 'socio-economic variables only' model, the effect of

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[2] The relative risk measures the odds ratio. This implies that the hazard of conception is 42 per cent higher for women with higher education assuming the reference category for all other covariates.

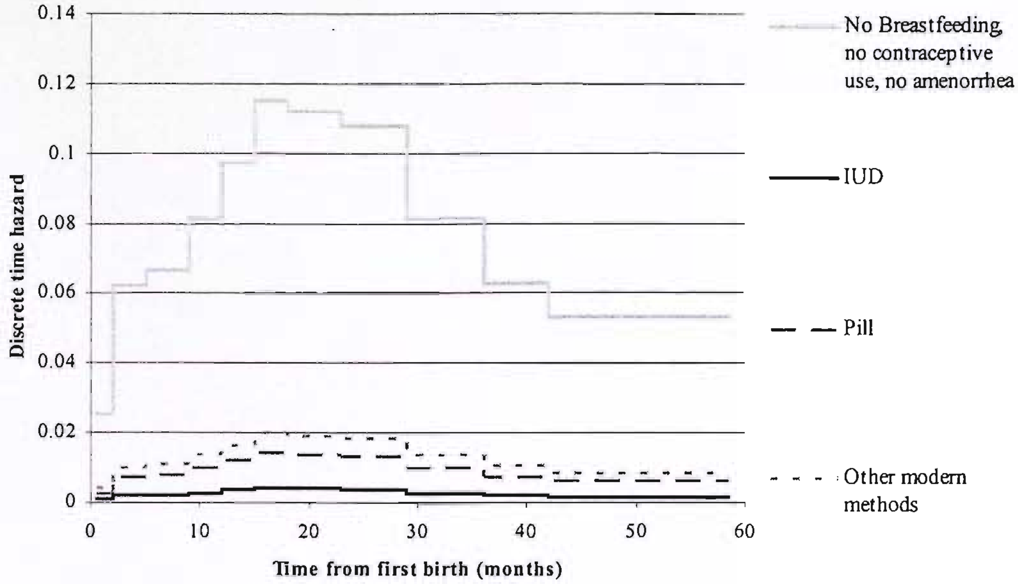
[3] There could be a potential problem on having used the survival status of the first child as fixed covariate in the model, measured at the survey date. Some children who did not survive at the survey might have died after the birth of the second child leading to wrong estimates of the model parameters. However, this problem could potentially lead to wrong parameters estimates if there was a big proportion of child death who happened after the birth of the second child, or alternatively if the Under-5 Mortality Rate in Egypt would have been high. However, the majority of child death in Egypt happens in the first year of life and the Under 5 Mortality Rate is considerably lower than the Infant Mortality Rate.

the survival of the first child appears to be strongly negative. One possible explanation of this is that while the first child survives, women rely on breastfeeding for contraception, whereas if the first child has died women are compelled to switch to appliance or hormonal methods, which are more effective than breastfeeding, and thus reduce their monthly risk of conception. To test this, I added to Model 3 a term measuring the interaction between the duration and the survival status of the first child. The results (not shown) were consistent with this account, in that the effect of the death of the first child was greatest at those durations where the surviving children were being breastfed, and the contraceptive effect of breastfeeding was gradually being eroded.

This gradual erosion of the contraceptive effect of breastfeeding as the first child grows up also explains why no multicollinearity problem exists with the introduction in the model of both breastfeeding information and the period of postpartum amenorrhea. Therefore, it is important to include both information on breastfeeding and postpartum amenorrhea in model specification in birth interval analysis. In addition, no multicollinearity problem appears also to exist between respondent's and husband's educational level, and between respondent's work status before marriage and respondent's level of education.

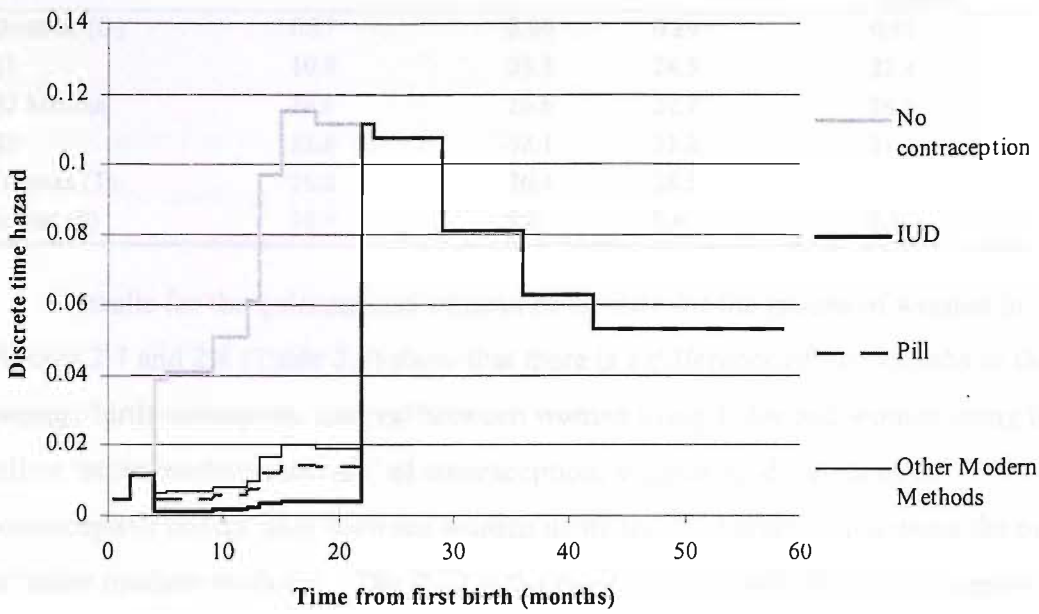
Figure 2.6 shows the shape of the hazard for four types of women: (1) a woman that did not breastfeed, who was never subject to post-partum amenorrhea and who did not use contraception over the study period; (2) a woman who used the pill but did not breastfeed and was never subject to post-partum amenorrhea; (3) a woman who used the IUD, did not breastfeed and who was never subject to post-partum amenorrhea; and (4) a woman who used 'other modern methods', who did not breastfeed and who was never subject to post-partum amenorrhea. Despite the fact that the shapes of the hazards displayed below refer to hypothetical women, Figure 2.6 helps to reveal the effectiveness of different types of contraceptive method. The IUD is the most effective method of contraception, whereas the pill is a less effective method.

Figure 2.6: Estimated hazard of conception of second birth for selected women.



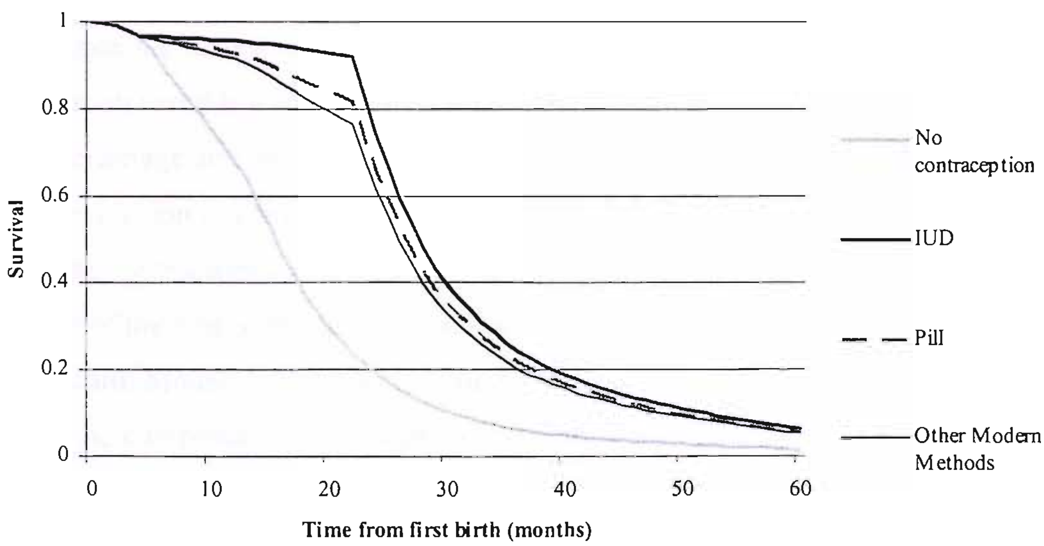
Figures 2.7 and 2.8 show the hazard and survivor functions of four more 'realistic' groups of women. All these groups of women were both breastfeeding and amenorrheic for the first four months after the birth of the first child. After this the amenorrhea ceased, but they kept on breastfeeding until month 13 after the first child was born. The first group did not use contraception at all during the observation period. The second group used the IUD for 18 months after the period of amenorrhea ended (they were both breastfeeding and using contraception for nine months, after which they continued to use the IUD for other 9 months). The third and fourth groups are like the second group, except that they used the pill and 'other modern methods' respectively instead of the IUD.

Figure 2.7: Estimated hazard function of conception of second birth for selected women.



Note: See text for detailed description of the characteristics of women in each category.

Figure 2.8: Estimated survival function of conception of second birth for selected women.



Note: See text for detailed description of the characteristics of women in each category.

Table 2.4: Estimation of quantum, median, trimean, and spread for women in Figure 2.7 and 2.8.

	Not using Contraception	*PILL*	*IUD*	*Other Modern Methods*
Quintum (Q)	0.97	0.90	0.89	0.91
Q1	10.8	23.5	24.5	22.4
Q2 Median	16.6	26.6	27.7	26.1
Q3	21.8	32.1	33.2	31.4
Trimean (T)	16.2	26.4	28.3	25.5
Spread (S)	10.9	8.6	8.6	9.0

Results for the quintum and trimean of fertility for the groups of women in Figures 2.7 and 2.8 (Table 2.4) show that there is a difference of two months in the average birth-conception interval between women using IUDs and women using the pill or 'other modern methods' of contraception, suggesting differences in contraceptive failure rates between women using the IUD and women using the pill or 'other modern methods'. The IUD is the most reliable method of contraception in Egypt.

2.5.2 Effect of length of first interval and contraception on the second birth interval.

I estimated three additional models to show the changes in the effect of other covariates on the hazard of conception of second birth after having excluded the contraception variables, and to assess if the effect of the length of the interval between marriage and birth (the first birth interval) is linear and if this effect changes with the exclusion of contraceptive use variables. Model 5 is the same as Model 4 but without the contraceptive use variables. Model 6 is a variation of Model 4 in which the length of the first birth interval is allowed to have a non-linear (quadratic) effect on the hazard. Model 7 is, in effect, a combination of Models 5 and 6, in that it both excludes the contraceptive use variables and allows the length of the first birth interval to have a quadratic effect.

The results of Models 5-7 are shown in Table 2.5. The results suggest that the length of the first interval has a non-linear effect on the length of second interval if we do not include contraceptive use variables (see Model 7). If we include contraceptive use variables in the model, the effect of the first birth interval length on the second birth interval is linear, as illustrated by the non-significant coefficient for the square of length of birth interval in Model 6. This result might be interpreted by suggesting that women who experience a short first birth interval consider themselves to be especially fecund and therefore are especially careful in their use of contraception to delay the second birth. Conversely, women who found it difficult to conceive their first child (that is, they had a long first birth interval), might rely on their low fecundity to produce an acceptably long second birth interval.

Comparing Models 4 and 5, there are changes in the effect of several socio-economic covariates when contraceptive use is excluded. Without the contraceptive use variables, the effect of having a secondary education is significant, whereas the effect of having higher education becomes insignificant. The effect of being resident in rural Upper Egypt and Frontier Governorates and the survival status of first child are significant when contraceptive use is excluded, but not when it is included. The opposite is true of husband's education. These results confirm the importance of accounting for contraceptive use practices in the study of birth intervals, but also that socio-economic variables do have something to add to the explanatory power of a model over and above the contribution made by the proximate determinants.

Table 2.5: Parameter estimates for discrete time hazard models for duration to conception of second child.

Covariate	*Model 4*	*Model 5* *Without contraceptive use variables*	*Model 6* *With non-linear effect of first birth interval*	*Model 7* *With non-linear effect of first birth interval and without contraceptive use variables*
Duration (months)				
1-2	0	0	0	0
3-5	0.943	0.779	0.942	0.775
	(5.21)***	(4.34)***	(5.20)***	(4.32)***
6-9	1.006	0.785	1.005	0.779
	(5.60)***	(4.40)***	(5.59)***	(4.37)***
10-12	1.223	0.987	1.221	0.979
	(6.62)***	(5.39)***	(6.61)***	(5.35)***
13-15	1.420	1.162	1.418	1.154
	(7.65)***	(6.32)***	(7.64)***	(6.28)***
16-18	1.613	1.390	1.612	1.385
	(8.67)***	(7.57)***	(8.67)***	(7.54)***
19-23	1.580	1.379	1.578	1.373
	(8.57)***	(7.58)***	(8.56)***	(7.55)***
24-29	1.535	1.452	1.534	1.447
	(8.07)***	(7.76)***	(8.07)***	(7.73)***
30-36	1.226	1.252	1.225	1.243
	(6.08)***	(6.30)***	(6.07)***	(6.26)***
37-42	0.943	1.155	0.941	1.141
	(4.09)***	(5.09)***	(4.08)***	(5.03)***
43-60	0.771	1.039	0.770	1.030
	(3.09)***	(4.22)***	(3.09)***	(4.18)***
Age group				
Less than 18 years	-0.167	-0.204	-0.164	-0.188
	(1.90)*	(2.35)**	(1.86)*	(2.16)**
18-22 years	0	0	0	0
22-27 years	0.054	-0.061	0.052	-0.074
	(0.87)	(1.01)	(0.83)	(1.23)
Over 27 years	-0.125	-0.077	-0.122	-0.054
	(1.25)	(0.80)	(1.21)	(0.56)
Educational level at birth of first child				
No education	0	0	0	0
Primary	0.036	-0.069	0.039	-0.058
	(0.40)	(0.79)	(0.44)	(0.67)
Secondary	-0.080	-0.239	-0.077	-0.224
	(1.12)	(3.44)***	(1.08)	(3.21)***
Higher	0.366	-0.003	0.370	0.016
	(3.36)***	(0.03)	(3.39)***	(0.15)
Region of residence				
Urban Governorates	0	0	0	0
Urban Lower Egypt	0.115	0.024	0.114	0.021
	(1.19)	(0.26)	(1.18)	(0.22)
Rural Lower Egypt	0.170	0.287	0.170	0.291
	(2.13)**	(3.71)***	(2.13)**	(3.77)***
Urban Upper Egypt	-0.008	0.121	-0.007	0.127
	(0.08)	(1.20)	(0.06)	(1.26)
Rural Upper Egypt	0.003	0.532	0.000	0.512
	(0.03)	(6.28)***	(0.00)	(6.03)***
Frontier Governorates	0.107	0.428	0.108	0.436
	(0.88)	(3.59)***	(0.89)	(3.66)***
Respondent's work status before marriage				
Working	-0.165	-0.162	-0.164	-0.155
	(2.26)**	(2.31)**	(2.25)**	(2.20)**
Not working	0	0	0	0

Covariate	*Model 4*	*Model 5*	*Model 6*	*Model 7*
		Without contraceptive use variables	*With non-linear effect of first birth interval*	*With non-linear effect of first birth interval and without contraceptive use variables*
Sex of first child				
Male	-0.105	-0.165	-0.105	-0.165
	(2.02)**	(3.25)***	(2.03)**	(3.25)***
Female	0	0	0	0
Survival status of first				
Alive	0.184	-0.488	0.184	-0.485
	(1.39)	(3.72)***	(1.39)	(3.70)***
Dead	0	0	0	0
Partner's education				
No education	0	0	0	0
	0.258	0.079	0.258	0.090
Some education	(3.33)***	(1.04)	(3.33)***	(1.19)
Amenorrhea	-1.237	-0.571	-1.237	-0.582
	(11.72)***	(5.44)***	(11.73)***	(5.56)***
Breastfeeding	-0.504	-0.645	-0.504	-0.647
	(7.10)***	(9.52)***	(7.11)***	(9.54)***
Types of contraceptive				
None	0		0	
PILL	-2.190		-2.188	
	(14.80)***		(14.78)***	
IUD	-3.427		-3.424	
	(27.32)***		(27.27)***	
Other modern methods	-1.861		-1.862	
	(7.71)***		(7.72)***	
Time from marriage to first birth	-0.012	-0.004	-0.010	0.007
	(7.67)***	(3.30)***	(2.88)***	(2.21)**
Time from marriage to first birth Squared / 100			-0.002	-0.009
			(0.74)	(3.39)***
Constant	-3.422	-3.417	-3.452	-3.587
	(14.83)***	(15.00)***	(14.74)***	(15.45)***
Log-Likelihood	-6004.3	-6965.0	-6004.0	-6957.0

Note: Absolute value of *z* statistics in parentheses.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

2.5.3 Unobserved heterogeneity

Finally, I estimated Model 4 (the combined model) incorporating a term for gamma-distributed unobserved heterogeneity. The results (Table 2.6) show that the unobserved heterogeneity parameter is significant suggesting that individual-level unobserved heterogeneity should be part of the model.

Comparing the two models (columns 1 and 2) in Table 2.6, it is seen that in the model with unobserved heterogeneity the duration parameters do not decrease with duration after 19-23 months, as they do in the model without unobserved heterogeneity. Instead they increase monotonically with time (Figure 2.9). This is due to the fact that the model without unobserved heterogeneity over estimates the degree of negative duration dependence because of a selection effect whereby 'high risk' women fail faster and the survivors are increasingly drawn from a 'low risk' group. The unobserved heterogeneity term controls for this selection effect, with the result that different duration segments contain women with similar levels of unmeasured risk. Moreover, once we account for unobserved heterogeneity all the socio-economic variables except husband's education loses their significance, whereas the effect of the proximate variables such as amenorrhea and contraceptive use become larger in size.

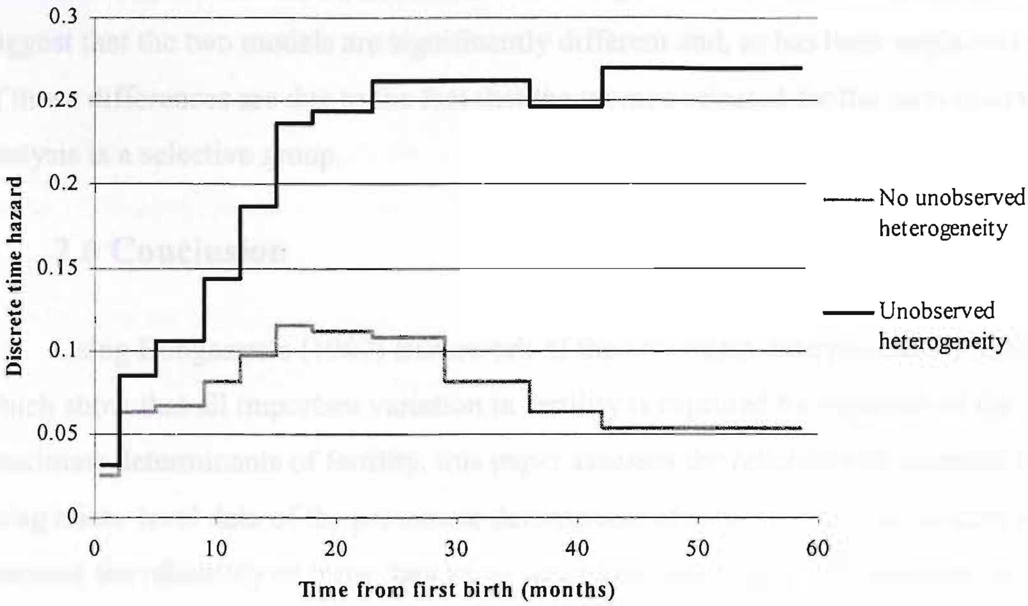
Table 2.6: Discrete-time hazard models of time to conception of second and third birth for model with and without accounting for unobserved heterogeneity.

Covariate	*Without unobserved heterogeneity*	*With gamma-distributed unobserved heterogeneity*	*Third birth interval*	*Third interval with unobserved heterogeneity*
Duration (months)				
1-2	0	0	0	
3-5	0.943	1.057	0.756	1.074
	(5.21)***	(5.60)***	(2.01)**	(2.51)**
6-9	1.006	1.291	1.417	1.936
	(5.60)***	(6.85)***	(3.99)***	(4.70)***
10-12	1.223	1.642	1.060	1.851
	(6.62)***	(8.43)***	(2.73)***	(4.13)***
13-15	1.420	1.965	1.551	2.484
	(7.65)***	(9.92)***	(4.10)***	(5.56)***
16-18	1.613	2.260	1.865	3.005
	(8.67)***	(11.26)***	(4.93)***	(6.51)***
19-23	1.580	2.303	1.660	3.046
	(8.57)***	(11.24)***	(4.34)***	(6.27)***
24-29	1.535	2.401	1.557	3.133
	(8.07)***	(11.06)***	(3.79)***	(5.95)***
30-36	1.226	2.397	1.731	3.409
	(6.08)***	(10.06)***	(4.00)***	(6.04)***
37-42	0.943	2.318	1.336	3.303
	(4.09)***	(8.38)***	(2.08)**	(4.10)***
43-60	0.771	2.438	0.617	3.313
	(3.09)***	(7.69)***	(0.57)	(2.40)**
Age group				
Less than 18 years	-0.167	-0.209	0.110	0.152
	(1.90)*	(1.60)	(0.59)	(0.53)
18-22 years	0	0	0	0
22-27 years	0.054	0.079	0.135	0.468
	(0.87)	(0.87)	(0.90)	(2.10)**
Over 27 years	-0.125	0.026	-0.441	0.023
	(1.25)	(0.18)	(1.65)*	(0.06)
Educational level at birth of first child				
No education	0	0	0	0
Primary	0.036	0.018	-0.200	-0.306
	(0.40)	(0.14)	(1.02)	(1.08)
Secondary	-0.080	-0.157	0.018	0.015
	(1.12)	(1.51)	(0.11)	(0.06)
Higher	0.366	0.255	0.148	0.068
	(3.36)***	(1.63)	(0.48)	(0.17)
Region of residence				
Urban Governorates	0	0		
Urban Lower Egypt	0.115	0.111	0.253	-0.180
	(1.19)	(0.79)	(0.92)	(0.47)
Rural Lower Egypt	0.170	0.185	0.046	-0.343
	(2.13)**	(1.60)	(0.20)	(1.10)
Urban Upper Egypt	-0.008	0.185	-0.036	-0.246
	(0.08)	(1.21)	(0.14)	(0.65)
Rural Upper Egypt	0.003	0.117	0.126	-0.139
	(0.03)	(0.92)	(0.56)	(0.45)

Covariate	*Without unobserved heterogeneity*	*With gamma-distributed unobserved heterogeneity*	*Third birth interval*	*Third interval with unobserved heterogeneity*
Frontier Governorates	0.107	0.131	-0.054	-0.075
	(0.88)	(0.73)	(0.19)	(0.18)
Respondent's work status before marriage				
Working	-0.165	-0.174	0.114	-0.048
	(2.26)**	(1.62)	(0.60)	(0.18)
Not working	0	0		
Sex of first (two) child(ren)				
Male	-0.105	-0.105	0.219	0.088
	(2.02)**	(1.39)	(1.24)	(0.35)
Female	0	0	0	0
Mixed pair	n.a	n.a	0.065	0.057
			(0.43)	(0.26)
Survival status of first child				
Alive	0.184	0.068	-0.380	-0.688
	(1.39)	(0.34)	(2.41)**	(2.79)***
Dead	0	0	0	0
Partner's education				
No education	0	0	0	0
Some education	0.258	0.254	-0.093	-0.141
	(3.33)***	(2.24)**	(0.57)	(0.57)
Time from marriage to first birth	-0.012	-0.014	-0.001	-0.001
	(7.67)***	(6.81)***	(0.17)	(0.23)
Amenorrheic	-1.237	-1.483	-1.321	-1.607
	(11.72)***	(12.96)***	(6.34)***	(6.85)***
Breastfeeding	-0.504	-0.575	-0.678	-0.778
	(7.10)***	(6.62)***	(4.31)***	(3.89)***
Types of contraceptive methods being used				
None	0	0	0	
PILL	-2.190	-2.621	-2.496	-3.234
	(14.80)***	(16.03)***	(7.87)***	(8.58)***
IUD	-3.427	-4.064	-3.400	-4.296
	(27.32)***	(29.55)***	(13.93)***	(13.67)***
Other modern methods	-1.861	-2.119	-4.365	-5.199
	(7.71)***	(7.59)***	(4.34)***	(4.95)***
Constant	-3.422	-3.166	-3.680	-2.921
	(14.83)***	(10.70)***	(8.03)***	(4.73)***
Gamma variance		0.939		0.342
		(11.16)***		(1.69)*
Log-Likelihood	-6004.1	-5859.9	-1207.9	

Note: Absolute value of *z* statistics in parentheses.
* Significant at 10%; ** significant at 5%; *** significant at 1%.
Third birth interval: 1270 women who had the second child after 1 January 1995 of which 309 conceived their third child within the calendar.

Figure 2.9: Discrete time hazard with and without unobserved heterogeneity for women in the reference category.



In Table 2.6 (columns 3 and 4) are also shown the results for the third birth interval without unobserved heterogeneity and the results of the third birth interval accounting for unobserved heterogeneity. The results for the third birth interval show that all the variation in birth interval length is captured by the proximate variables. The effects of work and education which were found significant on the second birth interval are not significant here. These results are also confirmed in the model for the third birth interval with unobserved heterogeneity.

In order to test formally for differences in the second birth interval and third birth interval model a likelihood ratio test has been performed. The log-likelihood of a model for the data for the second and third interval pooled together and the sum of log-likelihoods of the separate models for the second and the third interval have been used. However, should be noted that the women selected for the third birth interval analysis are those women which had a second birth in the five years prior the survey date (as oppose to the first birth for the women selected in the analysis for the second birth interval) and for this reasons not only tend to belong to an older cohort but are also a 'more' selected group of women as they already had their second birth. This also imply that when performing the likelihood ratio test only a subset of the parameters included in the models in Table 2.6 could be considered[4]. Furthermore, should also be noted that pooling together the women who had a second birth and a third birth implies that the observations will be dependent of each other. The results suggest that the two models are significantly different and, as has been explained part of those differences are due to the fact that the women selected for the birth interval analysis is a selective group.

2.6 Conclusion

Using Bongaarts's (1982) framework of the proximate determinants of fertility, which show that all important variation in fertility is captured by variation of the proximate determinants of fertility, this paper assesses the reliability of calendar data using micro level data of the proximate determinant of fertility. Previous studies have assessed the reliability of those data using aggregate techniques. The question we pose here is not whether individual level responses of calendar data are reliable or not, but rather if calendar data information are good enough to capture all the variation in fertility. If this is the case then calendar data could be used to study the effect of each proximate determinant on fertility in each country for which calendar data are available and hence investigation of fertility can be conducted in two stages: (1) modelling the effect of the proximate determinants on fertility, (2) analysing the effect of socio-economic variables on the proximate determinants.

The results shows that data on the proximate determinants of fertility available in the DHS calendar can explain almost all the variation in fertility and that socio-economic factors do indeed have their effect on fertility through the proximate determinants. Hence, the paper shows that calendar data provides important information to able demographer to identify the pathways by which social and economic factors influence fertility.

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[4] The models have been re-estimated using all the parameters considered in the previous analysis except for the survival status of the first child and the sex of the first child. The survival status of the first child has been excluded as the effect of the first child dead for the third birth interval will refer to the effect of the second birth interval. The sex of the first child cannot be directly compare with the second birth interval as in the third birth interval analysis the option of a mixed pair is also available. The log likelihood of the pooled model is 7252.67 where the sum of the log likelihood of the models for the second and third birth interval is 7219.17. A likelihood ratio test has been perform using twice the differences between the log likelihood, this gives a value of 67, with 29 degree of freedom which is significant (p=0.0005).

The results of this analysis demonstrate the importance of introducing detailed month-by-month information on contraception in birth interval analysis. They also show that we should not only include in the analysis the period of breastfeeding but also the period of post-partum amenorrhea. The results suggest that the hypothesis is largely confirmed, although one or two socio-economic characteristics still have a direct effect on second birth interval. The results suggest that the inclusion in the model of socio-economic variables can improve our measurement of the impact of biological variables in a model which does not control for unobserved heterogeneity. However, when unobserved characteristics are controlled for by incorporating a heterogeneity term, the direct impact of socio-economic variables on the hazard of conception becomes very small.

Despite the fact that the analysis reported in this paper was not designed to study contraceptive failure rates, it can help to provide some insight into contraceptive failure in Egypt. The results show a degree of failure of contraceptive use. The level of contraceptive failure varies by method, though a degree of failure is present in every method of contraceptive use. It seems that in Egypt the IUD is less prone to failure than the pill or other model methods. This suggests that policy makers should not only look to increase uptake of contraceptive methods but improve family planning counselling, as contraceptive methods have still a degree of failure, suggesting that Family Planning providers could provide adequate information.

2.7 References Chapter 2

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Chapter 3

Explaining the Geographical Differentials in Contraceptive Use in Egypt: a Decomposition Approach using the 2000 Egyptian Demographic and Health Survey

ABSTRACT

This paper examines the reasons for geographical differentials in contraceptive use in Egypt. Several studies have found marked geographical differentials in the use of contraception within Egypt, particularly between Lower and Upper Egypt and between their rural and urban areas, though the reasons for these differentials so far have not been clearly identified. The aim of this paper is to explore the reasons for them using a Oaxaca decomposition of a logistic model. This technique makes it possible to analyse what proportion of these differentials is due to behavioural aspects and what proportion is due to differences in the socio-economic characteristics of the population. The paper finds that one third of the differential between rural areas, and half the differentials between urban areas, are due to the composition of the population, with the reminder being attributable to differences in the behaviour of 'similar' persons.

3.1 Introduction

This paper examines the reasons for geographical differentials in contraceptive use in Egypt. Several studies have found marked geographical differentials in the use of contraception within the country, particularly between Lower and Upper Egypt and between their rural and urban areas, though the reasons for these differentials so far have not been clearly identified. According to the 2000 Egyptian Demographic and Health Survey geographical differentials are also found in basic socio-economic and demographic characteristics of the population. Despite the noticeable variation by region of residence in contraceptive level as well as of those characteristics which are considered to affect uptake of contraception, studies have predominantly explained those differentials as differences in behaviour and attitudes. The aim of this paper is to explore the reasons for those differentials using a Oaxaca decomposition of a logistic model. This technique makes it possible to analyse what proportion of these differentials is due to behavioural aspects and how much is due to differences in the socio-economic characteristics of the population.

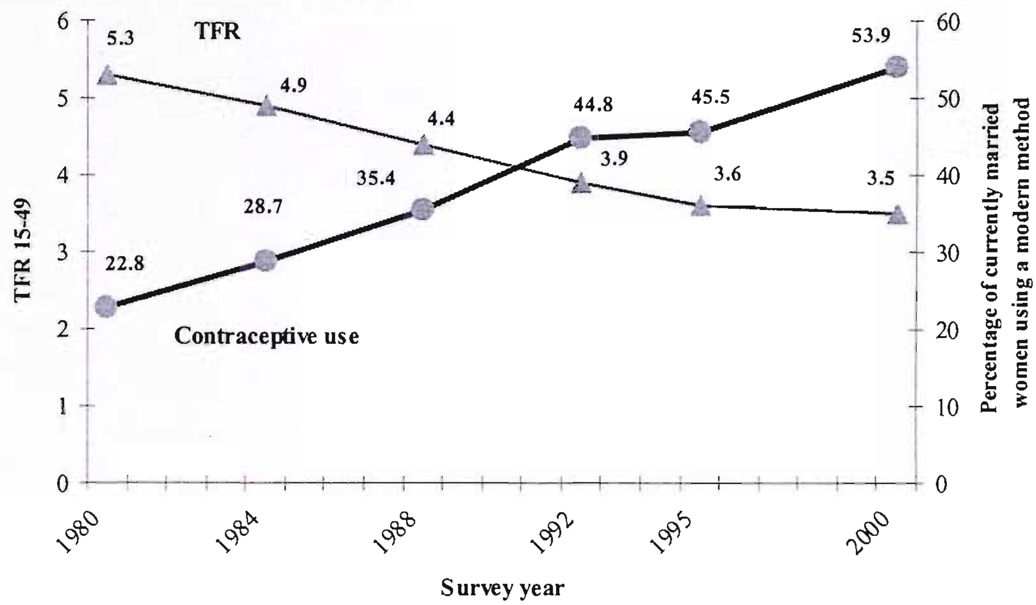
The paper analyses recent levels of use of modern methods of contraception using the 2000 Egyptian Demographic and Health Survey (EDHS). We shall also investigate factors affecting the level of contraceptive use in all of Egypt as well as in the major regional areas and identify how economic circumstances have different impacts in the various subpopulations of Egypt.

The paper is organized as follows. Section 3.2 presents the background of the study, Section 3.3 introduces the conceptual framework, Section 3.4 defines the data being used, Section 3.5 presents the method, Section 3.6 presents and comments on the major results, and Section 3.7 concludes the paper.

3.2 Background

Contraceptive use in Egypt. Contraceptive use levels have more than doubled in Egypt since 1980 (El-Zanaty and Way 2001). At the time of the 1980 Egyptian Fertility Survey (EFS) the percentage of currently married women using a modern method of contraception was 22.8; at the time of the 2000 EDHS the percentage had risen to 53.9 (Figure 3.1). The total fertility rate (TFR) decreased by almost two births from 5.3 births to 3.5 births over this period. This decline in fertility has been associated mainly with these increasing levels of contraceptive use (Govindasamy and Malhotra 1996). Although some scholars attribute some of the decline to a boost in the economy after the open door policies of the 1980s (Fargues 1997), the rise in contraceptive use cannot be disputed.

Figure 3.1: Trends in total fertility rate and use of modern methods of contraception in Egypt, 1980-2000.

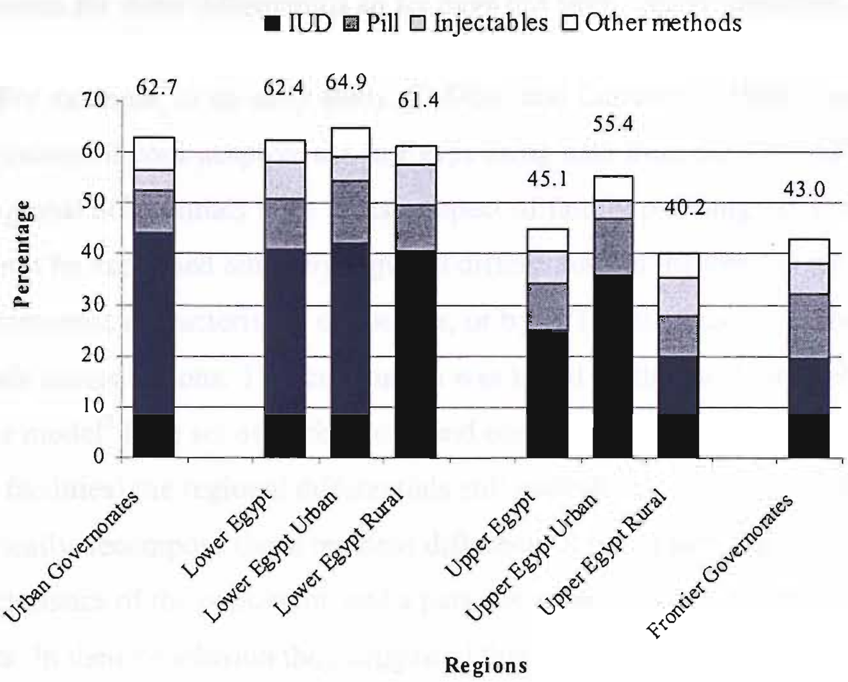


Source: El-Zanaty and Way (2001), Table 4.3 and Table 6.4, page 47 and 80 respectively. Data for the 1980 are from the Egyptian Fertility Survey, data for the 1984 are from the Egyptian Contraceptive Prevalence Survey, whereas data for 1988, 1982, 1995 and 2000 are from the Demographic and Health Survey series.
Note: Use of modern method defined as percentage of currently married women 15-49 that are currently using any modern methods. Modern methods of contraception include: pill, intra-uterine device, injectables, vaginal methods, condom, female sterilization, Norplant).

In the past decades the family planning programme, with strong educational and communication programs spearheaded by the State Information Service, has also improved knowledge and increased the rate of approval of family planning methods. According to the 2000 EDHS, family planning knowledge and approval is nearly universal. Almost all currently married women know about the pill, intra-uterine device, and injectables. No difference appears to exist by age, level of education or region of residence of the respondents. In the 2000 EDHS respondents were asked if they themselves approved of couples using family planning. The results suggest that almost all Egyptian women approve of a couple using family planning, with only 3 per cent expressing disapproval (El-Zanaty and Way 2001).

However, despite the continuous effort of family planning policies in Egypt, the increase of contraceptive use and the nearly universal knowledge and approval of family planning, there are significant differentials in use of contraception as well as fertility level by geographical area.

Figure 3.2: Current use of family planning by place of residence, 2000 EDHS.



Source: El-Zanaty and Way (2001), Table 6.1, p. 75.
Note: Currently married women 15-49 by family planning method currently used.

According to the 2000 EDHS, the current use of any modern method among currently married women aged 15 to 49, ranges from 60 per cent in the Urban Governorates and Lower Egypt to around 40 per cent in Upper Egypt and the Frontier Governorates (Figure 3.2). A gap in contraceptive use between Upper Egypt and Lower Egypt exists both in rural and urban areas. As far as urban areas are concerned there is a similar method mix in the Urban Governorates, urban Lower Egypt and urban Upper Egypt, but the level of contraceptive use in urban Upper Egypt is almost 10 per cent lower than in other urban areas.

By comparison, the TFR of women aged 15-49 in the three years preceding the survey ranges from around three births per women in the Urban Governorates and Lower Egypt and above four births per women in Upper Egypt and the frontier governorates.

Previous studies of regional differentials. A number of studies have examined trends in contraceptive use in Egypt. Almost all of them have emphasized the importance of regional patterns (Sayed, El-Zanaty and Zaky 1993), particularly between Lower and Upper Egypt and between their rural and urban areas. However, the reasons for these differentials so far have not been clearly identified.

For example, in an early study, El-Deeb and Casterline (1988)[1] looking at the determinants of contraceptive use in Egypt using data from the 1980 EFS, stressed that regional differentials were a basic aspect of family planning use in Egypt, which could not be explained either by regional differentials in the demographic or socioeconomic characteristics of couples, or by differential access to contraceptive methods across regions. This conclusion was based on the fact that after controlling in their model[2] for a set of background and contextual variables (such as time to outlet facilities) the regional differentials still existed. In their analysis they did not analytically decompose those regional differentials into a part due to the different characteristics of the population and a part due to differences in behavioral-cultural aspects. In their conclusion they suggested that further investigation of this matter was needed and that the regional differentials could be due to fundamental differences across regions in the value placed on childbearing.

The 1992 EDHS indicated that family planning use in Upper Egypt had doubled since the 1980; however the level of contraceptive use in Upper Egypt was still very low in comparison to other areas in Egypt. Although comparatively few

[1] This study used data from the 1980 EFS to look at the levels and trends in contraceptive use for different geographical areas in the late 1970s. It showed that knowledge of contraceptive methods was widespread at the time, reaching 90 per cent in 1980. This study confirmed the existence of sharp geographical differentials, particularly a wide gap in contraceptive prevalence between Upper Egypt and Lower Egypt. In 1980, the use level in rural Lower Egypt was 20 per cent compared with 17 per cent in 1974-75. In contrast, for rural Upper Egypt, the prevalence was around 4 percent in both surveys.

[2] They estimated first an Ordinal Least Square regression model with a binary dependent variable and subsequently in their exploratory work on the geographical differential in use they applied a logit model to the sub sample of each major regional area.

women in Upper Egypt were currently using family planning, the 1995 EDHS results showed that a large proportion wanted no more children (El-Zanaty *et al.* 1996).

In 1997, in response to the need to increase understanding of the low use of contraception in Upper Egypt the Egypt In-depth Study of Reasons for Nonuse of Contraception (EIS) was carried out to collect information on the factors which were contributing to the low level of use in Upper Egypt. In particular the study was designed to investigate the reasons for the high level of unmet need, and why contraceptive use levels in the region remain low. The EIS[3] was carried out in Upper Egypt in Assuit and Souhag governorates, which have the lowest levels of contraceptive use and amongst the highest unmet need in Egypt. The results of this study showed clearly the dynamic nature of contraceptive use decision-making in Assiut and Souhag. Forty-four percent of EIS respondents used contraception over the course of the (almost) 24-month period of the study, nearly double the percentage of women who were currently using at the time of the 1995 EDHS when the study began (24 per cent). Despite the large proportion of users in the interval between the two studies the current contraceptive use rate at the time of the final panel interview in late 1997 was 28 per cent, an increase of only 4 percentage points over the rate in 1995 (El-Zanaty *et al.* 1999). The relatively limited impact of the comparatively large number of women who adopted contraception during the period is a direct result of the fact that the average user discontinued use within 11 months of adopting a method. The study showed that the discontinuation amongst users was not a product of a high degree of instability in women's fertility preferences. The women who wanted no more children at the 1995 survey largely remained consistent in expressing a desire to limit their births throughout the study (El-Zanaty *et al.* 1999).

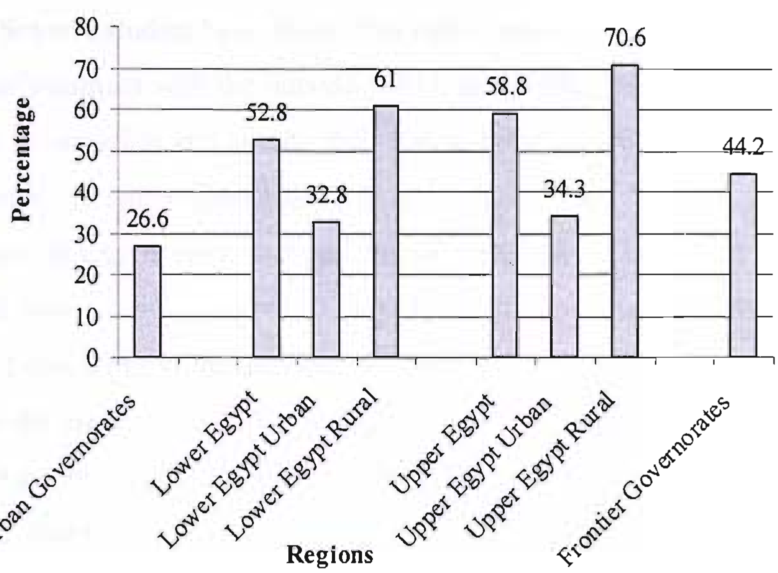
Regional differences in socio-economic characteristics. If we look at some demographic and socio-economic characteristics of the population living in the main geographical regions, we notice substantial differentials. The question, then, is

[3] The EIS involved a panel design in which two rounds of follow-up interviews were conducted with women from Assiut and Souhag governorates who had been interviewed in the 1995 EDHS. In the second round of the EIS, there were also interviews with husbands of a sub-sample of the EIS respondents in order to obtain a greater understanding of the role men play in the contraceptive decision-making process.

whether these alone are sufficient to account for the gap in modern contraceptive use. Let us consider some of these characteristics in more detail.

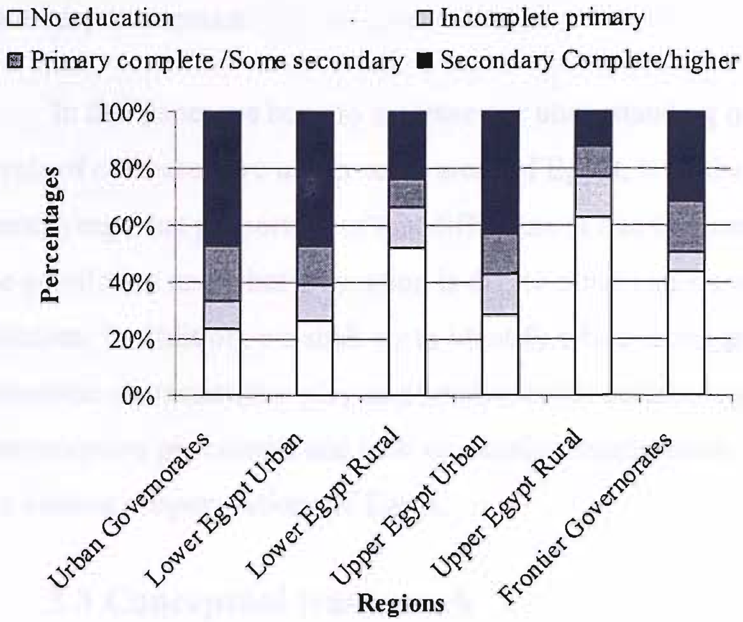
The level of education and the literacy rate have been widely considered to have a direct and consistent relationship with the practise of contraception (Jejeebhoy 1995). First, education affects exposure to and the understanding of mass media information, in particular reproductive health and family planning information. Second, it helps to boost women's level of autonomy and consequently to enhance the confidence they have to take their own decisions regarding health as well as reproductive behaviour. Figure 3.3 shows a high rate of illiteracy for ever-married women in rural areas of Upper Egypt compared to those in rural areas of Lower Egypt as well as those in urban areas. If we look at levels of education we can see similar patterns (Figure 3.4). The distribution of education appears to be uneven across the different regions of the country.

Figure 3.3: Illiteracy level of ever-married women by major geographical area, 2000 EDHS.



Source: El-Zanaty and Way (2001), Table 3.3 p 28.

Figure 3.4: Highest level of education of ever-married women by major geographical area, 2000 EDHS.



Source: El-Zanaty and Way (2001), Table 3.2 p 26.

Several studies have found that participation in the labour market increases women's contact with the outside world, increasing their exposure to reproductive health information and raising their status as they increase their ability to access economic resources (Jejeebhoy 1995). Women's participation in labour market is very low in Egypt; only 14.5 per cent of ever married women at the time of the 2000 EDHS reported being currently employed with continuous work in the previous year. If one looks at the distribution by region one can easily notice a difference across the main regions. According to the 2000 EDHS report the figures ranged from 5 per cent in rural Upper Egypt to 13 percent in rural Lower Egypt, 18.5 per cent in urban Upper Egypt and above 20 per cent in the Urban Governorates.

Therefore, although several studies have emphasized the pronounced geographical differentials in contraceptive prevalence in Egypt, the reasons for the differentials are not yet well understood. Some researchers seem to explain the different levels of contraceptive use with references to different values placed to childbearing and greater preference for large families in Upper Egypt. Other studies emphasize the high discontinuation rate in Upper Egypt. But not much attention has been given to differences in the socio-economic characteristics of the population across regions, despite the fact that according to the extensive literature on reproductive behaviors, these are considered to be strongly associated with contraceptive uptake.

In this paper we hope to increase our understanding of what causes lower levels of contraceptive use in some areas of Egypt, with the specific aim of identifying what proportion of this difference is due to observed characteristics of the population and what proportion is due to other factors, such as behavior and attitudes. In addition, we shall try to identify which demographic and socio-economic characteristics play important roles in determining the gap in contraceptive prevalence and how economic circumstances have different impacts in the various subpopulations of Egypt.

3.3 Conceptual framework

According to the vast literature on contraceptive use and behaviour the choice of using or not using contraception is considered to be associated with the socio-economic and demographic characteristics of the respondent, as well as the characteristics of household and the respondent's husband. Previous studies of contraceptive use in Egypt (El-Deeb and Casterline, 1988, Steele and Geel 1999, Mayer, El-Zanaty and Way 1995) have found that age of the respondent, number of living children, place of residence, and the level of education of the respondent and her husband are important determinants of contraceptive use. Other potentially important factors include exposure to mass media information, discussion with husband about family planning, and husband's approval.

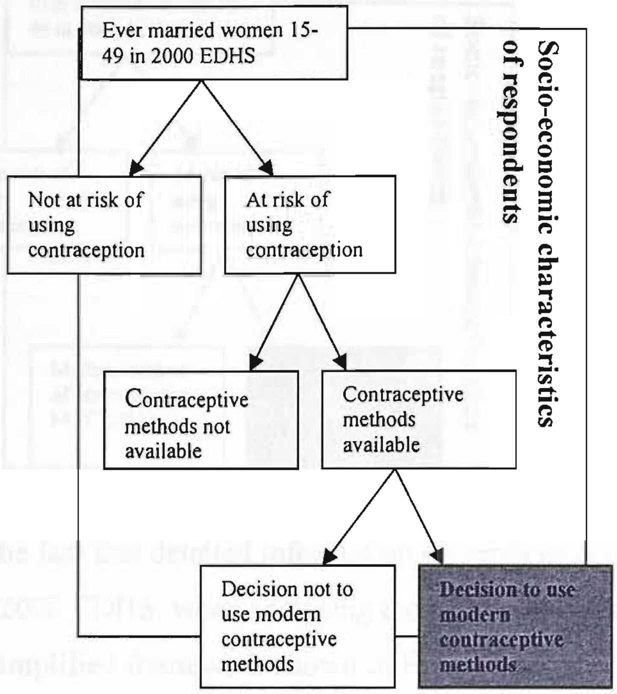
The previous study by El-Deeb and Casterline (1988), in which they were interested in the determinants of contraceptive use in Egypt, used a conceptual framework taken from Hermalin (1983), who derived it from the work of Easterlin (1978) and others. The model assumes that use is, proximately, a function of two types of factors: the motivation to use, and cost of use. To measure 'motivation to use' they include information on fertility preferences, and other variables that affect fertility preferences such as the number of living children, the number of living sons, and other socio-economic variables. Some of these variables, such as whether the respondent expects help from children later in life, or whether schooling is desired for children are not available in the 2000 EDHS. Amongst the factors affecting 'cost of use' were considered monetary costs, time to outlet (not available for the 2000 EDHS), socio economic costs, place of residence, spousal communication about fertility, and education. All other factors influence use through these two types of factors. Although their framework directs them to use a subset of variables which are particularly relevant to the investigation of contraceptive behaviour, and it provides a classification of them, these factors do not find a unique location in the classification scheme. For example place of residence, education, socio-economic status of household and age of respondent reflect both the motivation to use and the cost of use contraception.

Therefore when interpreting their results they admit the complexity of contraceptive behaviour and in their conclusion do not systematically follow the conceptual framework. Furthermore their analysis was not directly designed to look at the geographical differences in contraceptive use but was specifically designed to look at the full set of determinants that affect the use of contraception.

During the past decade there has been increasing interest in contextual factors, such as availability and accessibility of contraception. The accessibility of family planning services (FP) generally refers to the extent to which appropriate contraceptive methods are available and the extent to which those in a given location who are seeking contraceptives can obtain services (Bertrand *et al.* 1995). Furthermore Bertrand (1995) defined access as a 'multidimensional concept that not only includes physical proximity and travel time to services, but also involves economic, psychological and attitudinal costs, cognition and perceptions of potential clients'.

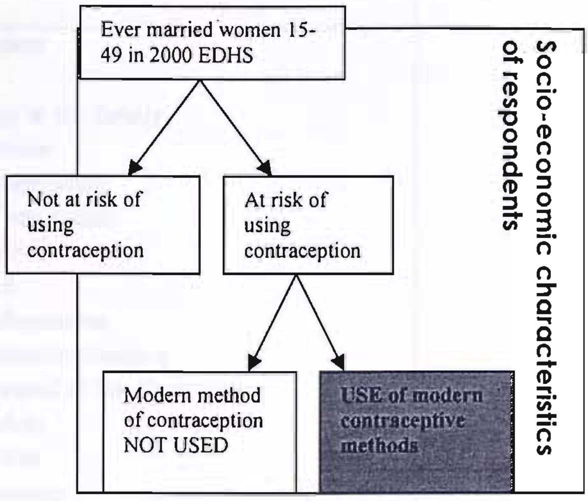
Since in this paper we are interested in differentials in current contraceptive use, we consider only the population at risk of using a contraceptive method (see the next section for a full explanation of sample selection). Figure 3.5 shows that the socio-economic characteristics of respondents affect their risk status for the use of contraception, as well the decision to use contraception given the availability of services. Furthermore the choice of a modern contraceptive method amongst those women that are at risk of using contraceptive methods is restricted by the availability of information on family planning services.

Figure 3.5: General conceptual framework on the decision to use contraceptive methods.



As far as data on the availability of Family Planning (FP) services in Egypt are concerned, the latest information was collected at the time of the 1988 EDHS in a parallel Service Availability Survey 1989 (Sayed 1991). Results from multilevel modelling that use both datasets suggest that availability was an important factor in accounting for geographical differences in contraceptive use in Lower and Upper Egypt at the time of the 1988 EDHS; in particular it seems to explain the high level of unmet need for family planning in Upper Egypt (Steele and Geel 1999). Other studies using the 1992 EDHS revealed a strong improvement in FP availability between 1988 and 1992. Harbison (1995), using data from the 1992 EDHS found a dramatic increase in contraceptive use between 1988 and 1992 which he attributed to the increased emphasis on the FP programme. He suggests that factors such as widespread accessibility of FP services (96 per cent of women live within 5 km of FP sources), widespread acceptability of FP, the affordability of services (in the 1992 EDHS, fewer than 1 per cent of women who were not using FP cited cost as reasons for not using), and a highly intensive and effective mass media campaign have contributed to this dramatic increase in FP use.

Figure 3.6: Conceptual framework on contraceptive use decision, applied to Egypt.



Because of the fact that detailed information on services is lacking for the period around the 2000 EDHS, when analysing the contraceptive use in Egypt we will consider the simplified framework shown in Figure 3.6 where we will look at the impact of the socio-economic characteristics of the respondent on the decision to use a contraceptive method for the population at risk of using contraceptive methods and we will not account for the effect of availability and accessibility on the decision to use a contraceptive method. In other words, we will model 'use' which reflect both 'availability and 'choice'. The fact the availability is widespread means that we probably do not lost much explanatory power by this omission. However Harbison (1995) did suggest that the quality of services affects the contraceptive uptake in Egypt. This aspect needs to be borne in mind when the results are interpreted, as one possible explanation of the gap in contraceptive use between Upper and Lower Egypt might be difference in perceived or actual service quality.

In Table 3.1 are listed factors that according to the vast literature on contraceptive use in Egypt and elsewhere are found to influence the use or non-use of contraception. The √ indicates that the variable that has been included in our model and X indicates a variable that is not included.

Table 3.1: Factors affecting the use of contraception.

	User of modern methods of contraception
Age of respondent	√
Parity	√
Number of boys in the family	√
Fertility preference	√
Education of respondent	√
Occupation of respondent	√
Husband education	√
Living standard	√
Exposure to information	X
Discussion of family planning	X
Husband's approval of family planning	X
Quality of services	X
Access to services	X
Women' s autonomy	X

√: included in the model, X: not included in the model.

As far as fertility preferences are concerned, Table 3.2 shows the percentage distribution of fertility preferences across regions. If we look at column 3 of Table 3.2 we can see that the percentage of women wanting no more children is lower in Upper Egypt and in the Frontier Governorates than elsewhere. Therefore the geographical differences in contraceptive uptake could be partly explained by differences in fertility preferences.

Table 3.2: Percentage distribution of fertility preferences, by major regional areas at the time of survey, 2000 EDHS.

	Have another (1)	*Undecided* (2)	*Want no more children/or sterilized* (3)	*Total* (4)
Urban Governorates	17	2	81	100
Lower Urban	18	3	79	100
Lower Rural	17	5	78	100
Upper Urban	19	9	72	100
Upper Rural	24	7	68	100
Frontier Governorates	25	12	63	100
Total	19	5	76	100

Note: Weighted percentage of fertility preference by regions (total un-weighted 9,736, with 2 cases with missing values). The weighted total population at risk is 9,860.

The inclusion in the model of fertility preferences will modify the effect of the other background variables on the probability of using modern contraceptive methods as the fertility preferences of respondent are a function of the same background characteristics that affect the probability of using contraception. A similar problem was encountered by El-Deeb and Casterline (1988) in their study of contraceptive determinants, and in their analysis they decided to estimate models with and without fertility preferences to allow a comparison of the coefficients of the background variables when they are assumed directly to affect contraceptive use with those when they are supposed indirectly to affect it through the fertility preferences. A similar approach will be applied here, allowing further comparisons of the effects of including or excluding fertility preferences from the model on the decomposition of contraceptive use gaps.

The decision to exclude female autonomy, discussion of FP with husband, and husband's approval of FP has been primarily dictated by the fact that, despite the presence in the 2000 EDHS of information on family decision making, access to resources, whether the respondent discusses FP with her husband or if her husband approves of family planning, this information was not enough to capture the several dimensions of female autonomy. Furthermore the inclusion of this variable in the model assumes a strong hypothesis about the relationship between husband and wife as well as what are the characteristics of low female autonomy[4]. Therefore the inclusion of a female autonomy variable based on the responses to these questions could lead us to misreport the effect of the level of autonomy on the gap in contraceptive use between the major areas of Egypt.

The exclusion of respondent-perceived quality of services has been dictated by the fact that the 2000 EDHS survey does not contain detailed information on quality of services. It does include some information about whether the respondent received information about other FP methods from a doctor or a pharmacist (only for those who obtained a method from doctor and pharmacist), and whether she was told about side effects but this information does not represent the various dimensions of

[4] In 2000 EDHS questionnaire there is a question regarding household decision making: decision regarding own health, large household purchase, everyday household purchase, what food to cook each day. The options which have been given to the respondents for this question were: 1) self only, 2) jointly with husband, 3) jointly with someone else, husband only, 4) someone else. One could argue that when is the husband only who is responsible for household decision as oppose to women only, then women show a lower level of decision making power. However, in the specific Egyptian setting these assumption is not necessary true as some household decision could be also be taken exclusively by the wife as they refer to her sphere as for example decision regarding the supply of food.

quality of services and therefore we decide to leave the service quality out of the model.

Overall then, we prefer to include in the model only those variables that can be unequivocally defined. This is important because our aim is to decompose analytically the geographical gap in contraceptive use in Egypt between background variable that are well-defined and other factors that are not clearly measured or not available from 2000 EDHS. In other words, we restrict our 'compositional' variables to those which we can easily measure, and which we believe to have a direct influence on contraceptive behaviour, such as respondent's education, age, parity, number of boys, husband's education, respondent's occupation, and living standards (see the Appendix A at the end of this thesis).

3.4 Data and measures

The data used in this study are from the individual and household questionnaire of the Egyptian Demographic and Health Survey (EDHS).

The primary object of the sample design of the 2000 EDHS was to provide estimates of key population and health indicators, including fertility and child mortality, at the national level. Furthermore the sample design allows estimation of the contraceptive prevalence rate and other basic health indicators, but not fertility and mortality rates, for each of the 21 governorates in the urban governorates, Lower Egypt, and Upper Egypt. In the frontier governorates, the sample size for the individual governorates is not sufficiently large to allow for separate governorate level estimation (because the sample is small the standard errors of estimates are too large). To meet the survey objectives, the number of households selected in the 2000 EDHS sample from each governorate was not proportional to the size of the population and a three stage probability sample was designed. As a result the 2000 EDHS sample is not self-weighting at the national level, therefore in the present analysis the weights and the survey design structure will be considered. For detailed information about the survey design see Appendix B in the 2000 EDHS report (El-Zanaty and Way 2001). The model that will be estimated will have to account for the data clustering. Ignoring this often results in statistical tests which are too liberal, resulting in too many false rejections of the null hypothesis (Hedeker, Gibbons and

Flay 1994). Not accounting for the clustering of the data could lead us to underestimate the standard errors of parameter estimates, and consequently to incorrect results and incorrect inferences.

In this paper the information collected on assets in the household questionnaire has been used to construct a household economic index. According to previous analysis using Demographic and Health Survey data, the household asset index is a good proxy of long-run household wealth (Filmer and Pritchett 1994), and it has been proved to be a good measure of living standard especially if it is related to health indicators (Gwatkin *et al.* 2000). This economic index has been constructed using a principal component analysis to derive the weights of a set of asset indicators (see the Appendix A for a full explanation of the set of household indicators used). The principal component analysis was carried out using the full dataset of the household questionnaire.

The present analysis is limited to the population at risk of using contraception, therefore we excluded from the analysis those women that were pregnant at the time of the survey and those who were potentially seeking to become pregnant as these by definition should not be using contraception[5]. Moreover, as in Egypt contraceptive use is largely confined within marriage and after the birth of the first child, we exclude from the analysis unmarried women and married women who had yet to conceive their first child[6]. Furthermore, since the aim of this analysis is to understand the gap in contraceptive behaviour of women of reproductive age that are exposed to pregnancy, we excluded also those women that are in menopause[7], as the exposure to pregnancy terminates when a women is in menopause[8].

[5] This group of women are those who express the desire to have a child in the following 12 months, in a previous analysis Govindasamy and Malhotra (1996) using the 1988 EDHS, decided to exclude from the analysis also those women that were unsure about their preferred timing for the next birth. In the present analysis we included those women as it is not clear they are non-users.

[6] Only 4 women out of 1485 with no children are using contraception and 12 out of 1180 not currently married.

[7] Women are defined to be in menopause who report that they are in menopause, or if they are not pregnant and not postpartum amenorrheic, are not currently using a contraceptive method, and have not had a period in the six months preceding the survey.

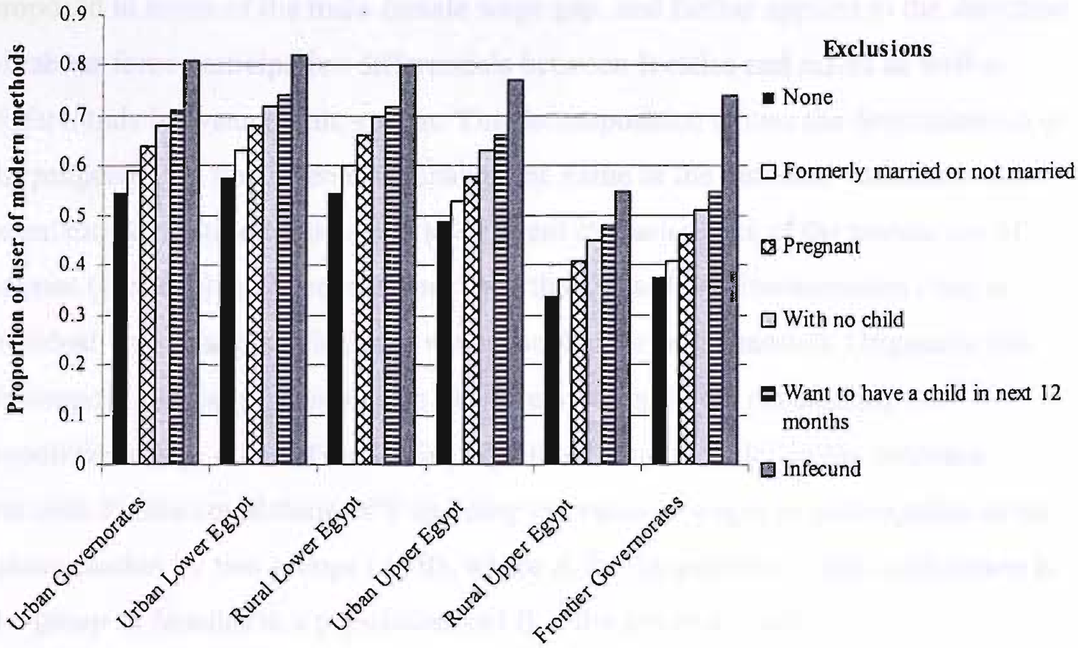
[8] A small group of menopausal women are still using contraception (primarily injections), despite the fact they are not biologically fertile. As the aim of this analysis is the contraceptive uptake of these groups that are exposed to pregnancy this group of women has been excluded.

Another group of women that are not exposing themselves to the risk pregnancy are those women that are infecund[9] and therefore are not at risk of pregnancy. In the literature there are different measures of infecundity. Some of these use self-reported infecundity, defining as infecund those women who report that they are infecund. Other definitions consider the birth history and the time between pregnancies (Ericksen and Brunette 1996). For the purpose of this analysis we will consider infecund those women that describe themselves to be infecund, as we are interested in the impact of infecundity on contraceptive behaviour and not in its impact on fertility levels. We assume that if a woman believes herself to be infecund she will not use contraception[10], but we include all women who think themselves to be fecund, even if their fecundity is low.

The proportion of women excluded from the analysis varies with the region of residence (Figure 3.7). The proportion of infecund women appears to be greater in the Frontier Governorates than in any other area. To summarise, the present analysis is confined to a sample of 9,738 currently married women age 15-49 that are not pregnant, with at least one child, who do not want to have a child in the next 12 months, that are not infecund or in menopause.

[9] Women are defined as being infecund if they are not menopausal and not postpartum amenorrheic and not pregnant, have had no birth in the five years preceding the survey, and have been continuously married and have not used contraception in the five years preceding the survey.
[10] Only two women out of 412 self-reported infecund women are using contraception.

Figure 3.7: Proportion of users of contraceptive methods after excluding successive groups of women.



Note: The figure above refers to the proportion of users after excluding (in sequence) formerly married and non-married women, pregnant women, married women with no children, women who want to have a child in the next 12 months, and women who consider themselves infecund.

3.5 Method

We apply a logistic regression model controlling for survey design factors. The dependent variable is a categorical binary variable which takes the value of one for women who are currently using a modern method of contraception and 0 for those who are not currently using a modern method of contraception. The explanatory variables in the model are: respondent's age, parity, number of boys, respondent's education and activity status, husband's education and living standards (asset index), estimated or measured as described above. The results of the logistic regression applied to each major regional area will be used to apply a decomposition method developed by Blinder (1973) and Oaxaca (1973), for a linear regression model and further extended by Gomulka and Stern (1990) for a model of discrete choice for a binary outcomes with a probit specification and later by Nielsen (1998) to a logit specification.

The Oaxaca-Blinder decomposition was originally used by labour economists to describe gender and race differentials in wages, more specifically it was originally proposed in terms of the male-female wage gap, and further applied to the detection of labour force participation differentials between females and males as well as differentials between ethnic groups. The decomposition allows the determination of the proportion of the difference between the value of the outcome variable in two populations of interest that is due to different characteristics of the population of interest (the 'explained' components) and that caused by discrimination (that is 'residual' components, which are not accounted for in the model). Originally this decomposition was proposed for a linear regression model considering two populations (e.g. A and B) and using equations 1 and 2 to define the outcome variable *Y*. One could think of Y as being the value of wages or participation in the labour market by two groups (A, B), where A for the purpose of this explanation is the group of females in a population and B is the group of males.

$$Y_i^A = \hat{\beta}_0^A + \hat{\beta}_1^A X_{1i}^A + ... + \hat{\beta}_K^A X_{Ki}^A \quad \text{for } \boldsymbol{i} \text{ belonging to group A,} \qquad (1)$$

$$Y_i^B = \hat{\beta}_0^B + \hat{\beta}_1^B X_{1i}^B + ... + \hat{\beta}_K^B X_{Ki}^B \quad \text{for } \boldsymbol{i} \text{ belonging to group B.} \qquad (2)$$

$\hat{\beta}_0^A$, $\hat{\beta}_0^B$ are the estimated constant parameter, $\hat{\beta}_K^A$, $\hat{\beta}_K^B$ are the estimated coefficient parameters and X_{Ki}^A and X_{Ki}^B are the characteristics of group A and B respectively.

In least squares regression, the mean of the outcomes for each group is equal to the sum of the mean of each observed variable times the estimated coefficient on the variable:

$$\overline{Y_i^A} = \hat{\beta}_0^A + \hat{\beta}_1^A \overline{X_{1i}^A} + ... + \hat{\beta}_K^A \overline{X_{Ki}^A} \qquad (3)$$

$$\overline{Y_i^B} = \hat{\beta}_0^B + \hat{\beta}_1^B \overline{X_{1i}^B} + ... + \hat{\beta}_K^B \overline{X_{Ki}^B} \qquad (4)$$

So, the differences between the average outcomes[11] for the two groups can be written as follows:

$$\overline{Y_i^A} - \overline{Y_i^B} = \left(\hat{\beta}_0^A + \hat{\beta}_1^A \overline{X_{1i}^A} + \ldots + \hat{\beta}_K^A \overline{X_{Ki}^A} \right) - \left(\hat{\beta}_0^B + \hat{\beta}_1^B \overline{X_{1i}^B} + \ldots + \hat{\beta}_K^B \overline{X_{Ki}^B} \right) \quad (5)$$

Now, define S as:

$$S = \left(\hat{\beta}_0^B + \hat{\beta}_1^A \overline{X_{1i}^B} + \ldots + \hat{\beta}_K^A \overline{X_{Ki}^B} \right) \quad (6)$$

Adding and subtracting S from the right-hand –side of the equation (5), and then rearranging the terms produces:

$$\begin{aligned} \overline{Y_i^A} - \overline{Y_i^B} = &\left[\hat{\beta}_1^A \left(\overline{X_{1i}^A} - \overline{X_{1i}^B} \right) + \ldots + \hat{\beta}_K^A \left(\overline{X_{Ki}^A} - \overline{X_{Ki}^B} \right) \right] + \\ &\left[\left(\hat{\beta}_0^A - \hat{\beta}_0^B \right) + \left(\hat{\beta}_1^A - \hat{\beta}_1^B \right) \overline{X_{1i}^B} + \ldots + \left(\hat{\beta}_K^A - \hat{\beta}_K^B \right) \overline{X_{Ki}^B} \right] \end{aligned} \quad (7)$$

The term in the first square brackets on the right-hand side denotes the portion of the difference between the average outcomes that is due to the difference in the *Xs* between the two groups (i.e. differences due to different population characteristics). The term in the second square brackets represents the portion due to the difference in the estimated coefficients (i.e. the difference in the estimated effects of the *Xs*) between the two groups.

In the present analysis the decomposition will be applied to a non-linear model. Our interest is to decompose the total difference in the proportions of current users of a modern method in the different major areas into the difference due to differentials in population characteristics (age structure, parity, level of education, and so on) and that due to differentials in the behaviour of women whose socio-economic characteristics are similar.

[11] This value could be the wages gap or differences in participation in the labour market between males and females.

We illustrate the extension of the Oaxaca-Blinder decomposition to a non-linear regression model as illustrated by Gomulka and Stern (1990) but considering as dependent variables for the decomposition the use of modern method of contraceptive in Upper Egypt and Lower Egypt.

Consider $\overline{P_U}$ and $\overline{P_L}$, the average predicted probabilities of being a user in Upper Egypt and Lower Egypt respectively, y being the dependent variable with value equal to 1 if the respondent uses a modern method of contraception and 0 if the respondent does not use a modern method of contraception. $\hat{\beta}_U$, $\hat{\beta}_L$ are defined as the vector coefficients for the set of explanatory variables x_{Ui}, x_{Li} for Upper Egypt and Lower Egypt respectively, where the subscript i indicates individuals. N_U, N_L are the sample sizes of people in Upper Egypt and Lower Egypt respectively.

Equation (8) defines the average probability of being a user of a modern method in Upper Egypt:

$$\overline{P_U} = \sum_{i=1}^{N_U} F\left[x_{Ui} ; \hat{\beta}_U \right] \Big/ N_U \quad . \qquad (8)$$

If the coefficients for residents of Lower Egypt are $\hat{\beta}_L$, the average probability of being a user in Lower Egypt is given by equation (9):

$$\overline{P_L} = \sum_{i=1}^{N_L} F\left[x_{Li} ; \hat{\beta}_L \right] \Big/ N_L \quad . \qquad (9)$$

Let us now define the average probability of being a user of modern methods for people living in Lower Egypt if they were to behave as people living in Upper Egypt (that is, to have the same coefficients, $\hat{\beta}_U$, of people living in Upper Egypt).

$$\overline{P_L^0} = \sum_{i=1}^{N_L} F\left[x_{Li} ; \hat{\beta}_U \right] \Big/ N_L \qquad (10)$$

The following equation defines the decomposition of the differential in average probability between people living in Upper Egypt and those people that live in Lower Egypt:

$$\overline{P_L} - \overline{P_U} = \underbrace{\overline{P_L} - \overline{P_L^0}}_{D} + \underbrace{\overline{P_L^o} - \overline{P_U}}_{C} \tag{11}$$

The term $D = \left(\overline{P_L} - \overline{P_L^0}\right)$ is the average probability of being a user of modern methods for people living in Lower Egypt minus the same probability calculated assuming that people living in Lower Egypt behaved as if they were as people living in Upper Egypt (same sample, different coefficients). The term $C = \left(\overline{P_L^o} - \overline{P_U}\right)$ is the difference between the average probability of using a modern method between the population of Lower Egypt and Upper Egypt assuming that both behaved as if they were Upper Egypt residents (different sample, same coefficients).

The above decomposition could also have been done by adding and subtracting the average probability of being a user in Upper Egypt if the coefficients used were the ones of Lower Egypt. The two approaches will not give exactly the same results (for a problem of index numbers).

The major interest of this analysis is to understand the gap in current contraceptive use levels in the different major areas of Egypt. The decomposition allows us to identify the proportion of the gap that is due to demographic and socio-economic characteristics (those characteristics that have been included and controlled in the model) that we could define as the 'explained' characteristics, and the proportion of the gap that it is due to the 'residual' component.

The C term of the decomposition represents the proportion of the gap that it is due to the difference in socio-economic characteristics of the population. The term D represents the residual part, due to different effects of those background characteristics on contraceptive use. In particular the gap that D identifies represents the effect of everything that has not been accounted for in the model. It should be noted that despite this technique allowing us to perform a detailed decomposition of the gap in contraceptive use, the part of the difference due to the different coefficient effects of women which have the same characteristics includes the effect of differences in the constant terms, see equation (7) above. These constant terms could have quite different absolute values. The constant term measures use among the baseline women, differences between $\hat{\beta}_U^0$ and $\hat{\beta}_L^0$ relate to unmeasured population specific factors.

3.6 Results

3.6.1 Logistic regression model for all of Egypt

The model has been first estimated using the selected sample for all of Egypt[12]. This model will not only allow to gain a general understanding of factors affecting contraceptive use in all of Egypt but also helps to select an appropriate model to study contraceptive use in the different regions. Second, it helps us to understand which factors are most important the decision to use or not to use modern methods of contraception. Third, it will allow us to gain a better understanding of factors affecting contraceptive use in each major regional area through comparison of the results of modelling for all of Egypt and for each major regional area. The percentage distributions of the individual characteristics considered in the analysis, with the categorisations used, are shown in Table 3.3.

[12] We use the svy command for the calculation of the proportion and for the estimation of the logistics model (Eltige and Sribney 1996).

Table 3.3: Proportion of women with selected background characteristics by region of population at risk, considered in the analysis.

	Urban Governorates	*Lower Egypt Urban*	*Lower Egypt Rural*	*Upper Egypt Urban*	*Upper Egypt Rural*	*Frontier Governorates*	*Total*
Age Group							
15-19	0.01	0.01	0.02	0.01	0.04	0.01	0.02
20-24	0.09	0.10	0.15	0.10	0.17	0.11	0.13
25-29	0.18	0.19	0.22	0.18	0.20	0.22	0.20
30-34	0.21	0.21	0.20	0.21	0.18	0.24	0.20
35-39	0.20	0.21	0.19	0.21	0.20	0.18	0.20
40-44	0.17	0.15	0.12	0.16	0.12	0.14	0.14
45-49	0.11	0.09	0.07	0.10	0.06	0.06	0.08
Family Composition							
1 Boy	0.06	0.08	0.08	0.05	0.06	0.05	0.06
1 Girl	0.07	0.05	0.05	0.07	0.04	0.04	0.05
1 Boy and 1 Girl	0.16	0.12	0.11	0.11	0.07	0.08	0.11
2 Boy	0.08	0.07	0.05	0.06	0.04	0.08	0.06
2 Girls	0.07	0.06	0.03	0.04	0.03	0.02	0.04
More than 3 children	0.54	0.60	0.67	0.64	0.74	0.71	0.65
Respondent's education							
No education	0.22	0.24	0.51	0.24	0.60	0.41	0.40
Primary	0.17	0.17	0.17	0.20	0.18	0.12	0.18
Secondary	0.41	0.44	0.27	0.40	0.19	0.37	0.32
Higher	0.18	0.14	0.03	0.14	0.01	0.08	0.08
Respondent's work status	0.22	0.25	0.17	0.22	0.07	0.23	0.18
Breastfeeding	0.26	0.25	0.30	0.30	0.48	0.38	0.33
Partner has some education	0.85	0.82	0.65	0.83	0.62	0.76	0.73
Fertility Preference							
Have another	0.17	0.18	0.17	0.19	0.24	0.26	0.19
Undecided	0.03	0.02	0.04	0.09	0.06	0.11	0.04
No more or sterilized	0.80	0.80	0.78	0.71	0.68	0.63	0.75
Quintiles of PCA Score							
Poorest	0.01	0.02	0.23	0.05	0.43	0.21	0.18
Middle-poor	0.04	0.08	0.33	0.08	0.28	0.11	0.20
Middle	0.09	0.19	0.27	0.18	0.18	0.24	0.19
Middle-upper	0.31	0.34	0.12	0.32	0.07	0.24	0.20
Richest	0.53	0.34	0.02	0.34	0.02	0.17	0.20

Note: The economic status has been derived as explained in the Appendix A of the thesis from the application of principal component analysis. The factor score has been considered as a set of weights for the household amenities and used to construct a household asset index that it is a continuous value. In the present table we categorise the household according to which quintile of the distribution of the household asset index it lies in. In the model the asset index has been introduced as the logarithm of the household index's value.

We first fit a model for all of Egypt using only regional dummies, and then we progressively add the other explanatory variables in order to see if the effect of place of residence still exists after controlling for the other background characteristics. We then add explanatory variables representing the demographic composition of the population (age, breastfeeding status and family composition which measures both parity and gender of the children) and subsequently variables representing the socio-economic characteristics of the population (as respondent's education, respondent's work status, partner education and living standards). Finally, we add variables which capture women's fertility preferences in order to see how results changes after their inclusion and to what extent differences in fertility preferences explain the regional differential in contraceptive use.

The results (Table 3.4) show that the geographical differences still exist after controlling for the background characteristics described above. After having fitted the model with age and parity of respondent, respondent's and husband's education, living standards, work status, and fertility preferences, women living in Upper Egypt and living in the Frontier Governorates were up to 15 and 12 percentage points, respectively, less likely to use contraception compared to women living in the Urban Governorates, whereas women living in rural Lower Egypt were up to 7 percentage points more likely to use contraception compared to women with same characteristics living in the Urban Governorates[13]. This latest result suggest that if women in rural Lower Egypt had the same characteristics as women living in the urban governorates, the rural Lower Egyptian women would in theory have a 44 per cent higher risk of using a modern contraceptive method[14].

[13] The impact of a variable x on the probability p is given by $\frac{dp}{dx} = p(1-p)\beta$ where β is the variables coefficient. Setting p=0.5 gives the maximum value of dp/dx.

[14] Considering women in the baseline category with an average living standard, the predicted probability of using a method of contraception for women living in rural Lower Egypt is 0.86 whereas the predicted probability of using a modern method of contraception in Urban Governorates is 0.81. The odds of using a modern method of contraception in rural Lower Egypt is 1.44 the odds of using a modern method in Urban Governorates.

Table 3.4: Results for logistics regression model for all of Egypt.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Place of residence									
Lower Egypt Urban	0.050	0.058	0.068	0.024	0.015	0.017	0.020	0.065	0.081
	(0.48)	(0.57)	(0.66)	(0.22)	(0.14)	(0.15)	(0.18)	(0.57)	(0.70)
Lower Egypt Rural	-0.066	-0.003	-0.001	-0.018	0.075	0.076	0.085	0.261	0.295
	(0.68)	(0.04)	(0.01)	(0.18)	(0.76)	(0.77)	(0.86)	(2.35)*	(2.63)**
Upper Egypt Urban	-0.265	-0.262	-0.248	-0.203	-0.203	-0.203	-0.203	-0.147	-0.049
	(2.05)*	(2.03)*	(1.90)	(1.56)	(1.55)	(1.55)	(1.55)	(1.15)	(0.38)
Upper Egypt Rural	-1.264	-1.197	-1.192	-1.066	-0.940	-0.941	-0.933	-0.693	-0.605
	(11.96)**	(11.36)**	(10.98)**	(9.90)**	(8.82)**	(8.83)**	(8.78)**	(5.56)**	(4.84)**
Frontier Governorates	-0.950	-0.938	-0.940	-0.888	-0.845	-0.843	-0.842	-0.658	-0.501
Ref. Urban Governorates	(4.28)**	(4.26)**	(4.32)**	(4.25)**	(4.30)**	(4.28)**	(4.25)**	(3.50)**	(2.72)**
Age group									
15-19		-0.460	-0.331	-0.248	-0.205	-0.205	-0.210	-0.192	-0.192
		(2.87)**	(1.99)*	(1.42)	(1.18)	(1.18)	(1.22)	(1.12)	(1.13)
25-29		0.302	0.248	-0.002	-0.025	-0.023	-0.022	-0.025	-0.070
		(3.87)**	(2.99)**	(0.02)	(0.28)	(0.26)	(0.24)	(0.28)	(0.77)
30-34		0.611	0.556	-0.007	-0.032	-0.028	-0.028	-0.053	-0.190
		(6.98)**	(5.57)**	(0.07)	(0.29)	(0.26)	(0.25)	(0.48)	(1.70)
35-39		0.683	0.639	-0.169	-0.155	-0.149	-0.142	-0.165	-0.351
		(8.03)**	(6.13)**	(1.51)	(1.36)	(1.29)	(1.22)	(1.42)	(2.91)**
40-44		0.707	0.667	-0.321	-0.298	-0.292	-0.280	-0.329	-0.538
		(7.32)**	(5.87)**	(2.55)*	(2.29)*	(2.24)*	(2.14)*	(2.53)*	(3.97)**
45-49		0.556	0.522	-0.640	-0.593	-0.589	-0.572	-0.623	-0.843
Ref. 20-24		(4.90)**	(4.00)**	(4.47)**	(4.09)**	(4.02)**	(3.88)**	(4.23)**	(5.56)**
Family composition									
1 boy			-0.126	-0.081	-0.203	-0.203	-0.206	-0.227	0.168
			(1.01)	(0.64)	(1.55)	(1.55)	(1.58)	(1.75)	(1.15)
1 girl			-0.343	-0.288	-0.407	-0.408	-0.410	-0.436	-0.033
			(2.75)**	(2.22)*	(3.16)**	(3.17)**	(3.18)**	(3.38)**	(0.22)
1 girl + 1 boy			0.296	0.162	0.060	0.060	0.059	0.038	0.157
			(3.25)**	(1.67)	(0.61)	(0.61)	(0.60)	(0.39)	(1.54)
2 boys			0.271	0.206	0.130	0.131	0.123	0.096	0.216

			(2.16)*	(1.61)	(0.98)	(0.99)	(0.93)	(0.73)	(1.59)
2 girls			-0.128	-0.175	-0.278	-0.277	-0.281	-0.309	-0.083
Ref. More than 3			(1.00)	(1.27)	(1.96)	(1.96)	(1.99)*	(2.20)*	(0.54)
Breastfeeding				-1.573	-1.583	-1.584	-1.583	-1.560	-1.554
Ref. not breastfeeding				(23.70)**	(23.57)**	(23.58)**	(23.64)**	(23.25)**	(22.98)**
Respondent's education									
Primary					0.179	0.178	0.133	0.079	0.084
					(2.29)*	(2.27)*	(1.65)	(0.97)	(1.03)
Secondary					0.439	0.445	0.380	0.247	0.260
					(5.84)**	(5.67)**	(4.51)**	(2.75)**	(2.87)**
Higher					0.352	0.367	0.295	0.100	0.134
Ref. No education					(2.47)*	(2.38)*	(1.86)	(0.60)	(0.79)
Respondent work status						-0.033	-0.031	-0.029	-0.024
Ref. No work						(0.36)	(0.34)	(0.32)	(0.26)
Partner has some education							0.147	0.087	0.093
Ref. partner no education							(2.11)*	(1.22)	(1.29)
Household wealth									
Ln household index								0.460	0.449
								(4.47)**	(4.31)**
Fertility preference									
Undecided									-0.265
									(1.95)
Want no more									0.633
									(6.42)**
Ref. have another									
Constant	1.489	1.006	1.026	2.208	1.991	1.989	1.909	1.073	0.622
	(20.27)**	(11.07)**	(9.06)**	(16.71)**	(14.41)**	(14.39)**	(13.48)**	(4.41)**	(2.37)*
Observations	9738	9738	9738	9738	9738	9738	9738	9738	9738

Note: Absolute value of t statistics in parentheses. * significant at 5%; **significant at 1 %.

Women with a secondary education have a higher probability of using contraception but this effect decreases after controlling for partner's education and living standards. Whether a woman is working or not does not make much difference to her use of modern contraception. Women with households belonging in the lowest economic quintiles are 15 per cent less likely to use contraception compare to women belonging to the richest quintiles[15]. Moreover, when the household asset variable is added to the model, the effect of residence in Upper Egypt on the probability of using modern methods of contraception decreases.

Looking at the results for all of Egypt, it seems that adding fertility preferences to the model does not change the effect of economic status, education, or women's participation in the labor market very much, but it does change the effect of age on the probability of using contraception. Once we control for fertility preferences, the effect of the place of residence diminishes and the effect of family composition disappear. This seems to suggest that fertility preferences are cultural things independent of socio-economic status, but related to the age, family composition and region effects. In order to clarify the effect of fertility preferences in explaining the geographical differential in contraceptive use we will present the results of the decomposition both for a model where we include fertility preference and also for a model without fertility preferences (see the Appendix to Chapter 3, Table A.3.1). Furthermore, for women who do not want any more children, the likelihood of using a modern contraceptive method increase by almost 15 percentage points compare with women who do want more children.

Finally, as previous studies have found (Gadalla, McCarthy and Campbell 1985; Yount, Langsten and Hill 2000) Egyptian family planning behaviour is characterized by gender preferences. However, the effect of gender preferences is no longer significant after controlling for fertility preferences. This does not means that the effect of gender preferences disappears, but that its effect is captured by the fertility preference variables. If we look at the results of the model without the

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[15] The asset index score has been introduced in the model as the natural logarithm of the factor score. Each value of the factor score has been add a value of 7 so each factor score will have a value above the zero to enable the calculation of the natural logarithm. For the estimation of the effect of living standard we consider the upper bound of the factor score for the lowest quintile (-2.63) and the lower bound of the factor score for the highest quintile (2.61), see Appendix A Table A.4.

fertility preferences variables for all of Egypt (Table 3.4, column 8), we could see that women having one girl are up to10 per cent less likely to use modern contraception than women having more than three children, and the same figure could be found for women having two girls.

3.6.2 Logistic regression models for major regional areas in Egypt.

Table 3.5 shows the results of the logistic model applied to the samples from the Urban Governorates, urban Lower Egypt, rural Lower Egypt, urban Upper Egypt, rural Upper Egypt and the Frontier Governorates separately. As expected, estimating the model to the regional samples we loose precision of the coefficient estimates due to the smaller sample in each major region.

Table 3.5: Results of logistic regression for each major regional area.

	Urban Governorates	*Lower Egypt Urban*	*Lower Egypt Rural*	*Upper Egypt Urban*	*Upper Egypt Rural*	*Frontier Governorates*
	(1)	(2)	(3)	(4)	(5)	(6)
Age Group						
15-19	-0.887	0.189	-0.252	0.993	-0.024	-0.624
	(1.75)	(0.35)	(0.92)	(1.48)	(0.07)	(0.49)
24-29	-0.121	0.237	-0.048	-0.208	-0.219	-0.413
	(0.45)	(0.97)	(0.31)	(0.72)	(1.29)	(1.19)
30-34	-0.493	-0.224	0.090	-0.175	-0.359	-0.306
	(1.70)	(0.81)	(0.39)	(0.40)	(1.91)	(0.79)
35-39	-0.271	-0.789	-0.383	-0.633	-0.153	-0.352
	(0.74)	(2.14)*	(1.77)	(1.52)	(0.73)	(0.92)
40-44	-0.660	-0.638	-0.574	-0.817	-0.397	-0.430
	(1.81)	(1.86)	(2.18)*	(1.61)	(1.70)	(0.94)
45-49	-1.302	-0.551	-0.384	-1.408	-0.862	-0.233
Ref. 20-24	(3.53)**	(1.40)	(1.27)	(2.93)**	(3.03)**	(0.39)
Family Composition						
1 Boy	0.557	-0.226	-0.069	0.302	0.039	0.806
	(1.50)	(0.54)	(0.23)	(0.59)	(0.15)	(1.44)
1 girl	0.145	-0.121	-0.274	-0.191	-0.078	1.083
	(0.40)	(0.33)	(0.87)	(0.40)	(0.28)	(1.26)
1 boy and 1 girl	0.099	-0.364	0.159	0.699	0.192	1.243
	(0.48)	(1.39)	(0.84)	(1.98)	(0.83)	(2.95)**
2 boy	0.144	0.169	0.008	0.028	0.645	0.245
	(0.51)	(0.43)	(0.04)	(0.07)	(2.08)*	(0.57)
2 girl	0.302	-0.183	-0.340	-0.285	-0.266	0.427
Ref. More than 3	(0.94)	(0.45)	(1.25)	(0.50)	(0.80)	(0.71)
Breastfeeding	-1.444	-1.255	-1.689	-1.548	-1.657	-1.684
Ref. not breastfeeding	(7.88)**	(7.04)**	(12.36)**	(7.67)**	(14.01)**	(7.74)**

	Urban Governorates	*Lower Egypt Urban*	*Lower Egypt Rural*	*Upper Egypt Urban*	*Upper Egypt Rural*	*Frontier Governorates*
Respondent's education						
Primary	-0.519	0.125	0.153	0.073	0.202	0.623
	(2.08)*	(0.50)	(0.91)	(0.30)	(1.44)	(2.00)
Secondary	-0.208	0.247	0.314	-0.175	0.656	0.506
	(0.83)	(0.73)	(1.79)	(0.70)	(3.93)**	(1.80)
Higher	-0.504	0.404	0.225	-0.030	0.943	0.199
Ref. no education	(1.27)	(0.96)	(0.66)	(0.07)	(2.15)*	(0.44)
Respondent working	-0.154	-0.043	0.078	0.121	-0.032	0.239
Ref. not working	(0.79)	(0.17)	(0.46)	(0.39)	(0.16)	(0.85)
Partner has some education	0.135	0.089	0.129	0.109	0.099	0.187
Ref. partner no education	(0.64)	(0.40)	(0.89)	(0.66)	(0.82)	(0.74)
Household wealth						
Log household index	0.563	-0.059	0.389	1.067	0.425	0.337
	(1.40)	(0.19)	(1.84)	(3.47)**	(2.56)*	(0.85)
Fertility Preferences						
Undecided	-0.383	-0.725	-0.427	-0.355	0.111	-0.608
	(1.08)	(1.83)	(1.49)	(0.96)	(0.46)	(1.37)
Want no more	0.726	0.529	0.414	0.565	0.852	1.313
Ref. have another	(2.45)*	(1.58)	(2.07)*	(2.16)*	(5.07)**	(3.36)**
Place of Residence						
Urban						-0.189
						(0.52)
Constant	0.761	1.837	1.165	-0.331	-0.189	-0.295
	(0.91)	(2.86)**	(2.60)*	(0.53)	(0.55)	(0.37)
Observations	1988	1239	2784	1017	2161	549

Note: Absolute value of t statistics in parentheses. * significant at 5%; ** significant at 1%.

Having a secondary education in rural Upper Egypt increases the chance of using contraception by almost 16 percentage points compared to women having no education, and having higher than secondary education in this area increases the risk of using contraception by almost 23 percentage points. In the Urban Governorates having a primary education decreases the likelihood of using contraception by almost 12 percentage points compared to not having an education. Possible explanations of this could be that in Urban Governorates women with education are either controlling their reproductive life with traditional methods, or that women with some types of education may use contraception to limit the family size but not to space, resulting in a lower take-up rate than those women with no education.

As far as fertility preferences are concerned, among women that want no more children living in rural Upper Egypt the probability of using a modern contraceptive method increases by almost 21 percentage points, whereas for women residing in the

Urban Governorates the probability increases by 18 percentages points; for all the other areas the increase is around 10-12 percentage points, compared with women who want another child. Son preference appears to be influential only in rural Upper Egypt where a family with two boys is more likely to use contraception (see column 5 in Table 3.5). The effect of household wealth is significant in urban and rural Upper Egypt and women belonging to the highest quintile are 8 per cent more likely to use contraception compare to women belonging to the lowest quintile in rural area, whereas in urban area they are 12 per cent more likely. Table A.3.1 in Appendix to Chapter 3 show the results of the models excluding fertility preferences.

3.6.3 Results of decomposition

The coefficients of the region-specific models have been used to apply the decomposition described earlier in Section 3.5. Table 3.6 shows the results of the decomposition. It should be noted that the predicted probability of Table 3.6 refers to the population at risk of using a modern contraceptive method. Many groups of non-users have been excluded, so the predicted probabilities presented in the table will be higher than the percentages of users of modern methods of contraception shown in Figure 3.2, as the latter are based on all currently married women aged 15 to 49.

Table 3.6: Average predicted probability of using a modern contraceptive method in the major regional areas in Egypt.

		Coefficients of					
		Urban Governorates	**Urban Lower**	**Rural Lower**	**Urban Upper**	**Rural Upper**	**Frontier Governorates**
Sample of	**Urban Governorates**	**0.82**	0.82	0.85	0.82	0.75	0.77
	Urban Lower	0.81	**0.82**	0.85	0.81	0.75	0.76
	Rural Lower	0.77	0.80	**0.80**	0.73	0.66	0.72
	Urban Upper	0.77	0.76	0.82	**0.76**	0.70	0.71
	Rural Upper	0.70	0.79	0.72	0.62	**0.55**	0.60
	Frontier Governorates	0.73	0.77	0.77	0.69	0.63	**0.63**

Table 3.6 shows the results of decomposition. Along the diagonal of the table above there are average predicted probabilities in each major regional area in Egypt. Off the diagonal going right or left there are the average predicted probabilities of each regional area when to the sample has been applied the coefficients of other regional areas. Down each column there are average predicted probabilities of being a user of modern methods applying the coefficients of one area to all other regional samples. For example, the predicted probability of being a user of modern methods in urban Upper Egypt is 76 per cent (in diagonal). Moving left along the same row shows that the predicted probability of a resident of urban Upper Egypt using contraception, applying to the sample of urban Upper Egypt the coefficient of rural Lower Egypt is 82 per cent.

Table 3.7 shows the results of the decomposition in a friendlier format. Between urban Lower Egypt and the Urban Governorates there is no difference in the use of modern contraception. This tells us that both the characteristics of population and the effect on the levels contraceptive use of those characteristics are the same for both regions. Elsewhere, *compensating effects* are found when comparing the Urban Governorates and rural Lower Egypt, urban Lower Egypt and rural Lower Egypt, and rural Lower Egypt and urban Upper Egypt. These *compensating effects* seem to suggest that rural Lower Egypt has a more ‘contraceptive friendly behaviour’, and the urban governorates, urban Lower Egypt and urban Upper Egypt have a more ‘contraceptive friendly composition’, resulting in no difference in the average predicted probability. However, if we look at the results of the decomposition between rural Lower Egypt and rural Upper Egypt, there is a 25 percentage point difference between the predicted probability of the two population and between 14 to 17 percentages point of those difference is due to differences in behavioural aspect, whereas around 8 to 10 points are due to differences in the characteristics of the population. We obtain a range of estimates as the decomposition are due to the fact that the decomposition can be done in either direction and can gives different results for a problem of index numbers.

Table 3.7: Result of decomposition.

	Coefficient of Urban Governorates	Urban Lower	Rural Lower	Urban Upper	Rural Upper	Frontier Governorates
Urban Governorates	**0.82**	No difference	*Compensating Effects*	All differences C	6-14 D 12-20 C	9-14 D 9-14 C
Urban Lower		**0.82**	*Compensating effects*	2-3 D 4-3 C	8-20 D 7-14 C	6-14 D 5-13 C
Rural Lower			**0.80**	*Compensating effect*	14-17 D 8-10 C	9-14 D 3-8 C
Urban Upper				**0.76**	5-6 D 14-15 C	5 D 8 C
Rural Upper					**0.55**	0-4 D 8-4 C
Sample of **Frontier Governorates**						**0.63**

Note: C: difference due to different characteristics of the population, D: difference due to different coefficient effect.

Looking again at the results of Table 3.6 and 3.7 we could see that the only comparisons where the behaviour dominates the difference are between rural Lower Egypt and rural Upper Egypt and rural Lower Egypt and the Frontier Governorates. This seems due to the 'contraceptive friendly behaviour' of rural Lower Egypt's population.

Another interesting result is shown in Table 3.8, which illustrates the results of the decomposition for the gaps in contraceptive use between Upper and Lower Egypt for their rural and urban areas.

Table 3.8: Decomposition of the gap between rural and urban areas in Egypt.

	Rural Lower Egypt and rural Upper Egypt	**Urban Lower Egypt and urban Upper Egypt**	**Urban Governorates and urban Upper Egypt**
Gap in contraceptive use between:	25 percentage points	6 percentage points	5 percentage points
C: gap and proportion explained by differences in characteristics of population	8-10 percentage points (32-40 %)	3-5 percentage points (50-83 %)	None
D : gap and proportion explained by different coefficients	15-17 percentage points (60-68 %)	1-3 percentage points (17-50 %)	5 percentage points (100 %)

Note: The decomposition has been applied as described earlier in the method section, but it could also have been applied adding and summing the other sample, which would give slightly different results because of the index number problem.

The comparisons between the Frontier Governorates and the other governorates areas need to be carefully interpreted as the sample in the Frontier Governorates is small (549 observations) and includes both urban and rural areas. In Table 3.8 the results of the decomposition between the frontier governorates and all other major area in Egypt are, for these reasons omitted. Furthermore, the decomposition between the urban governorates and urban Lower Egypt is omitted as we can see from Table 3.7 that there appear to be no differences either in characteristics or in coefficient effects between those two areas.

In Table 3.8, the differences between urban and rural areas are due to different aspects. The differences between rural areas of Upper and Lower Egypt are explained one third by different characteristics of the population and two thirds by the different coefficient effect. On the other hand differences between urban areas in Lower and Upper Egypt are more than a half explained by differences in the characteristics of the population and less than a half by differences in coefficient effects in the two areas. Differences between the Urban Governorates and urban Upper Egypt are entirely explained by differences in population characteristics. Those results are also confirmed if we repeat the decomposition for the model which excludes the fertility preference variables (Table A.3.2 in Appendix to Chapter 3).

3.7 Conclusion

Contraceptive use levels in Egypt are characterise by a strong regional differentials, and despite two decades of strong effort from the State Information Service to promote Family Planning, not much improvement has been recorded in some areas of the country. The gaps in contraceptive use in those areas need to be properly addressed if the government's goal of replacement levels of fertility by 2016 is to be considered a realistic attainment considering both the problem of population pressure (UNDESA 2002) and the restrictive funding for family planning service that will be available in the future (Moreland 2000). In the light of these condition it will became necessary to target the effort in order to make the most effective use of the resources available. This emphasises the need to understand the status quo of contraceptive prevalence in each major area, and to clarify the reasons behind the geographical differences in contraceptive use.

This analysis tries to answer the question why some areas in Egypt are less receptive to change than other areas, comparing the population characteristics as well as the effect of those characteristics of the level of contraceptive use. The paper finds that one third of the differential between rural areas, and half the differentials between urban areas, are due to the composition of the population, with the reminder being attributable to differences in the behaviour of 'similar' persons.

The results of this study shows that differences between rural areas of Egypt are only for a third due to the composition of population and for two third explained by differences in behavioural aspects and difference in contraceptive level in urban areas are for half due to characteristics and for the other half are due to behavioural aspect.

The results of this study suggest that both characteristics of the population and non-compositional and behavioural factors play a role in explaining the regional differences in contraceptive prevalence in Egypt. Amongst the population characteristics education and household wealth have a positive effect on contraceptive use mainly in Upper Egypt, suggesting the presence of a subgroup of Upper Egyptian population which present more developed characteristic in term of wealth and education to the rest of the population of the region which place them in a position more receptive to change.

The results also suggest that the population of rural Lower Egypt has extremely contraceptive friendly behaviour compare to the other regions, whereas Urban Governorates, urban Lower Egypt and urban Upper Egypt have more contraceptive friendly composition. Furthermore, these results do not change with the inclusion of fertility preference amongst observable characteristics, suggesting that the geographical differences in contraceptive use behaviour are not related to the regional differences in fertility preferences.

Furthermore the results of this study show that in order to raise the contraceptive prevalence in rural Upper Egypt population policies in Egypt should be developed regionally, and specific and appropriate policies need to be developed for low prevalence areas like rural Upper Egypt. This study suggest that if behaviour as well as quality of service (those unmeasured factors) were to be change in rural Upper Egypt as those of rural Lower Egypt the contraceptive prevalence the gap between rural area will close up more than fifty per cent.

3.8 Appendix Chapter 3

Table A.3.1: Results of logistic regression for each major regional area in Egypt without fertility preferences variables.

	Urban Governorates	*Lower Egypt urban*	*Lower Egypt rural*	*Upper Egypt urban*	*Upper Egypt rural*	*Frontier Governorates*
	(1)	(2)	(3)	(4)	(5)	(5)
Age Group						
15-19	-0.935	0.243	-0.290	0.983	-0.007	-0.610
	(1.91)	(0.46)	(1.04)	(1.48)	(0.02)	(0.46)
25-29	-0.112	0.246	-0.029	-0.188	-0.143	-0.438
	(0.42)	(1.01)	(0.19)	(0.64)	(0.87)	(1.29)
30-34	-0.369	-0.173	0.183	-0.092	-0.158	-0.086
	(1.25)	(0.68)	(0.82)	(0.20)	(0.87)	(0.22)
35-39	-0.096	-0.700	-0.268	-0.466	0.102	0.126
	(0.27)	(1.91)	(1.28)	(1.11)	(0.52)	(0.33)
40-44	-0.460	-0.522	-0.455	-0.594	-0.107	0.033
	(1.33)	(1.65)	(1.76)	(1.18)	(0.47)	(0.06)
45-49	-1.073	-0.428	-0.256	-1.168	-0.553	0.393
Ref.20-24	(2.95)**	(1.20)	(0.86)	(2.44)*	(1.99)*	(0.63)
Family Composition						
1 Boy	0.048	-0.597	-0.315	-0.042	-0.457	0.223
	(0.15)	(1.58)	(1.32)	(0.10)	(1.84)	(0.50)
1 Girl	-0.348	-0.490	-0.537	-0.508	-0.605	0.422
	(1.12)	(1.45)	(2.12)*	(1.38)	(2.28)*	(0.53)
1 boy and 1 girl	0.073	-0.423	0.050	0.557	-0.041	0.987
	(0.35)	(1.69)	(0.29)	(1.67)	(0.17)	(2.25)*
2 boy	0.077	0.054	-0.087	-0.043	0.428	-0.142
	(0.28)	(0.14)	(0.40)	(0.11)	(1.53)	(0.44)
2 girls	0.129	-0.312	-0.535	-0.565	-0.662	0.001
Ref. More than 3	(0.43)	(0.75)	(2.17)*	(1.07)	(2.26)*	(0.00)
Breastfeeding	-1.417	-1.289	-1.687	-1.565	-1.674	-1.680
Ref. No Breastfeeding	(7.91)**	(7.27)**	(12.35)**	(7.68)**	(14.16)**	(8.10)**
Respondent's education						
primary	-0.481	0.124	0.158	0.037	0.197	0.712
	(1.95)	(0.49)	(0.93)	(0.16)	(1.42)	(2.14)*
secondary	-0.173	0.235	0.297	-0.185	0.632	0.348
	(0.70)	(0.70)	(1.68)	(0.74)	(3.95)**	(1.19)
higher	-0.480	0.349	0.201	-0.025	0.807	-0.014
	(1.24)	(0.84)	(0.59)	(0.06)	(1.93)	(0.03)
Respondent's work	-0.140	-0.054	0.072	0.098	-0.029	0.317
Ref. No work	(0.72)	(0.21)	(0.42)	(0.32)	(0.14)	(1.10)
Partner some education	0.098	0.080	0.111	0.134	0.098	0.357
	(0.46)	(0.36)	(0.77)	(0.84)	(0.82)	(1.57)
Ln of PCA score	0.507	-0.045	0.412	1.037	0.443	0.477
	(1.32)	(0.15)	(1.92)	(3.43)**	(2.73)**	(1.12)
Place of Residence						
Urban						-0.114
						(0.30)
Constant	1.404	2.238	1.423	0.043	0.328	-0.035
	(1.86)	(3.62)**	(3.69)**	(0.07)	(1.06)	(0.05)
Observations	1988	1239	2784	1017	2161	549

Note: Absolute value of t statistics in parentheses. * significant at 5%; ** significant at 1%.

Table A.3.2: Average predicted probability in the major regional area in Egypt without fertility preferences variables in the model.

		Coefficient					
		Urban Governorates	**Urban Lower**	**Rural Lower**	**Urban Upper**	**Rural Upper**	**Frontier Governorates**
Sample of	**Urban Governorates**	**0.82**	0.82	0.85	0.81	0.74	0.74
	Urban Lower	0.81	**0.82**	0.85	0.79	0.73	0.73
	Rural Lower	0.78	0.81	**0.80**	0.72	0.64	0.67
	Urban Upper	0.79	0.81	0.82	**0.76**	0.70	0.70
	Rural Upper	0.72	0.77	0.73	0.62	**0.55**	0.56
	Frontier Governorates	0.76	0.80	0.79	0.70	0.64	**0.63**

Note: Along the diagonal of the table above there are average predicted probabilities in each major regional area in Egypt. Off the diagonal going right or left there are the average predicted of each regional area when to the sample has been applied the coefficient of other regional area. Along each column there are average predicted probabilities of being a user of modern methods applying the coefficient of one area to all other regional sample.

3.9 References Chapter 3

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Chapter 4

Effect of Modernization on Desired Fertility in Egypt

ABSTRACT

Using a conceptual framework that borrows notions both from the economic theory of fertility and social interaction theory, this paper assesses the relative importance of social and economic modernization at the individual and community level in explaining geographical differentials in desired fertility in Egypt. Using the 2000 Egyptian Demographic Health Survey and an up-to-date map of land cover in Egypt, this paper provides an application of an advanced methodology which uses a combination of multilevel modeling and Geographical Information System (GIS) techniques. The paper shows how the GIS techniques facilitate the construction of several variables representing the level of economic modernization such as land use, road density and urbanization. This study also analyses the effect of current family composition on desired fertility in Egypt and reveals the desire of Egyptian society to have at least two children and at least one boy.

4.1 Introduction and background to the study

After the 1980 Egyptian World Fertility Survey (EWFS) a series of studies designed to look at the salient features of diversity in patterns of demographic preferences and fertility behaviour in Egypt was conducted through collaboration between the Central Agency for Public Mobilization and Statistics (CAPMAS[1]), the World Fertility Survey (WFS) and the World Bank (WB). These studies found strong regional differences between Upper and Lower Egypt in fertility levels, contraceptive use and patterns of desired fertility (Hallouda, Farid and Cochrane 1988). Easterlin *et al.* (1988) looked at the effects of modernization on the demand and supply side of fertility considering a range of individual-level modernization variables, mainly education level, husband's occupation, and wife's work experience. They found that modernization variables played a more important role in explaining differences in demographic behaviour than cultural variables, and among the modernization variables, education was by far the most important. Using data from a parallel community survey to the WFS, Casterline and Eid (1988) looked at the effect of community characteristics on desired fertility and found that substantial variation between communities still existed after controlling for individual-level characteristics. They found that village setting influenced the motivation for a small family size and non-agricultural economic opportunity and modernization of agricultural practice were hypothesized to transform the role of children, and as a consequence the value placed on them.

In subsequent decades other studies have confirmed the persistence of marked geographical differentials in desired fertility between urban and rural areas of Lower and Upper Egypt (El-Zanaty and Way 2001; Osheba and Cochrane 1988; Zaky 1995). According to the 2000 Egyptian Demographic and Health Survey (EDHS), urban women express a desire to limit family size at lower parities than rural women. For example, 69 per cent of urban women with two children want to stop childbearing, compared with 48 per cent of rural women with two children (Table 4.1). Women living in the frontier governorates and rural Upper Egypt are generally the least likely to want to limit childbearing. More than half of married women with two children in the Urban Governorates, in urban areas in Upper and Lower Egypt, and in rural

[1] The Egyptian statistical agency.

Lower Egypt want no more children, but only one in three women with two children in rural Upper Egypt (El-Zanaty and Way 2001).

Table 4.1: Desire to limit childbearing. Percentages of currently married women who want no more children, by number of living children and selected background characteristics, Egypt 2000.

	Number of living children [1]							
	0	1	2	3	4	5	6+	Total
Urban-Rural Residence								
Urban	0.9	8.2	68.8	87.9	91.6	91.0	93.1	66.9
Rural	1.2	7.0	48.3	76.8	88.3	91.3	92.4	64.2
Place of Residence								
Urban Governorates	1.5	10.0	76.6	91.6	90.1	94.8	93.9	69.2
Lower Egypt	1.5	8.3	61.7	88.1	95.6	94.8	96.5	69.4
urban	0.0	7.6	70.6	90.0	95.4	96.8	97.7	69.9
rural	2.0	8.6	57.4	87.2	95.6	94.3	96.3	69.2
Upper Egypt	0.4	5.1	40.5	67.1	80.9	86.9	90.2	58.8
urban	0.4	5.6	51.9	79.1	89.4	82.7	90.6	60.6
rural	0.4	4.8	31.9	59.1	77.2	88.6	90.1	58.0
Frontier Governorates	1.4	5.5	32.0	57.7	78.8	77.5	83.1	52.3

Sources: (El-Zanaty and Way 2001), Table 9.3. p. 113.
[1] Includes current pregnancy.

Recent years have witnessed a growing recognition of the importance of contextual influences on demographic behaviour (Clements *et al.* 2004; DeGraff, Bilsborrow and Guilkey 1997; Entwisle, Casterline and Sayed 1989; Hirschman and Guest 1990; Madise and Diamond 1995). However, few studies have looked at contextual effects and more specifically the effects of modernization on desired fertility (Casterline and Eid 1988). Several studies have found that fertility intentions are a good predictor of subsequent fertility behaviour (Bankole 1995; Tan and Tey 1994) and that studies of the determinants of desired fertility can help in predicting not only future fertility but also contraceptive use.

This study intends to look at both the contextual and the individual-level effects of modernization on fertility intentions. In the next subsection, the definition of modernization used in this study is illustrated and the relationship between aspects of modernization and individual fertility behaviours elaborated. Section 4.2 introduces the conceptual framework used in this study, Section 4.3 presents the data, Section 4.4 illustrates the sample selection and methodology, Section 4.5 presents the major results, Section 4.6 discusses the major results and Section 4.7 concludes the chapter.

4.1.1 Modernization and its effect on individual fertility behaviour

Various authors have provided definitions of modernization, but a review of the literature reveals there is no standard definition. Modernization is rather a multivariate phenomenon, incorporating economic, social and political characteristics. In common with much of the literature, this paper will consider the term 'modernization', to be interchangeable with the term 'development', and will consider two major aspects of modernization: economic modernization and social modernization.

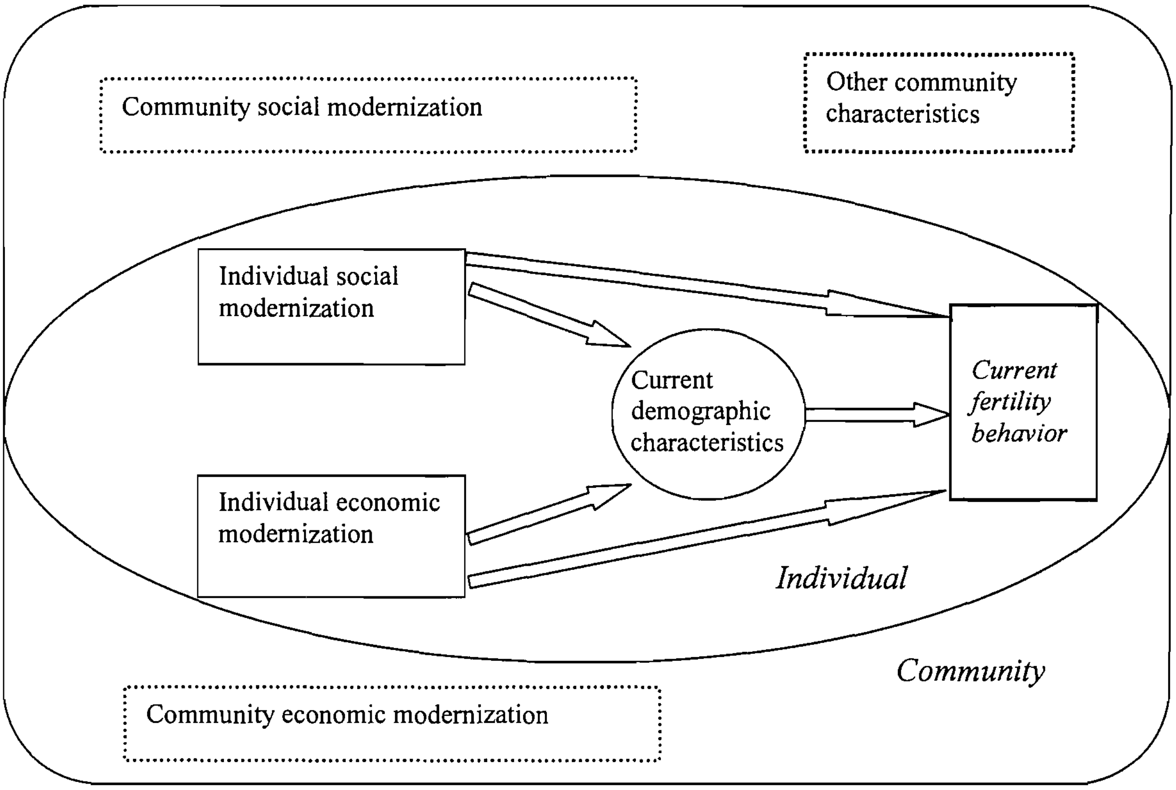
Easterlin (1983:645) defines economic modernization as 'a transformation in economic, social, and political organization. On the economic side, this transformation involves a sustained rise in real output per capita. It encompasses wide-ranging changes in techniques of producing, transporting, and distributing goods; in the scale and organization of productive activities; and in types of output and inputs. It embraces major shifts in the industrial, occupation, and spatial distribution of productive resources and in the degree of exchange and monetization of the economy'. In this paper economic modernization will considered as referring to all economic aspects that characterise modernization. For this reason the present definition of economic modernization is narrower than the one proposed by Easterlin (1983) as aspects as political and social modernization will be not included. Economic modernization as here defined is characterised by a rise in real income per person, an improvement in the economic subsystem of the society which includes the consumption, production, and distribution of goods and services, and improvement in transportation. It refers to 'industrial well being', and the growth and efficiency of the economy. Economic modernization will also be considered as referring to increases in employment opportunity through getting new business relocated in a community or the expansion of existing businesses. In less industrialized regions, economic modernization is also believed to be achieved by an increase in industrial production and relative decline in the importance of agricultural production.

By social modernization I mean a major improvement in social structure, the enhancement of women's status, and an increased level of education. Social modernization encompasses a commitment to individual well being and volunteerism, and the opportunity for citizens to determine their own needs and to influence decisions which affect them. It also refers to an increased openness to new experience, increased independence from parental authority, and reductions in the functions of the family and kinship groups. In other words social modernization is what Inkeles and Smith (1974) consider as the phenomenon of transforming a society with traditional values to a society of modern values and the associated behavioural changes.

Both social and economic modernization potentially have effects at the individual and contextual-community level. Social modernization refers to the enhancement of social structure in terms of a higher educational level, women's status, and social development. At the individual level this has an effect on individual autonomy, specifically through attenuating the influence of family and kinship groups; it can translate into work opportunities and can help to increase the reception of new ideas. At the community level it increases the community's social capital, which can in turn have the effect of increasing community wealth. Economic modernization results in enhancement of the economic wealth and per capita income both at individual and contextual levels. At the contextual level it can change the economic system both in terms of the mode of production and exchange, and through the development of a non-agricultural market sector. At the individual level economic modernization instigates a restructuring of employment sectors, which will enhance work opportunities, resulting in an effect on per capita income.

Individual fertility behaviour is influenced directly by individual demographic characteristics, and both individual social and economic modernization (see Figure 4.1). The community in which the individual lives influences the effect of individual characteristics and individual social and economic development on fertility behaviour. For example, it might be hypothesized that the strength of the effect of social and economic modernization changes according to the community where an individual lives. For example, in communities where an industrial type of production prevails the individual level of social modernization (measured for example, by a woman's status), and the individual level of economic modernization (represented, for example, by individual/household wealth) might influence individual fertility behaviour in a manner, and to an extent, different from that in a community which is less 'modern' and where, for example, agriculture is the major mode of production.

Figure 4.1: Community and individual influences on of fertility behaviour.



In the literature there have been few studies (Easterlin *et al.* 1988) which have conceptually separated these two aspects of modernization and their effect on fertility behaviour and no study has looked at their individual and community role. The two aspects of modernization are likely to be interlinked and highly correlated with each other, hence the lack of attempts in the literature to disentangle their separate effects, even though in terms of policy implication they do not necessary imply similar action. If economic modernization appears to have a stronger effect on fertility in a certain area than social modernization, then policies that tend to promote economic investment or improvement in infrastructure will probably result in a stronger reducing effect on fertility than policies that promote women's education. If aspects of social modernization appear to be more important for fertility behaviour, then policies that promote the education and status of women and enhance women's work opportunities will have more impact on fertility.

To summarise this paper assesses the relative importance of social and economic modernization at the individual and community levels in explaining geographical differentials in desired fertility in Egypt. It analyses how important are community effects in explaining geographical differentials in the decision to have another child. The paper conceptually separates the effects of social modernization and economic modernization on desired fertility, and analyses which aspect plays the major role in explaining geographical differences in desired fertility in Egypt.

4.2 Conceptual framework

This chapter looks at the role of modernization on the demand side of fertility which is defined as 'the number of living children parents would want if fertility regulation were costless' (Easterlin 1975:55). In the literature there are two possible measures of the demand of fertility, one refers to the ideal number of children parents want given their current family size and the other measure refers to the desired or not for another child given again the current family size. The desired for another child is a static measure of demand and it is a reliable indicator of current fertility preference for this reasons we prefer it to the ideal number of children the parents want. There are two main reasons why we prefer the desired for another child as oppose to the number of children the parent want. Firstly, the number of children parents want is often inconsistent with the actual family size, questions about the desired number of children could produce responses in which women's desired number was fewer than the number they already had. Secondly, the number of children parents would want is related to tastes and economic circumstances which are likely to change over time (Bongaarts 1992; Bulatao and Lee 1983) and the survey does not contains, detailed information on incomes and fertility preferences over time which could allow us to control for changing in circumstances. Therefore, we limit the analysis to the desire or not for additional children at the survey date.

Several authors have recognized that modernization and development have an effect on the demand for children (Bongaarts and Watkins 1996; Bulatao and Lee 1983; Easterlin 1983), reducing fertility from high to low levels. Modernization has been often associated with countries in their fertility transition (Bongaarts and Watkins 1996; Easterlin 1983). However, a number of studies have shown that the economic theory of fertility alone is not enough to explain the process of fertility transition across countries and within countries. Bongaarts and Watkins (1996) suggest that differences between countries and within countries in their fertility level might be due to differences in the distribution of channels of social interaction. In other words, despite similar levels of modernization or development, one region might proceed faster in its fertility reduction because of the multiplicity of channels of social interaction that connect communities within a country. Furthermore, the social interaction within a community will affect the perceptions of the costs and value of children, and these influence both the individual and the community's relative price of children compared to other goods and strength of tastes for goods relative to children. The social interaction theory would therefore help in explain the formation of tastes (Easterlin 1975).

The conceptual framework I use to study the role of modernization on the demand side of fertility borrows notions both from the economic theory of fertility as defined by Easterlin (1975) and from social interaction theory or diffusion theories (Bongaarts and Watkins 1996; Cleland 2001). As has been previously suggested by Easterlin (1975) those theories are likely to be both relevant in explaining the fertility transition, as 'the real world process would inevitably be characterized by timing differences between various groups in the population'(Easterlin 1975:62). As he proposed a 'needed extension of fertility theory is to take explicit account of the diffusion processes'(Easterlin 1975:62). This paper will uses both of those theories as we believe that they are not mutually exclusive and both can be applied in order to gather more understanding of the role of modernization in changing fertility behaviour.

According to the economic theory of fertility (Becker 1960, 1991; Easterlin 1975) the demand for children is determined by the interplay between tastes for children and constraints on couples. According to Easterlin (1975:55) there are three immediate determinants of fertility: the demand for children, or 'the number of surviving children parents would want if fertility regulation were costless'; the potential output of children, or the 'number of surviving children parents would have if they did not deliberately limit fertility'; and the cost of fertility regulation. In this paper we will concentrate on the demand for children. Easterlin defines as the immediate determinants of the demand for children incomes, prices of other goods relative to children, and tastes by which norms regarding family size and 'quality' of children (standard of child care and rearing) operate. A couple is assumed to have some preference between children and other goods, including consumer durables and leisure. 'Preference for children is constrained by the resources available to the couples as income and time, combined with the relative prices and time-intensities of children and other goods'(Bulatao and Lee 1983:6). Evaluating these constraints requires attention to the direct economic benefits and costs of children (Caldwell 1983), and the value placed on them by every couple becomes a salient determinant of future desired fertility. According to Easterlin (1975) the process of modernization influences fertility behaviour by altering the 'nature of the problem, from one to having too few to one having too many' (Easterlin 1975:62), in other words from a situation where childbearing is 'taken for granted' (Easterlin 1975:62) to one where couples take decisions on fertility limitation.

The way in which modernization affects demand depends on the stage of development. In the early stages of development, an increase in fertility has been observed in some societies which Easterlin (1975) relates to an 'income effect' due to relaxing of the budget constraint, so that couples are able to 'afford' both more children and more other goods. In the later stages of development, however, the other two determinants also change as the price of children rises relative to other goods and tastes alter (especially the quality-quantity trade off).

Bongaarts and Watkins (1996:657) argue that social interaction 'includes the active evaluation and transformation of new information and ideas by peers' and suggest three salient aspects which characterize it. First, social interaction involves exchanges of new ideas; second, it involves a sharing of information and its joint evaluation within a local context; and third it refers to social influence, where perceptions of the views of others affect a person's own behaviour. The diffusion of ideas is then a implication of the process of social interaction which Bongaarts and Watkins (1996:656) define as 'the process by which innovation spreads among regions, social groups, or individuals, often apparently independently of social and economic circumstances'.

I believe that both the economic theory of fertility and social interaction theory might help to explain geographical differences in desired fertility in Egypt. Where the level of modernization does not completely explain the differences, the social interaction theory helps to fill in the gap. As Ermisch (2003:239) suggested that 'social influence captures the possibility that a person's preferences may be altered by those with whom the person interact', hence social influence might directly affect the perception of prices. Despite an increased level of modernization, certain changes in fertility behaviour will not occur if channels of social interaction are not efficient.

Figure 4.1 displays the pathways by which individual and community modernization affect individual fertility behaviour. The effect of individual modernization on fertility behaviour operates both through the individual demographic characteristics and directly. In other words, part of the effect of individual modernization is conditional on the individual demographic characteristics and part of this effect operates directly on fertility behaviour. Community modernization is hypothesised to influence the effect of the individual characteristics (both demographic and socio-economic). In the context of the economic theory of fertility, individuals living in a community with a higher level of modernization (in both its economic and social aspects) will see an increase in the opportunity costs of having a child as the relative price of children compared to other goods increases. According to social interaction theory, community interactions affect the perception of those perceived changes. Thus, social interaction theory explains the community variation in fertility behaviour which is not explained by socio-economic individual and community characteristics.

To consider a few aspects of both social and economic modernization, the next section outlines possible effects that modernization indicators could have on the demand for another child using both the economic theory of fertility and social interaction theory.

Increase of the level of education

According to the economic theory of fertility, an increase in the level of education tends to reduce the demand for children by shifting tastes in a manner unfavourable to children and decreasing the price of goods relative to children (Lindert 1983). Moreover, better education and modernization improve the income-earning possibilities of women, and the opportunity cost of the mother's time required for child-rearing is increased. Furthermore, education may lead to higher standards with regard to child care and rearing, creating more emphasis on the quality of children at the expense of the quantity. According to social interaction theory a higher level of education might increase the level and the range of channels of interaction. It might increase the frequency with which individuals interact together both directly or though its effect on work opportunity. For women, a higher level of education might mean a higher freedom of movement and increased autonomy, resulting in greater opportunities to exchange ideas.

Urbanization

According to the economic theory of fertility, urbanization reduces the demand for children by reducing tastes and lowering the price of goods relative to children. The relative price of children of a given 'quality' is usually higher in urban areas than rural areas (Cochrane 1983; Lindert 1983). Urbanization, therefore, increasingly places the population in an environment where goods become relatively less expensive than children, and (other things being equal) more attractive (Easterlin *et al.* 1988). For the social interaction theory, urbanization augments the channels of social interaction by facilitating physical interaction though an improved transport network and enhanced work opportunities which promote communication between colleagues in the workplace.

In this study I will account for both individual demographic and socio-economic characteristics at the individual level, and community social and economic modernization using a range of contextual data sources. I will analyse, after controlling for demographic characteristics, how individual socio-economic modernization influences desired fertility in Egypt according to the economic theory of fertility. The unexplained community and governorate-level variation that remains after controlling for individual level characteristics will be then estimated. I will test if the effect of both social and economic modernization variables changes by community. I will then select a range of contextual variables available at different levels which represent social and economic modernization and see how those variables help in explaining the variation at contextual level and assess how much social rather than economic modernization helps in explaining the regional differences. The results will be interpreted using both economic theory of fertility and social interaction theory. We will not directly measure social interaction with in each community as the available data do not provide enough information to allow us to capture the complex phenomena of social interaction. However, we will interpret the results considering the level of social interaction as part of our unobserved component.

4.3 Data

The data used in this study are: (1) the individual and household questionnaires of the 2000 Egyptian Demographic and Health Surveys (EDHS); (2) information about Global Positioning System (GPS) locators for primary sampling units (PSUs) in the survey obtained by DHS Measure Macro International ORC Macro, (3) governorate-level indicators available in the 2003 Egypt Human Development Report (Saad 2003) based on estimated values for 2001, 4) a map of landcover for Egypt obtained from the Africover project from the Food Agricultural Organization (FAO) which is called Spatially Aggregated Multipurpose Landcover databases, and (5) a road map for Egypt also available from the Africover project.

The 2000 EDHS is a nationally representative three-stage probability sample of 15,573 ever-married women aged 15-49 years. In recent years Demographic and Health Survey (DHS) data have included information about Global Positioning System (GPS) locators for primary sampling unit (PSUs) in the survey. This new information allows the linking of other contextual data sources to the DHS data.

The locations of PSUs were obtained by DHS Measure Macro International ORC Macro. They were collected using the Global Positioning System locators (Montana and Spencer 2001). The information of PSUs locations together with a map of land use and road infrastructure for Egypt allow the construction and the linking of contextual data sources to the DHS survey data.

The map of land cover, the so-called Spatially Aggregated Multipurpose Landcover databases (which are a spatially reaggregated version of the original national Africover Land cover multipurpose database) were obtained from the Africover project from the FAO (Di Gregorio 2003). They were available in an ArcView 8.2 (© ESRI International) shapefile, which is a format for storing geometric location and associated attribute information. The road map (also obtained from Africover project) where available as an ArcView 8.2 layer (a logical set of thematic data described and stored in a map library). Both the land use shapefiles and road layers were produced by the FAO project from visual interpretation of the digitally enhanced LandSat TM images (Band 4, 3, 2) acquired mainly in the years 1997. The land cover classes have been developed using the Food and Agricultural Organisation and United Nations Environmental Project (FAO/UNEP) international standard Land Cover Classification System (LCCS)[2].

The digital map for Egypt which has been used in this chapter it uses the aggregate classification of LCCS develop by the Africover project from FAO as access to disaggregated classification was not provided by the national focal point in Egypt. If this access had been granted, the GIS analysis of the land use could have allowed a more precise definition of environmental data and hence a more detailed scrutiny of the relationship between our independent variable and those contextual variables derived through the GIS analysis.

In the next section I illustrate the method used in this study and explain the model applied to the data. I describe how information from the DHS are used as well as how the GIS maps of Egypt are used to construct several contextual variables related to different aspect of modernization.

4.4 Methods

In this paper multilevel modelling techniques and Geographical Information Systems (GIS) are used to examine the role of contextual variables representing social and economic modernization in explaining geographical differentials in the desire for another child in Egypt. The GIS techniques allow the construction of several variables indicating levels of economic modernization in terms of land use, representing the extent of the agricultural and non-agricultural market sectors in a community, the road density and the degree of urbanization (see the section on contextual data). The multilevel modelling technique not only allows us to accommodate the hierarchical nature of the data, but it corrects the standard errors to

[2] See the following web site for technical details of procedure used to construct Africover maps http://www.africover.org/tech_insight.htm

allow for the clustering within each area unit (Goldstein *et al.* 1998) and facilitates the identification of area-level random effects that often remain even after controlling for a range of individual, household and community factors. The area-level variation (random effect) will allow us to assess how the contextual effects of social and economic modernization affect the desired fertility in Egypt.

A three-level hierarchy in the data has been considered: individual/household, PSU, and governorate. At the first level I only consider the individual level responses as there were too few women per household to allow for separate household level estimates. Two levels of aggregation have been used, the PSU which represent villages; and governorates which are the administrative district. These two levels refer to two important characteristics of the environment: the local community where individual lives and the administrative structure and quality or types of services provided. The PSUs define the community context which refers to village, it represents the local environment whereas the governorates represent the unit of administration and implementation of state policies. Each governorate is headed by a governor who is appointed by the president. Furthermore, the local governments are responsible of providing services in the each governorate.

In order to analyze which aspects of modernization helps more in explaining the geographical variation in desired fertility in Egypt a three-level logistic model has been applied which is written as:

$$\log_e(\pi_{ijk}/(1-\pi_{ijk})) = \alpha + \beta_k X_{ijk}^T + U_{jk} + V_k + \varepsilon_{ijk}.$$

Where π_{ijk} denotes the probability of wanting another child and $(1-\pi_{ijk})$ the probability of not wanting another child for individual *i* in PSU *j* in governorate *k*. The variance of the individual residual term ε_{ijk} is constrained to be one and the term is normally distributed. The outcome variable $\log_e(\pi_{ijk}/(1-\pi_{ijk}))$ fitted in the model is the log-odds of wanting versus not wanting another child. The variance of the residuals is constrained to follow a binomial variance of π_{ijk} $(1-\pi_{ijk})$.

The parameter α is a constant, whilst β_k is the vector of parameters corresponding to the vector of potential explanatory factors defined as X_{ijk} . β_k will be initially assumed not to vary by governorates (a random intercept model).

Subsequently, to allow for the fact that some of the women's characteristics might have different effect on desired fertility accordingly to the governorates where they live, β_k will be allowed to vary by governorate (giving a random slope model). The PSU (level 2) residual term is defined as $U_{jk} \sim N(0, \sigma_u^2)$, and the governorate (level 3) residual term is defined as $V_k \sim N(0, \sigma_v^2)$. A final assumption is that the there is no covariance between U_{jk} and V_k, or between either of these and the individual-level error term ε_{ijk}.

The models are estimated using MLWin software which allows the calculation of the residual variance remaining after the model fitting. The design of the EDHS is accounted for by including the factors used in stratifying the sample either as covariates or as levels in the model. However, the analysis is not weighted as this can potentially bias random effects in multilevel models (Brown, Madise and Steel 2002). Thus the design of the survey was accounted for by the levels of the multilevel model and by either urban-rural residence.

The dependent variable is a categorical binary variable denoting whether or not a woman wants another child at the time of the survey, which takes the value of 1 for women who want another child and 0 otherwise. Despite studies which have looked at the demand for children stressing the importance of considering both husband's and wife's responses on desired fertility, the 2000 EDHS did not collect information about husband's desired fertility, so we cannot compare the two responses. Previous studies of Egypt, however, have found that husband's preferences do not have a significant effect on their wives' preferences (Cochrane, Ali Khan and Osheba 1990).

Currently married women aged 15-49 with at least one child who were fecund, not sterilized and not pregnant were selected for the analysis, comprising a total of 10,116 women, which resides in 499 PSUs and 26 governorates.

Individual level variables. In order to capture the effect of modernization variables on the desire for another child we control for a set of individual demographic variables such as age, and family composition and place of residence. Previous studies have found an effect of gender preference on contraceptive use and fertility in Egypt (Yount, Langsten and Hill 2000), though no one study has looked at the effect of family composition on desired fertility. In this study we will look at the desired fertility conditional on current family composition. We control for a set of variables which potentially captures the value placed on children or the potential opportunity cost of having an extra child: ownership of land, whether the husband is self-employed in agriculture, the woman's current work status and the respondent's educational level. The ownership of land has been previously found in other countries to be positively associated with fertility, and could capture the household's need for child labor which is a practice recorded in Egypt cotton fields and other agricultural areas (Human Right Watch 2001). The same could be said about the husband's employment in agriculture, which might also be a proxy for the value placed on children by the household. Another variable which could capture an aspect of the cost for children (in terms of the opportunity cost of an extra child) is the respondent's current work status. If a woman is employed, her opportunity cost of having another child might be higher due to her loss of future earnings because of childbearing and child rearing. The same could be said about the respondent's educational level, but this time instead of capturing the loss in earnings we could capture her diminished future earning potential. The model also accounts for previous experience of child death because according to the economic theory of fertility the demand for another child could be directly affected by the survival prospects of children, and previous experience of child death affects the individual perception of survival probability. Easterlin (1975:55) notes that 'even though tastes, prices and income remain unchanged, birth behavior might vary because of changes in the survival prospect of children'. The model also includes level of wealth and the husband's educational level. Other studies have considered the husbands educational level as a proxy for income. According to the economic theory of fertility both wealth and income, should directly affect the demand for another child as they represent the budget constraint.

Descriptive statistics, and cross tabulations with desire for another child, are shown in Table 4.2 for the selected women from the 2000 EDHS. In column 1 are shown the percentage distributions of each covariate included in the model by category, whereas in column 3 are shown their frequency distributions. In column 2 are shown the proportion of women wanting another child respectively for each category.

Younger women are more likely to want another child: 69 per cent of women below age 25 in this selected sample want another child compared with 27 per cent of women between age 25 and 35 and only 4 per cent of women aged above 35 respectively (Table 4.2). There appear to be no differences in the desire for another child for women with one child according to the sex their child. However, amongst women with two children, 46 per cent of women with two daughters desired another child compared with around 30 per cent for those women who have two sons or a son and a daughter. A similar pattern appears also among women with three children: 20 per cent of women with three daughters want another child compared with fewer than ten per cent for other currently family compositions. One in five of the women living in the capital or in large cities desired another child compared with one in four women living in small cities, towns or in the countryside. More than 27 per cent of women who had no experience of child death expressed a desire for another child compared to only 10 per cent of women for whom at least one previous child was dead.

At individual level I also include in the model both individual social and economic modernization variables. As economic modernization variables I consider husband's education, as it is often considered as a proxy for income, whether the husband is employed in agriculture and if the household owns land. I also consider a measure of living standards, in term of the asset index (see the Appendix A for a detailed description). According to previous analyses using DHS data, the household index is a good proxy of long-run household wealth (Filmer and Pritchett 1994), and it has been proved to be a good measure of living standards.

Table 4.2: Descriptive statistics and cross-tabulations with desire for another child for the selected women from the EDHS 2000.

	Percentage %	*Proportion wanting another child (%)*	*Number of women*
Age			
Below 25	16.4	0.69	1667
25-35	41.9	0.27	4234
Above 35	41.7	0.04	4215
Family Composition			
A boy	7.3	0.89	733
A girl	6.7	0.91	678
A boy and a girl	11.7	0.27	1185
Two boys	6.3	0.31	641
Two girls	5.0	0.46	508
Two boys and a girls	8.2	0.13	833
Two girls and a boy	9.1	0.07	919
Three boys	3.3	0.09	332
Three girls	2.2	0.21	220
Three boys and a girl	4.3	0.04	434
Two boys and two girls	6.4	0.04	648
A boy and three girls	3.8	0.08	380
Four girls	0.7	0.27	74
Four boys	1.1	0.08	113
5 or more children	23.9	0.04	2418
Previous experience of child death	22.0	0.12	2228
No previous experience	78.0	0.28	7888
Respondent's education			
No education	39.7	0.18	4016
Primary	17.5	0.18	1766
Secondary	34.0	0.33	3436
Higher	8.8	0.29	898
Husband's education			
No education	25.9	0.16	2621
Primary	22.0	0.19	2225
Secondary	37.6	0.32	3802
Higher	14.5	0.25	1467
Don't know	0.0	0.0	1
Respondent currently work	17.7	0.25	8330
Respondent does not work	82.3	0.19	1786
Husband self-employed in agriculture	10.2	0.24	1034
Husband employed in agriculture	8.1	0.22	826
Husband do not work in agriculture	81.7	0.25	8256
Own a land	21.1	0.25	2439
Does not own a land	75.9	0.24	7677
Place of residence			
Capital, large city	16.9	0.20	1709
Small city	22.1	0.24	2237
Town	7.9	0.26	805
Countryside	53.1	0.25	5365
Quintile of asset score			
Poorest	18.7	0.23	1895
Middle-poor	19.8	0.25	2003
Middle	19.6	0.25	1985
Middle-upper	20.6	0.25	2085
Upper	21.2	0.20	2148

Source: Author's calculation using 2000 EDHS. The asset index has been introduced in the model as a continuous variable, for the above table we consider the quintile of the household whereas the woman reside.

As variables measuring individual social modernization I consider respondent's education and respondent's work status as both of these have been extensively considered in the literature as characteristic of modern society. Both increases in female education and women's participation in the labor market have been associated with an increased level of female autonomy. As we can see from Table 4.2, 32 per cent of women with secondary or higher education desired another child compared with 18 per cent of women with a primary or no education. These results are partly explained by the fact that lower educated women are those with higher parity, whereas higher educated women are those with lower parity. Furthermore, 25 per cent of women who are currently working want another child compared with 19 per cent of women who are not currently working.

Contextual variables. The list of contextual variables and their descriptive statistics, together with their classification into social or economic modernization variables is shown in the Appendix Chapter 4 (Table A.4). Some contextual variables were collected using different sources (see Table A.4, column 4), whereas other contextual variables have been constructed throughout the application of GIS techniques using the ArcView 3.2 and 8.2 software.

As has been previously mentioned two levels of aggregation has been used, the PSU and the governorate level. At the PSU level some variables have been constructed both through the GIS techniques using the Africover maps and (for selected variables) by calculating their mean values at PSU level using the 2000 EDHS. At the governorate level indicators available in the 2003 Egypt Human Development Report (Saad 2003) based on estimated values for 2001 have been also used.

At the PSU level I use location data collected by ORC Macro using the Global Positioning System concomitant with the DHS data collection (Montana and Spencer 2001). This additional information allows the linking of individual-level data to the area where information was collected and consequently the linking of contextual data at the PSU level. Using the GPS (Global Positioning System) locator for the PSUs, a series of GIS variables was constructed using the Spatially Aggregated Multipurpose

Landcover database[3] and road layer. I constructed variables measuring the proportion of land area dedicated to each specific category of land use (which includes cotton plantations, rice, water, bare areas, urbanized area, road density) within a 10 kilometre (km) buffer (a zone of a specific distance around a feature or point, in this case the location of the PSUs). This buffer was been constructed around the sampling point and then intersected with the land cover reclassified layers. Using an Avenue script[4] in ArcView 3.2, the area dedicated to each land cover type within each 10 km buffer was calculated, obtaining the proportion of specific land use types within the area of each. A similar procedure was applied to calculate the road density within each buffer, by intersecting the road layer with the 10 km buffer thus obtaining the total road length within each buffer (see Figure 4.2). The road density was then calculated as the ratio between road length within the buffer and the surface area of the buffer.

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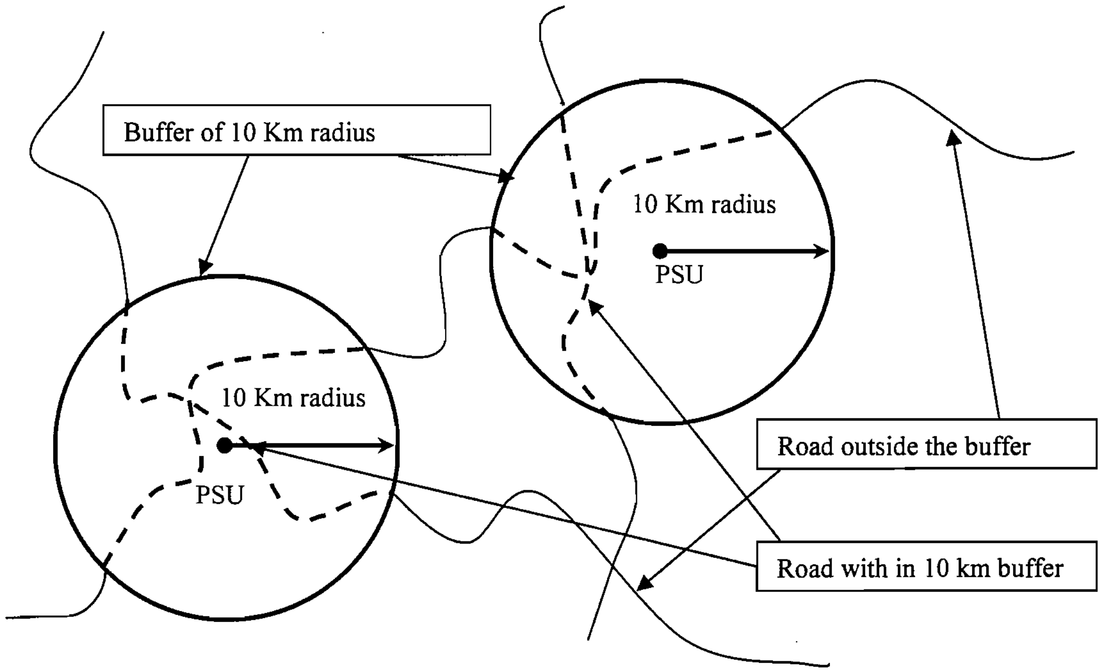
[3] Using ArcView 2.1 and 8.2 we classified the shapefile of the Spatially Aggregated Multipurpose Landcover database in to eight major classes of land use:
1) cultivated terrestrial areas and managed lands (composed of rain fed tree crops and irrigated tree crops such as olive, peach, date palm, citrus, mango, apple, etc.),
2) cultivated terrestrial areas and managed lands (composed of rain fed herbaceous crops and irrigated herbaceous crops such as wheat, cotton, sugar cane, maize, etc.),
3) natural and semi-natural terrestrial vegetation (mainly scrubland),
4) cultivated aquatic or regularly flooded areas,
5) natural and semi-natural aquatic vegetation,
6) artificial surfaces and associated areas (mainly urban areas and industrial areas),
7) bare areas,
8) artificial water bodies and inland water bodies(lakes, river, reservoirs, etc.).

[4] Developed by Andy Murdock from the Geodata Institute at Southampton University.

Figure 4.2: Illustration of GIS analysis to calculate road density.



The contextual variables selected represent different aspect of modernization (social and economic). A range of contextual variables was tested in the model and those that will reduce the area variance at governorates and PSU levels will be selected. To measure social modernization, I considered variables representing educational level (the mean number of years of education for women within a community, the female enrolment ratio for basic and secondary level and the female literacy rate), female-male gaps in education (the women-husband secondary education ratio or literacy rate of female as percentage of males), and the female role in the labour market (measured by the percentage of women in the labour force or the female unemployment rate). To measure economic modernization, I consider variables representing land use (the proportion of the 10 km buffer dedicated to cotton plantation, rice or the total agricultural area), variables representing the level of urbanization (the proportion of urbanized area within 10 km buffer, road density within 10 km buffer and population density), and variables representing the level of wealth (such as the gross domestic product per head per governorate or the mean asset index per PSU).

Those variables selected do show a high variability from place to place, which suggests that differences in fertility behaviour might be explained by differences in those contextual modernization variables.

4.5 Results

The results of the modelling will be presented in three sections. In the first section I will begin with the results for a model including only individual-level variables in order to show the effect of these variables on desired fertility, and to assess which of them have significant effects. In the second section contextual variables measuring social and economic modernization will be added to the model with the aim of reducing the area-level variances, and to highlight which contextual factors help in explaining the geographical variation. In the third section the effect on the area random effect of the inclusion of the selected contextual variables will be described as well as the respective roles of social and economic modernization in explaining governorate-level variation.

4.5.1 Individual variables model

In this section four models will be presented. First, the estimate of the three-level random intercept model for all women for the selected sample will be presented to show the effect of current family composition on desired fertility, and the effect of individual social and economic modernization variables conditional on current family composition and a set of demographic variables. Second, the same model is applied to a subset of the sample of women having at least two children, in order to test whether the effect of the covariates changes with current parity. Third, the model will be re-estimated without controlling for current family composition to see if the effect of social and economic modernization at the individual level changes and thereby to see to what extent the individual-level effect of those variables is captured by the effect of family composition. Fourth, I shall test whether the effect of the covariates changes according to the governorate where a woman lives and estimate a random slope model for the covariates that appear to have a significantly different effect according to the governorate where a women lives. The results are presented in Table 4.3.

Table 4.3: Results of three- level logistic modelling.

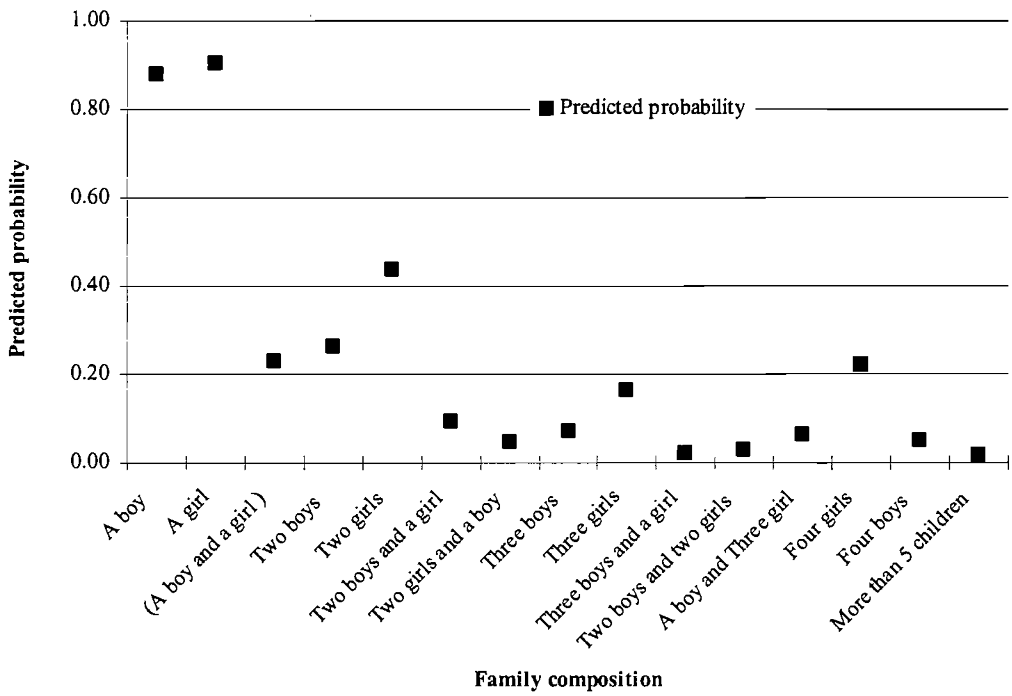
	Individual variable model			*Individual variable model for women with at least two children*			*Individual variable model excluding family composition variables*			*Individual variable model with random slope for individual wealth*		
	(A)			(B)			(C)			(D)		
Place of residence		SE			SE			SE			SE	
Small city	0.573	0.297		0.582	0.339		0.279	0.209		0.611	0.243	**
Town	0.753	0.321	*	0.837	0.362	*	0.361	0.228		0.828	0.269	**
Countryside	0.803	0.291	**	0.908	0.332	**	0.186	0.204		0.904	0.245	***
(Capital city)												
Age												
25-35	-0.437	0.092	***	-0.395	0.103	***	-1.918	0.069	***	-0.451	0.092	***
Above 35	-1.876	0.136	***	-1.657	0.148	***	-4.070	0.106	***	-1.894	0.137	***
(Below 25)												
Family composition												
A boy	3.189	0.153	***	n.a						3.126	0.161	***
A girl	3.46	0.167	***	n.a						3.381	0.176	***
Two boys	0.164	0.121		0.157	0.122					0.157	0.120	
Two girls	0.955	0.126	***	0.984	0.128	***				0.922	0.126	***
Two boys and a girl	-1.069	0.142	***	-1.128	0.143	***				-1.068	0.142	***
Two girls and a boy	-1.803	0.165	***	-1.873	0.167	***				-1.830	0.166	***
Three boys	-1.346	0.223	***	-1.426	0.226	***				-1.362	0.224	***
Three girls	-0.430	0.209	*	-0.483	0.211	*				-0.447	0.208	*
Three boys and a girl	-2.561	0.286	***	-2.680	0.287	***				-2.641	0.291	***
Two boys and two girls	-2.344	0.234	***	-2.462	0.236	***				-2.385	0.237	***
A boy and three girls	-1.535	0.227	***	-1.639	0.229	***				-1.580	0.229	***
Four girls	-0.063	0.328		-0.121	0.331					-0.067	0.326	
Four boys	-1.727	0.403	***	-1.854	0.405	***				-1.796	0.407	***
More than five children	-2.786	0.176	***	-2.986	0.181	***				-2.882	0.182	***
(A boy and a girl)												
Previous experience of child death	0.171	0.105		0.206	0.109		-0.168	0.087		0.162	0.106	
Individual social modernization												
Respondent education												
Primary	-0.032	0.119		0.042	0.126		0.069	0.096		-0.025	0.119	
Secondary	0.002	0.112		-0.013	0.12		0.505	0.089	***	-0.026	0.111	
Higher	0.036	0.183		-0.041	0.201		1.064	0.146	***	-0.032	0.182	
(No education)												

	Individual variable model			Individual variable model for women with at least two children			Individual variable model excluding family composition variables			Individual variable model with random slope for individual wealth		
Women currently working	0.007	0.105		-0.059	0.114		0.046	0.084		0.026	0.104	
Individual economic modernization												
Husband's education												
Primary	0.177	0.118		0.191	0.124		0.170	0.095		0.189	0.118	
Secondary	0.269	0.118	*	0.218	0.126		0.411	0.094	***	0.274	0.118	*
Higher	0.281	0.164		0.281	0.177		0.276	0.131	*	0.269	0.164	
(No education)												
Asset index	-0.343	0.126	**	-0.378	0.132	**	-0.298	0.102	**	-0.174	0.144	
Household own a land	0.136	0.097		0.103	0.103		-0.115	0.078		0.139	0.097	
Husband is self-employed in agriculture	0.346	0.141	*	0.365	0.147	**	0.237	0.114	*	0.381	0.142	**
Husband is employed in agriculture	0.083	0.15		0.072	0.159		0.053	0.12		0.089	0.152	
(Husband not employed in agriculture)												
Constant	-0.534	0.409		-0.522	0.447		0.683	0.291	*	-0.890	0.454	*
Governorate variance	0.654	0.196	***	0.736	0.220	***	0.194	0.063	**	2.213	0.839	*
Random slope for asset index										0.125	0.094	
Covariance										-0.550	0.273	*
PSU variance	0.131	0.047	**	0.148	0.054	**	0.073	0.029	**	0.112	0.045	*
Number of clusters	499			499			499					
Number of governorates	26			26			26					
Number of observations	10116			8705			10116					

Note: *** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level.

A significant effect of family composition (Figure 4.3, model A) was found. Women with one child show a strong desire for another child, with a predicted probability of around 0.90 that they will want another child, though there is not a significant difference according to the sex of their one child. There seems to be the strong desire in Egyptian society to have at least two children. On the other hand, women who have two children, both of whom are girls, have a 20 percentage point higher probability of wanting another child compared with those who have a mixed pair, and those who have two boys. A similar pattern appears for women at higher parities having only girls, which seems to suggest a strong desire to have at least one boy. However, those differences in predicted probability of wanting another child by the gender composition of the children are not significantly different (see Figure 4.3). The desire for another child is, in general lower after three children than after two.

Figure 4.3: Predicted probability of wanting another child by current family composition.



Source: 2000 EDHS, author's calculation
Note: Predicted probabilities evaluated using the reference category on all other covariates and considering the value of the asset score equal to 0. Need to be noted that the asset has been introduced in the model as the natural logarithm of the factor score and to prevent the factor score having value below the zero, a scalar of 7 have been added to the factor score.

As far as the **individual social modernization** variables are concerned, unlike previous studies we do not find a significant difference in the desire for another child by respondent's educational level or respondent's current work status after having accounted for demographic variables like the age of the woman and her parity.

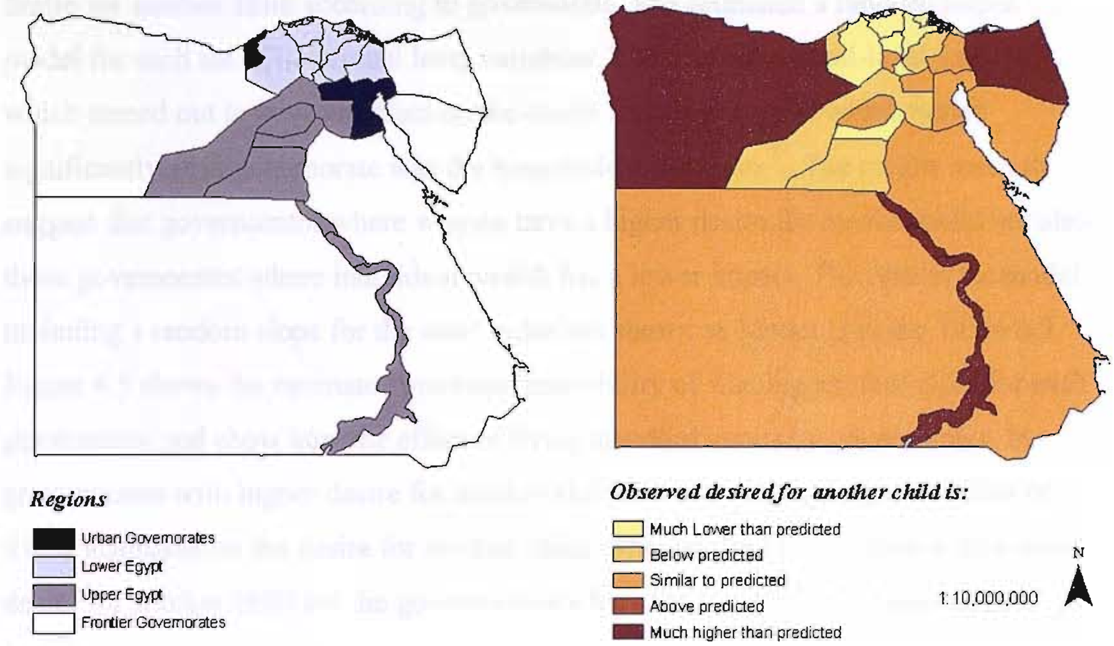
As far as the **individual economic modernization** variables are concerned, there is a weakly significant effect for husband's education. Husbands with secondary education have a five percentage point higher probability of wanting another child than do husbands with no education, though the effect is significant only at the 10 per cent level. Women married to husbands who are self-employed in agriculture have a 6 per cent higher probability of wanting another child compared with those married to husbands who do not work in agriculture, but again this effect is only significant at the 10 per cent level. There appears to be a significant effect of place of residence, women living in countryside having almost 20 percentage point higher probability of wanting another child than women living in the capital or a large city[5]. Women belonging to a household with a higher living standard (top quintile) appear to have a 20 percentage lower probability of expressing a desire for an extra child compared with women in households with lower living standard (bottom quintile)[6].

The governorate-level residuals from the multilevel logistic model (Figure 4.4) show that some governorates in Upper Egypt tend to have an observed value much higher than predicted. This area is characterized by an unusually high desire for another child. On the other hand, several governorates in Lower Egypt show a much lower observed value than predicted, revealing that this is an area with 'unusually' low desire for another child. Urban governorates show values similar to those predicted by the model.

[5] The asset index has been introduced in the model as the natural logarithm of the factor score and to prevent the factor score having a value below the zero a scalar of seven has been added to the model. In order to derived those predicted probability we consider the factor score at its mean value of zero.

[6] The cut of points of the quintile of the factor score as shown in Table A4 of Appendix A. A value of the factor score equal to -2.63 has been considered for the bottom quintile and a value of 2.61 has been considered for the top quintile. Hence, we consider the natural logarithm of the factor score plus a scalar of seven in order to derive the effect of living standards. The predicted probability of wanting another child, after having consider the reference categories for all the other variables, for women residing in a household which below to the lowest quintile is 0.26, whereas the predicted probabilities for women residing in a household belonging to the highest quintile is 0.21.

Figure 4.4: Adjusted governorate variation in observed desire for another child.



Note: Much lower than predicted: the desire for another child is 1.64 standard deviations (SD) below the desire for another child predicted by the model; Below predicted : the desire for another child is between 1.64 SD to 1 SD below the predicted desire for another child; Similar to predicted: the desire for another child is within 1 SD of the predicted desire for another child; Above predicted: the desire for another child is between 1 SD and 1.64 SD above the predicted desire for another child; Much higher than predicted: the desire for another child is greater than 1.64 SD above the predicted desire for another child.

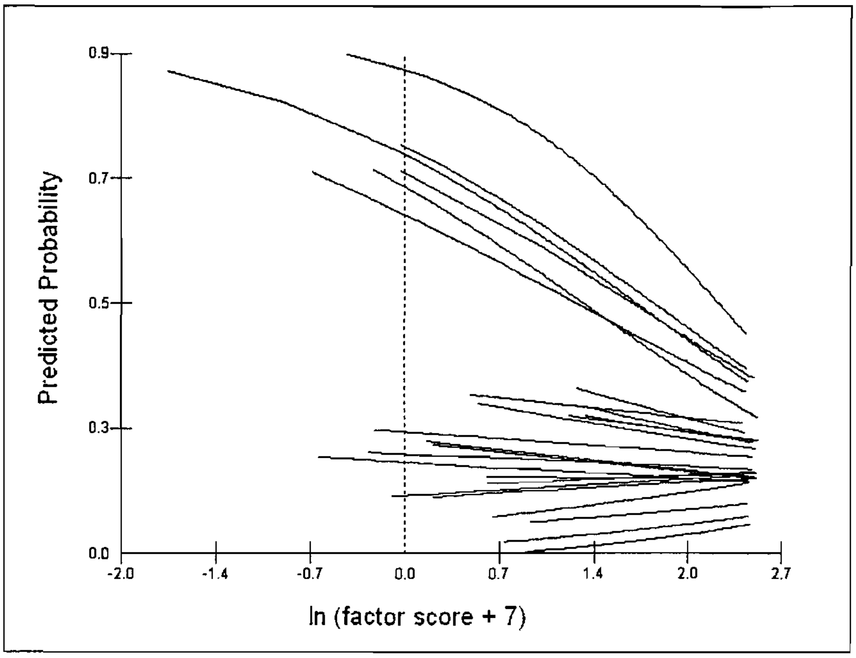
In order to verify that our results on the modernization variables did not change with parity, I estimated the same model for women aged 15-49 years with at least two children who were fecund, not sterilized and not pregnant (a total of 8705 women). The results of this model are displayed in Table 4.3 Model B. There are no major differences in the significance of the modernization variables for women with at least two children (Model B) compared with women with at least one child (Model A).

I then estimated the individual variables model without controlling for current family composition and found a significant effect for both husband's and wife's education (Table 4.3 Model C). This seems to imply that the effect of education at the individual level (both for husband and wife) in desired fertility is almost completely captured by the effect of family composition.

I then tested whether the individual level variables had a different effect on the desire for another child according to governorate, and estimated a random slopes model for each set of individual level variables. The only individual-level variable which turned out to have an effect on the desire for another child which varied significantly with governorate was the household asset index[7]. The results seem to suggest that governorates where women have a higher desire for another child are also those governorates where individual wealth has a lower impact. The results for model including a random slope for the asset index are shown as Model D in the Table 4.3. Figure 4.5 shows the estimated predicted probability of wanting another child for each governorate and show how the effect of living standard varies by governorates. In governorates with higher desire for another child there is a strong negative effect of living standards on the desire for another child, whereas the governorates with a lower desire for another child are the governorates where the effect of living standards is lower.

[7] We test the significant of the covariance between the random slope and random intercept and the significance of the governorate variance, we apply a Wald test with 2 degree of freedom. They are significant at 1 per cent level.

Figure 4.5: Estimated predicted probability of wanting another child for each governorate for the random slope model.



Note: the predicted probability have been calculated considering the reference categories for each covariate. The range of values that the asset index takes varies by governorates.

4.5.2 Contextual variables model

A forward selection procedure to select contextual variables that best fit the model and reduce the area-level variance has been used. After having fitted the three-level logistic model using individual-level variables with random effects at levels 2 and 3 (i.e. variance components) I noticed a significant random effect at governorate and PSU level (Table 4.3). Using the chi-squared test I selected the contextual variable that best fit the data and most reduce the area-level variance. I then re-estimated the individual-level model adding this selected contextual variable, and tested again using the remaining contextual variables to see which had the highest chi-squared value. I repeated this selection procedure until no other contextual variables significantly improved the model. Some contextual variables were correlated with each other, as some of them were capturing the same aspects of modernization. In such cases I choose those which were more significant, avoiding having highly correlated variables together in the model. Moreover, the random slope for the asset index appeared no longer to be significant once we included the contextual variables, so I removed the random slope for the asset for the estimation of the contextual variables model. The results are displayed as Model E in Table 4.4.

Table 4.4: Results of multilevel modelling with and without contextual variables, 2000 EDHS.

	Individual variable model (A)			*Contextual variables model (E)*		
Place of residence		SE			SE	
Small city	0.573	0.297		0.825	0.248	***
Town	0.753	0.321	*	0.919	0.274	***
Countryside	0.803	0.291	**	1.039	0.246	***
(Capital or large city)						
Age						
25-35	-0.437	0.092	***	-0.430	0.092	***
Above 35	-1.876	0.136	***	-1.863	0.136	***
(Below 25)						
Family composition						
A boy	3.189	0.153	***	3.192	0.152	***
A girl	3.460	0.167	***	3.459	0.166	***
Two boys	0.164	0.121		0.165	0.121	
Two girls	0.955	0.126	***	0.954	0.126	***
Two boys and a girl	-1.069	0.142	***	-1.066	0.142	***
Two girls and a boy	-1.803	0.165	***	-1.807	0.166	***
Three boys	-1.346	0.223	***	-1.347	0.224	***
Three girls	-0.430	0.209	*	-0.421	0.209	*
Three boys and a girl	-2.561	0.286	***	-2.569	0.286	***
Two boys and two girls	-2.344	0.234	***	-2.353	0.234	***
A boy and three girls	-1.535	0.227	***	-1.525	0.228	***
Four girls	-0.063	0.328		-0.079	0.328	
Four boys	-1.727	0.403	***	-1.736	0.404	***
More than 5 children	-2.786	0.176	***	-2.807	0.177	***
(A boy and a girl)						
Previous experience of child death	0.171	0.105		0.171	0.105	
Individual social modernization						
Respondent's education						
Primary	-0.032	0.119		-0.035	0.120	
Secondary	0.002	0.112		0.010	0.112	
Higher	0.036	0.183		0.028	0.183	
(No education)						
Woman currently working	0.007	0.105		0.028	0.105	
Individual Economic Modernization						
Husband's education						
Primary	0.177	0.118		0.177	0.118	
Secondary	0.269	0.118	*	0.282	0.118	*
Higher	0.281	0.164		0.299	0.164	
(No education)						
Asset index	-0.343	0.126	**	-0.358	0.127	**
Household owns land	0.136	0.097		0.141	0.097	
Husband is self-employed in agriculture	0.346	0.141	*	0.336	0.141	*
Husband is employed in agriculture	0.083	0.150		0.082	0.150	
(Husband not employed in agriculture)						

	Individual variable model (A)			Contextual variables model (E)		
Contextual social modernization						
Women in the labor force(as % of the total)				-0.105	0.028	***
Infant Mortality Rate				0.037	0.010	***
Female enrolment ratio				0.031	0.014	*
Contextual economic modernization						
Proportion of cotton area in 10km buffer including cotton area with majority rice				-0.738	0.194	***
Constant	-0.534	0.409		-2.533	1.255	*
Governorate variance	0.654	0.196	***	0.166	0.059	**
PSU variance	0.131	0.047	**	0.137	0.047	**
Number of cluster	499			499		
Number of governorates	26			26		
Number of observations	10116			10116		

Note: *** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level.

Amongst the social modernization variables I found a significant effect for women's participation in the labor market, the female school enrolment rate, and the infant mortality rate (IMR), whereas amongst the economic modernization variables I found a significant effect for the proportion of area dedicated to cotton crops within the 10 km buffer around the PSU.

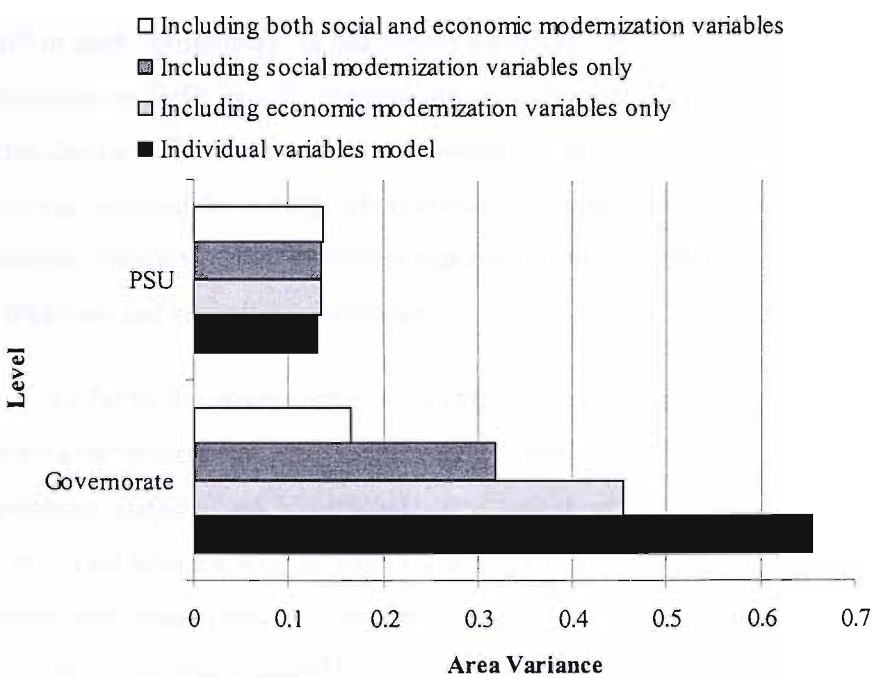
Women living in an area with a high participation of women in the labor force are less likely to desire another child, though the size of the effect is rather small. Women living in governorates with an IMR one standard deviation higher than the mean have a 13 percentage point higher probability of wanting another child compared with women living in governorates with an IMR one standard deviation below the mean. This could be due to a 'compensation' effect. Women living in an area with high infant mortality compensate with increased fertility for the possibility of future child death. Contrary to expectations, women living in an area with high female enrolment in secondary or higher education are more likely to express a desire for another child. Women living in governorates with a female enrolment ratio one standard deviation higher than the mean have a 14 per cent higher probability of wanting another child compared with women living in governorates with a female enrolment ratio one standard deviation above the mean.

Women living in the proximity of agricultural area are less likely to want another child. However, moving from an area with a higher proportion of land area dedicated to cotton (such as rural Lower Egypt) to an area with a low proportion (such as the Frontier Governorates) does not have a big effect on the probability of wanting another child.

4.5.3 Area random effect

Figure 4.5 shows the changes in the governorate-level and PSU-level variances after the inclusion of just the social modernization variables, after the inclusion of just the economic modernization variables and after the inclusion of both sets of variables in the model.

Figure 4.6: Area variance.



Source: 2000 EDHS, author's calculations.

Contextual modernization variables appear to help greatly in explaining the governorate-level variation, which decreases by almost 73 percentage points after the inclusion of contextual modernization variables. Including only economic modernization variables among the contextual variables appears to reduce the governorate-level variance by 30 per cent, whereas after the inclusion only of social modernization variables the governorate-level variance decreases by almost 50 per cent. Thus, social modernization variables appear to be relatively more important in explaining regional variation in desired fertility than economic modernization variables.

The PSU variance does not change with the inclusion of contextual variables in the model. Both the PSU and governorate variances are significant after the inclusion of modernization variables. This result seems strongly to suggest that the community where women live influences her fertility behaviour. Social and economic modernization variables do not reduce the community-level variation, suggesting that there are other unobserved community characteristics that influence desire for another child in each community. In our model we could not account for community social interaction as DHS data do not provide enough information about community interaction and for this reason, it is considered as an unobserved component. We did, however, account for a range of community characteristics representing socio-economic modernization, therefore our unobserved component refers to such aspects as tradition and community attitudes.

As far as the governorate-level variance is concerned, despite the reduction of the area variances after the inclusion of modernization variables, there is still a significant unexplained governorate-level variation. This also seems to suggest that the governorate where a woman lives (and not just her local community) is affected by unobserved characteristics which are not related to the level of development of the area, and as has been argued before, this could be related to the channel or types of social interaction, which vary from place to place.

4.6 Discussion

The results for the effect of individual modernization variables on fertility preferences differ from those of previous studies conducted by Easterlin *et al.*(1988). We do not find a significant effect of respondent's and husband's education on desired fertility. One main reason for this is that Easterlin's model (1988a) looks at the desired family size and does not account for current family composition, whereas this study looks at the desired fertility and does account for current family composition. Our results show that the effect of education is acting through the current fertility and not directly on the desired fertility at individual level.

We found a strong effect of current family composition on desired fertility, showing complex family preferences. There appears to be a strong desire in Egyptian society to have at least two children and at least one boy. These results partially confirm the literature on gender preferences in Egypt (Yount *et al.* 2000) though they add an extra layer of information, in that we have shown that gender preferences act on the desire for at least one boy and at least two children.

Excluding family composition from the model we found a significant positive effect of respondent's education on desired fertility. This could be partly explained by the fact that highly educated women are also those having lower parity. Hence, the effect of women's education when parity is not controlled is then a spurious effect of the fact that educated women have lower average parity than non-educated women, and desired for another child varies negatively with parity. The question is then *why* there is no effect of women's education on desired for another child once parity is controlled. It could be that the opportunity costs of further childbearing are, effectively, zero. This is to say that if, for example, higher educated women are working at the time of the survey are not going to enter the labour market whatever is their future fertility intention, and those women who are working will find a way of working whatever if their future fertility. Alternatively, it might be the case that a complex trade-off is taking place between the opportunity costs of future childbearing and the hypothetical expanded budget which more educated women (if they work outside home) will bring. In another words, more educated women will relax the budget constraint by more than less educated women if the take up paid work (which would allow increased fertility) but their higher opportunity costs of childbearing and higher quality of children they demand compensate for this, leading to the net effect of education on desired fertility being zero. As far as the effect of husband education results suggest a relaxation of the budget constraint, which lead to an increase demand for increased demand for children, however this results it is only significant at 10 per cent level.

At the individual level there appears to be a significant negative effect of wealth on desired fertility. One interpretation of this is that wealthier families are those which have accumulated more wealth and have been wealthier than others for more than one generation. In this case the increased income does not just increase the budget constraint but also increases the price of children relative to other goods, resulting in a reduction in the demand for children.

There appears also to be a significant positive effect of the husband being self-employed in agriculture. This could show that in an agricultural society, especially where the family economics is related to agriculture, the returns to having an extra child are higher than for a family which is not self-employed in agriculture. In other words children are valued more probably because of their possible involvement in agricultural work.

In the estimation of the contextual variables model I keep family composition variables in the model to control for individual family composition and enable the contextual variables model to capture the direct effect of modernization variables on desired fertility

At the community level the most important effects I found were of the IMR and female enrolment ratio. The level of infant mortality in a community influences the individual desired fertility. Women living in a community with a high level of infant mortality have higher desired fertility. This appears to confirm Easterlin's (1975) hypothesis of a direct effect on fertility, and possible 'compensation effect'. The perceived survival probability in a community with a higher incidence of infant mortality is lower, hence families within that community have an higher desired fertility in order to compensate for their possible future loss. Communities with a high female enrolment ratio have a higher probability of wanting another child.

Overall we find that there is a substantial variation across governorates, which is partly explained by the contextual effects of modernization. Differentials among governorates in the level of modernization do not, however, play a role in reducing the community-level variation. In saying this, through, we need to bear in mind that we did not account for community differentials in tradition, or in attitudes, which characterize the channels of social interaction and define the process of diffusion of new idea. These results suggest that the economic theory of fertility does help to explain regional variation, though this theory appears not to be completely sufficient as there is remaining unexplained difference between communities. These results also suggest that the channels or types of social interaction vary between communities and to some extent also between governorates, and that social interaction theory may help explaining variation in desired fertility between communities in Egypt.

Overall, social modernization plays a more important role in explaining community-level variation than economic modernization, and the results also suggest that the increase in women's role in society and more importantly the promotion women's gender role within families should translate into a reduction of fertility. The traditional women's role in Egyptian society has not changed despite the modernization of Egyptian society in the past twenty years. Women are still, to a large extent, accepting their traditional gender role. Policy directed to reduce fertility should aim to promote gender equality and enhance women's role in society, which will in turn be translated in a fertility reduction.

4.7 Conclusion

Using a conceptual framework that borrows notions from both the economic theory of fertility and social interaction theory, this chapter looks at the role of different aspects of modernization both at the individual and community level on desired fertility in Egypt.

Previous studies have found that place of residence is one of the most important determinants of desired fertility and that different levels of modernization play an important role in explaining the regional differences in demographic behaviour (Easterlin *et al.* 1988; Hallouda *et al.* 1988). This study also confirmed the finding that village setting is an important determinant of the desire for another child (Casterline and Eid 1988). It has also shown that modernization helps in explaining governorate-level differences but not local community-level differences and a significant unexplained variation still exists at governorate level.

Considering modernization in terms of the two components: economic and social modernization, we found that at the individual level modernization variables do not play a major role in determining desired fertility in Egypt once family composition is accounted for, and at the community level the social development of an area is more important than economic modernization in explaining governorate-level differences and in reducing the desire for another child.

The results show a strong effect of family composition on desired fertility in Egypt. There appears to a strong desire in Egyptian family for at least two children and at least one boy. The effect of education disappears once one accounts for family composition, a finding which seems to explain the differences in results between our analysis and the analysis of Easterlin *et al.* (1988), where using the 1980 WFS, they found that education, women work's experience and husband's occupation play a major role in explaining differences in demographic behaviour.

This paper also provides an application of a method that uses both multilevel modelling and Geographical Information System (GIS) techniques based on an up-to-date map of land cover in Egypt made available from the Africover project (Di Gregorio 2003) of Food and Agricultural Organization(FAO).

These results suggest that the economic theory of fertility does help to explain regional variation though the theory appears not to be sufficient in explaining all differences between communities. The results also suggest that the channel or types of social interaction may vary between communities and between governorates. Social interaction theory may help in explaining variation in desired fertility between communities in Egypt.

4.8 Appendix Chapter 4

Table A.4: Descriptive statistics of contextual variables.

	Mean	SD	Level	Sources
Social Modernization				
Mean years of education (respondent) per PSU	4.56	0.81	PSU	M
Mean years of education (husband) per PSU	4.80	0.49	PSU	M
Proportion of women with secondary or higher education per PSU	0.40	0.24	PSU	M
Proportion of husbands with secondary or higher education per PSU	0.50	0.21	PSU	M
Woman-husband secondary education ratio [a] per PSU	0.77	0.30	PSU	M
Proportion of husbands employed in a professional an managerial job per	0.22	0.17	PSU	M
Proportion of husbands employed or self-employed in agriculture per PSU	0.18	0.20	PSU	M
Mean parity per PSU	3.12	0.59	PSU	M
Human Development Index (HDI) 2001	0.68	0.05	G	HDR
Infant Mortality Rate (IMR) 2001	29.4	10.9	G	HDR
Female literacy rate 2001	53.6	14.8	G	HDR
Female enrolment ratio (basic and secondary) 2001	84.0	9.5	G	HDR
Percentage of population 15 + with secondary education or higher	23.1	8.7	G	HDR
Percentage of women in the labour force	15.3	4.5	G	HDR
Literacy rate of females as percentage of males	59.1	14.8	G	HDR
Under 5 mortality rate	38.6	11.8	G	HDR
Percentage of labour force 15 + in agriculture	30.1	17.2	G	HDR
Female unemployment rate	19.0	8.3	G	HDR
Economic Modernization				
Mean asset index per PSU	1.8	0.36	PSU	M
Proportion of bare land in 10 km buffer	0.17	0.22	PSU	GIS
Proportion of herbaceous (cultivated area) in 10 km buffer	0.11	0.14	PSU	GIS
Proportion of urbanized are a in 10 km buffer	0.12	0.18	PSU	GIS
Proportion of cultivated tree area	0.09	0.13	PSU	GIS
Proportion of inland water in 10 km buffer	0.04	0.06	PSU	GIS
Proportion of natural and semi natural terrestrial vegetation	0.02	0.02	PSU	GIS
Proportion of cotton area in 10 km buffer excluding cotton in majority rice	0.20	0.26	PSU	GIS
Proportion of cotton area in 10 km buffer including cotton in majority rice	0.36	0.36	PSU	GIS
Proportion of rice area in 10 km buffer, include majority of rice	0.16	0.31	PSU	GIS
Proportion of agricultural area in 10km buffer	0.57	0.33	PSU	GIS
Proportion of cotton area within agricultural area in 10km buffer	0.28	0.33	PSU	GIS
Road density km /1000km2	0.22	0.08	PSU	GIS
Gross domestic product per capita in Egyptian Lira	5737	2498	G	HDR
Urban population as percentage of the total	45.6	27.6	G	HDR
Population of largest city (as % of the total urban)	52.1	26.5	G	HDR
Population density (per km^2)	630	817	G	HDR
Person per feddan	88.2	376	G	HDR

Sources: Egypt Human Development Report 2003 (Saad 2003), Egyptian Demographic and Health Survey 2000 (El-Zanaty and Way 2001), Africover map of Egypt(Di Gregorio 2003),
Notes: M variable constructed as means of PSU values, G: governorates variables, PSU: primary Sampling Unit level variables.
[a] Number of women with secondary education as percentage of number of husbands, calculated using the whole dataset.

4.9 References Chapter 4

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Chapter 5

Summary and conclusions

5.1 Summary of findings

The thesis looked at the determinants of fertility and contraceptive use in Egypt and uses the 2000 Egyptian Demographic and Health Survey data. It looked at three aspects of Egyptian fertility focusing on fertility and contraceptive use in its past, current and future dimensions. The first essay analysed the past trend on fertility with a special emphasis on the second and third intervals and it explored the effect of contraceptive use on the timing of fertility. The second essay analysed the current use of modern contraceptive methods and explored the reasons for geographical gaps in the levels of contraceptive use. The third essay looked at future fertility intentions by analysing the determinants of desired fertility.

Previous studies have identified peculiar patterns regarding geographical differentials in fertility levels and contraceptive use in Egypt and this research assigned the study of the geographical differentials of fertility and contraceptive use a primary role. The regional patterns are covered throughout the thesis but most explicitly in the second and third essays, where the socio-economic determinants of fertility behaviour and contraceptive use are largely addressed in their local environments. The results of Chapter 3 suggested that both the characteristics of the population, and non-compositional and behavioural factors play a role in explaining the regional differences in contraceptive prevalence. The results of Chapter 4 confirmed previous findings that the village setting is an important determinant of the desire for another child. They also found that the community social development of an area is more important than economic modernization in explaining the governorates-level differences and in reducing the desire for another child.

This thesis provides unconventional applications of the Demographic and Health Survey (DHS) data not only in the types of method used but also in the way the data themselves are used to answer questions on fertility and reproductive health. DHS calendar data, geographical data and more general environmental data are used as part of the DHS data set allowing the inclusion of another dimension of analysis. This thesis also provides alternative methods to analyse issues on fertility and reproductive health from those currently in common use in demographic fields. The second essay provided an application of a decomposition technique normally used by labour economics, whereas in the third essay standard Geographical Information System techniques commonly used by geographers and environmental planners are combined with multilevel modelling techniques which are widely used by demographers.

This thesis provides both methodological and substantive contributions increasing the understanding of fertility and contraceptive use patterns in the context of Egypt. Section 5.2 highlights the major findings of this research and draws policy implications from the findings, Section 5.3 discusses the data limitation of this study and further research on this topic.

5.2 Key findings and policy implications

The DHS calendar data can be used to study the effect of the proximate determinants on fertility in different contexts allowing researchers to gather an insight into the specific mechanisms through which socio-economic factors affect fertility through the proximate determinants and the effect of the importance of the proximate determinants on the timing of fertility and ultimately on fertility levels. Hence, calendar data provides important information which enables demographers to identify the pathway by which social and economic factors influence fertility.

The results of Chapter 2 showed that **studies of fertility which are able to drawn on calendar data could be designed in two stages**. The first stage would use the DHS calendar to clarify the effect of each proximate determinant on fertility, allowing the evaluation of the relative importance of the effect of each proximate determinant on fertility. The results from the first stage would then be used to clarify the effect of the socio-economic factors on each proximate determinant and ultimately their effects on fertility.

The results of Chapter 2 revealed **the importance of accounting for unobserved heterogeneity in birth interval analysis.** Accounting for unobserved heterogeneity in birth interval analysis helps to prevent the underestimation of the risk of conception at higher durations. It also provides a tool for accounting for fecundity.

Despite the fact that the analysis reported in Chapter 2 was not designed to study contraceptive failure rates, it can help to provide a picture on contraceptive failure in Egypt. **The results of the analysis of the second birth interval in Egypt show a degree of failure of contraceptive use.** The level of contraceptive failure varies by method, though a degree of failure is present in every method of contraceptive use. It seems that in Egypt the IUD is less prone to failure than the pill or other modern methods. Results suggest that policy makers should not only look at increasing the uptake of contraceptive methods but also at improving family planning counselling, as contraceptive methods still have some degree of failure, suggesting inadequate assistance from Family Planning providers in providing information to users.

The results from Chapter 3 showed that **one third of the differentials in contraceptive use between rural areas, and half the differentials between urban areas are due to the composition of the population, with the remainder being attributable to differences in the behaviour of 'similar' persons.** This suggests that both the characteristics of the population and non-compositional or behavioural factors have a significant effect on contraceptive prevalence. The results showed that in order to bring up the contraceptive prevalence in low prevalence areas, population policies in Egypt should be developed regionally. Specific and appropriate policies need to be developed for low prevalence areas like rural Upper Egypt. The results also suggest that if behaviour as well as the quality of service (those unmeasured factors) were to be changed in rural Upper Egypt so that they matched rural Lower Egypt the contraceptive prevalence gap between rural areas would fall by more than fifty per cent.

The results of Chapter 4 confirmed the finding that village setting is an important determinant of desire for another child (Casterline and Eid 1988). This study shows that **modernization helps in explaining governorate-level differences but not the community-level differences and significant unexplained variation still exists at governorate level.** The results suggested that the economic theory of fertility does help to explain regional variation, though the theory appears not to be sufficient in explaining all differences between communities. The results suggested that the channel or type of social interaction may vary between communities and between governorates and that these differences may partly explain the variation in the desired fertility between different communities.

The **community level of social development of an area appears to be more important than economic modernization in explaining the governorate-level differences and in reducing the desire for another child**.

There appears to be a **strong effect of family composition on desired fertility in Egypt, showing complex family preferences.** There appears to be a **strong desire** in Egyptian society to have **at least two children and at least one boy**. These results confirm the literature on gender preferences in Egypt adding an extra layer of information, by suggesting that gender preferences act on the desire for at least one boy and at least two children.

At the **individual level modernization variables show a complex effect on desired fertility.** Women's education appears not to be significant once family composition is accounted for. However, these results suggest that the opportunity costs of further childbearing are effectively zero, or alternatively, it might be the case that a complex trade off is taking place between the opportunity costs of future childbearing and the hypothetical expanded budget which more educated women will bring. Husband's education shows only a weak effect on desired fertility, showing that higher education raises the desire for another child. The effect of living standard on desired fertility appears to vary greatly across communities: those communities with a high desire for another child are also the communities where higher living standards have a stronger effect on reducing desired fertility, whereas the communities with lower desired fertility are also the communities where the effect of living standards is lower.

Chapter 4 also provided an **application of a method that uses both multilevel modelling and Geographical Information System (GIS) techniques** based on an up-to-date map of land cover in Egypt made available from the Africover project (Di Gregorio 2003) of the Food and Agricultural Organization (FAO). The results suggested that further studies using a combination of GIS and multilevel modelling technique are needed, especially in the development of hypotheses about possible alternative ways of specifying the effects of GIS variables on individual fertility behaviour.

5.3 Data Limitation and further work

As I have previously mentioned according to the 2000 EDHS there is almost no contraceptive utilisation among Egyptian couples between marriage and the first birth. However, these results suggest that the DHS sample was limited since it only sampled the ever-married population, especially in the light of the declines in Egyptian fertility due to the delay in marriage. The cultural assumption that women are not engaging in sexual activity prior to marriage limits the DHS sample to the ever married population. As a result, the data cannot be generalised to all women because a growing fraction of young women are postponing marriage and this is contributing to at least a period effect in the fertility decline.

Hence, the DHS data on Egypt does not focus on young women and more importantly on contraceptive use and attitudes before marriage. This implies that the recent changes on fertility behaviour cannot be captured analysing the DHS data. For this reason it would be interesting to design a survey which specifically captures the fertility and contraception use dynamics of these young generations in order to establish the differences between the married and unmarried generations in Egypt.

As far as the relationship between environment and individual level behaviour it would be interesting to further explore the relationship between type of crop cultivated in an area and pattern of desired fertility. However, to enable this it is necessary to have access to the disaggregate version of the land cover map distributed by FAO. Furthermore a natural extension of these case studies would be to further explore this relationship in different study countries in order to establish the extent to which these findings represent a general picture of such relationships.

One of the limitations of studying the use of family planning in Egypt has been the lack of information on the quality of services; hence the lack of evidence on the role of the quality of services itself on the decision to use family planning. Recently the ORC Macro (Measure DHS+) have released an Egypt Service Provision Assessment (ESPA 2002) Survey which was designed to extract information about the general performance of outpatient facilities that provide health services related to paediatric, maternal, and reproductive health needs. Therefore, this survey provides information on the quality of services. Furthermore, during the implementation of this survey Global Positioning System locator data on the health services has been collected. The linking of the 2000 EDHS, the 2002 ESPA and data from the land cover map of Egypt provides a unique opportunity to assess the role of the quality of services, environment and individual socio-economic factors on the use of family planning in Egypt and to discern the roles of the quality of services and the environment in influencing individual-level fertility behaviour in Egypt.

Finally, the results suggested that modernization alone does not adequately explain the geographical differences in fertility and contraceptive use levels and higher level of modernization does not necessary imply lower fertility levels. One might argue that it is the level of social interaction which could help in explaining these differences. Furthermore, the available data do not allow for the capture of the dynamics of those interactions as well as the role of civil society in shaping fertility behaviours. The government of Egypt has been actively promoting population policy as early as the 1930s and at national level the view of the government is clearly promoting lower fertility and higher contraceptive up-take. However, what is not clear is the role that civil society and religious leaders have in the implementation process of the national population policies. Further research is therefore needed to establish the dynamics of social interaction and the role of the community context in promoting national population policies.

Appendix A

Household Economic Index

Very few demographic surveys in developing countries gather information on household income or consumption expenditure, despite the theoretical importance of these measures. Furthermore income and consumption data are both expensive and difficult to collect, and many otherwise useful data sources lack direct measures of living standards (notably the Demographic and Health Surveys (DHSs)). On the face of it, this precludes the analysis of socio-economic inequalities in health, as well as testing of hypotheses relating to the impact of living standards on health and fertility. Moreover, the exclusion of living standards measures in multivariate analysis raises the possibility that other coefficients are rendered biased, because of their correlation with living standards measures. Consequently researchers have been forced to rely on *ad hoc* use of proxies for measures for living standards (Bollen, Glanville and Stecklov 2001; Kakwani, Wagstaff and Doorslaer 1997; Montgomery *et al.* 2000; Wagstaff and Watanabe 1999).

In the literature there are three primary approaches to constructing living standards indices, which differ in how different household assets and characteristics are weighted in the overall index[1].

- *"Arbitrary" approach*: Some studies have used indices constructed as the sum of indicator or dummy variables for whether or not a household possesses certain assets (Morris *et al.* 2000).

- *Principal component and factor analysis*: As an alternative to simple sums of asset variables that are available in the data, it is possible to use statistical techniques to determine the weights in the index. The two most common approaches for doing this are principal components analysis and factor analysis.

- *Predicting consumption*: In the cases where complementary consumption data are available from past or parallel surveys, it may be possible to derive weights for a living standards index through a 'consumption regression'.

A number of studies have applied principal components analysis to construct wealth indices using asset variables. All of these studies confirm that an economic index calculated with principal component analysis is a good proxy for wealth when it is related to health indicators and when other economic variable as income and consumption are not available. Filmer and Pritchett (1994), using the principal component analysis technique tested this methodology to construct an asset index based on information provided in common demographic surveys, They compared a proxy based on the principal components score of several consumer durable goods and housing quality to a proxy based on household expenditures. In their study using DHS data they showed how the household asset index is a good proxy of long run household wealth. In addition, by using instrumental variable and reverse regression techniques, they found evidence that this composite may be less error-laden when representing long run economic status than expenditures. Other studies have shown that asset indices calculated with principal components analysis technique are a good measure of living standards especially if related to health

[1] http://www.worldbank.org/poverty/health/wbact/health_eq_tn04.pdf

indicators (Gwatkin *et al.* 2000). Bollen *et al.* (2001) in their study compared different types of economic status proxies in the study of fertility, using information from Living Standard Measurement Studies[2]. They found that the choice of economic status can affect the assessment of economic status's impact on fertility, but the estimates of the other covariates exhibit a greater robustness. They also found that an economic index constructed by applying the principal component analysis technique performs better than other economic proxies and there is no improvement with additional information available only in the LSMS.

In this thesis I applied the principal component analysis technique using data from the household questionnaire of the 2000 Egyptian Demographic and Health Survey in order to construct an economic index that will allow comparison of inequalities in the contraceptive use level and fertility desires by different economic status. The DHS household questionnaire includes questions, typically posed to the head of each household, concerning the household's ownership of a number of consumer items ranging from a fan to a television and car; dwelling characteristics such as flooring material; the type of drinking water source and toilet facilities used; and other characteristics that are related to wealth status (see Table A1 below for a list and descriptive statistics of assets information and dwelling characteristics available in the 2000 DHS). With this technique the socio economic status is defined in terms of assets or wealth, rather than in terms of income or consumption.

Each household asset for which the information was collected though the DHS was assigned a weight or factor score generated through principal components analysis. The principal components analysis (PCA) is a dimension reduction technique (Chatfield and Collins 1980). This multivariate statistical technique is used to examine the relationships between a set of correlated variables.

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[2] The World Bank's Living Standards Measurement Study (LSMS) surveys collect extensive expenditure data. However, the demographic and health data collected in the LSMS survey are far more limited than in the DHS.

Table A1: List and descriptive statistics of assets variables considered in the present analysis

	Mean	*Standard Deviation*	*Min*	*Max*
1.Has electricity	0.973	0.161	0	1
2.Has radio	0.818	0.385	0	1
3.Has television	0.891	0.311	0	1
4.Has refrigerator	0.660	0.473	0	1
5.Has bicycle	0.158	0.364	0	1
6.Has video	0.119	0.324	0	1
7.Has electric fan	0.709	0.454	0	1
8.Has water heater	0.354	0.478	0	1
9.Has sewing machine	0.086	0.280	0	1
10.Has automatic washing machine	0.112	0.316	0	1
11.Has other washing machine	0.764	0.424	0	1
12.Has motorcycle	0.018	0.133	0	1
13.Has car	0.086	0.280	0	1
14.Has farm/other land	0.206	0.404	0	1
15. Has livestock/ poultry	0.381	0.485	0	1
16. If piped drinking water in residence	0.816	0.387	0	1
17. If uses public tap	0.064	0.244	0	1
18. If uses open well water in residence	0.008	0.090	0	1
19. If uses public open well water	0.009	0.096	0	1
20. If uses covered well in residence	0.060	0.237	0	1
21. Other sources of drinking water	0.100	0.103	0	1
22. If uses modern flush toilet	0.349	0.476	0	1
23. If uses traditional flush toilet	0.590	0.491	0	1
24. If uses other types of toilet (latrine, bush, field)	0.060	0.239	0	1
25. If has dirt, sand, dung as a principal floor in dwelling	0.204	0.403	0	1
26. If has tiles as a principal floor in dwelling	0.038	0.192	0	1
27. If has cement as a principal flooring material	0.672	0.469	0	1
28. Other types of flooring	0.084	0.277	0	1
29. How many members of family are per sleeping room	1.587	0.999	0.066	12
30. Has telephone	0.291	0.454	0	1
31. Share toilet with other household	0.059	0.233	0	1
32. Owned dwelling	0.617	0.486	0	1
33. Owned jointly	0.107	0.309	0	1
34. Dwelling rented	0.232	0.422	0	1
35. Owned by other	0.043	0.203	0	1
36. Dwelling is an apartment	0.488	0.499	0	1
37.Dwelling is a fee standing house	0.477	0.499	0	1
38. Other types of dwelling	0.033	0.179	0	1

Note: The number of member of family per sleeping room is calculated by considering number of household member divided by the number of rooms in household.

As the number of asset variables available in EDHS is 38, the dimension of this dataset, which is equal to the number of variables, will be 38. Since it is not straightforward to visualize any data with more than three-dimensions, the PCA allows the reduction of the number of variables and thus dimensionality without losing too much information in the process. The PCA technique achieves this by creating a smaller number of variables which account for most of the variation in the original variables. The new variables (which are created such that they are uncorrelated with each other) are linear combinations of the original variables (factor scores). They are derived in decreasing order of importance so that, for example, the first new variable will account for as much as possible of the variation in the original data. The following section presents an illustration of PCA.

Suppose we have p variables (in our case p variables on household asset), X_1, $X_2,\ldots, X_p$, for n individuals.

The first principal component is the linear combination of these variables

$$Z_1 = a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + \ldots\ldots\ldots + a_{1p}X_p$$

The coefficients a_{11}, $a_{12},\ldots, a_{1p}$ are chosen such that the variance of Z_1 is maximised.

The coefficients are subject to the constraint that:

$$a_{11}^2 + a_{12}^2 + \ldots + a_{1p}^2 = 1$$

If this constraint is not introduced then the variance of Z_1 can be increased simply by increasing any one of the coefficient.

The second principal component is the linear combination

$$Z_2 = a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + \ldots\ldots\ldots + a_{2p}X_p$$

such that the variance of Z_2 is maximised subject to the constraint that

$$a_{21}^2 + a_{22}^2 + \ldots + a_{2p}^2 = 1$$

and also that Z_1 and Z_2 are uncorrelated.

The third principal component is the linear combination

$$Z_3 = a_{31}X_1 + a_{32}X_2 + a_{33}X_3 + \ldots\ldots\ldots + a_{3p}X_p$$

such that the variance of Z_3 is maximized subject to the constraint that

$$a_{31}^2 + a_{32}^2 + ... + a_{3p}^2 = 1$$

and also that Z_3 is uncorrelated with Z_1 and Z_2.

Further principal components (up to the maximum of p) are defined in a similar way. Each principal component is uncorrelated with all the others and the squares of its coefficients sums to one.

The principal components analysis involved finding the eigenvalues and eigenvectors of the covariance matrix. These are just special functions of the covariance matrix.

If I consider the ith principal component (PC),

$$Z_i = a_{i1}X_1 + a_{i2}X_2 + a_{i3}X_3 + ... + a_{ip}X_p$$

the variance of Z_i is the ith eigenvalue ,i.e. $Var(Z_i) = \lambda_i$;

One important property of PCs is that the total variation in the data is preserved. The sum of the variances of the PCs is equal to the sum of the variance of the original variables,

$$\text{var}(X_1) + \text{var}(X_2) + ... + \text{var}(X_p) = \text{var}(Z_1) + \text{var}(Z_2) + ... + \text{var}(Z_p)$$

$$= \lambda_i + \lambda_2 + \lambda_3 + ... + \lambda_p$$

The variables used in this analysis are measured in different scales (some of the variables are binary, some other categorical and some other continuous). This can lead to one variable having an undue influence on the principal components simply because of the scale of measurement. To avoid this problem usually the original variables are X_1, X_2,..., X_p are standardized before performing PCA.

The covariance matrix of the standardised variables, which we shall label X_1^*, X_2^*,... X_p^* is simply the correlation matrix of the original variables X_1, X_2,..., X_p. In other words we could carry out PCA by obtaining the eigenvalues and eigenvectors of the correlation matrix (rather than the covariance matrix).

Therefore the sum of the variance of the standardized variables is

$$\mathrm{var}(X_1^*) + \mathrm{var}(X_2^*) + ... + \mathrm{var}(X_p^*) = 1 + 1 + 1 + ... + 1 = p$$

which means that the sum of the variances of the PCs is

$$\lambda_1 + \lambda_2 + \lambda_3 + ... + \lambda_p = p$$

One important thing to be considering is that the proportion of variance explained by the first principal component will depend on the number of variables included in the analysis. As our aim is to explore the maximum variation amongst household score in order to obtain a 'better measure of wealth inequalities' we will try in this analysis to include all the variables related to household economics for constructing an household asset. In this way we will be able to capture more variation in living standards of the household. Including all the variables that are related to household economics present in the dataset will give us an asset index compose of around 38 variables. When we perform the PCA the dimension of the variable will be 38 and the proportion of variance explained by the first PC will be compared with the total variance of the 38 variables. If I use a small number of variables the proportion of variance explained from the first PC will be higher but this PC will be based on a small number of variables with supposedly smaller variance, and as well with less information. The dilemma is which and how many sets of variables we should consider in this analysis and which choice will best help us to obtain a good proxy of wealth inequalities in Egypt.

A previous study from the World Bank for Egypt which used the 1995 DHS and applied the method of Filmer and Pritchett (1994) they used a set of 22 variables, and the use the asset score derived from this analysis to explain the wealth inequalities amongst health indicator (Gwatkin *et al.* 2000). With those 22 variables the first principal component explained around 23 percent of the total variation. It needs to be said that the purpose of their analysis was to construct an asset index that could allow comparisons across countries , so the limitation in the number of variables used was primarily driven by the comparative elements of their studies.

In this thesis the PCA has been applied to the correlation matrix, and the proportion of variance explained by the first principal component is close to 19 per cent. Table A2 presents the results of the variance of the principal components analysis considering 38 variables. The results of PCA on the correlation matrix using only 15 variables (mainly those that represent household ownership of durable good, numbered 1-15 in Table A1), produced a first principal component explaining 23 per cent of the variation of original data (results not shown). Therefore we decided to consider the eigenvector resulted for PCA on 38 variables as although the proportion of variance explained is a little lower (19 per cent) it is based on a larger number of variables. And it will include also information on dwelling characteristics, leading us to a proxy for economic wealth that explains almost a quarter of original variation of the data, including not only information on ownership of goods but also dwelling characteristics.

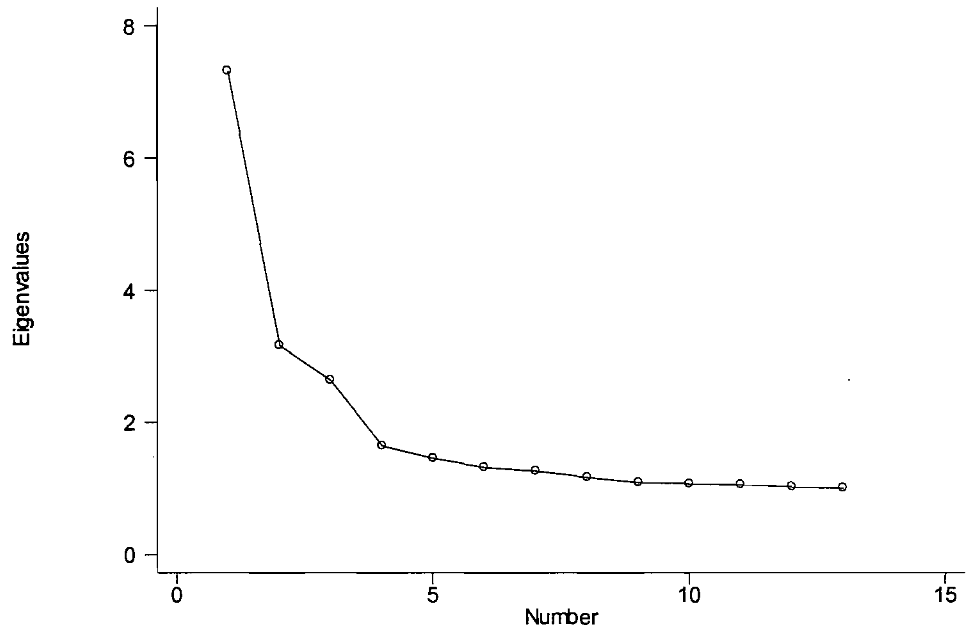
Table A2: Total variance explained by each component.

Component	*Eigenvalues*	*Differences*	*Proportion variance explained*	*Cumulative proportion of variance explained*
1	7.308	4.145	0.192	0.192
2	3.163	0.533	0.083	0.275
3	2.629	0.991	0.069	0.344
4	1.638	0.189	0.043	0.387
5	1.449	0.132	0.038	0.426
6	1.316	0.058	0.034	0.460
7	1.257	0.094	0.033	0.493
8	1.163	0.081	0.030	0.524
9	1.081	0.015	0.028	0.552
10	1.065	0.016	0.028	0.580
11	1.049	0.033	0.027	0.608
12	1.015	0.012	0.026	0.635
13	1.003	0.028	0.026	0.661
14	0.974	0.014	0.025	0.687
15	0.960	0.031	0.025	0.712
16	0.929	0.011	0.024	0.737
17	0.917	0.096	0.024	0.761
18	0.821	0.020	0.021	0.782
19	0.801	0.048	0.021	0.803
20	0.753	0.037	0.019	0.823
21	0.715	0.063	0.018	0.842
22	0.065	0.026	0.017	0.859
23	0.625	0.014	0.016	0.876
24	0.610	0.044	0.016	0.892
25	0.566	0.037	0.014	0.907
26	0.528	0.017	0.013	0.921
27	0.511	0.031	0.013	0.934
28	0.479	0.035	0.012	0.947
29	0.444	0.019	0.011	0.958
30	0.424	0.026	0.011	0.970
31	0.397	0.059	0.010	0.980
32	0.338	0.029	0.008	0.989

33	0.308	0.213	0.008	0.997
34	0.095	0.094	0.002	1.000
35	0.000	0.000	0.000	1.000
36	0.000	0.000	0.000	1.000
37	0.000	0.000	0.000	1.000
38	0.000	0.000	0.000	1.000

The first principal component explains the largest share of the variance on of the original variable and each subsequent component explains a decreasing proportion of the variance. The scree plot shown in Figure A1 displays the proportion of variance explained by each principal component. The x-axis represents the component (we only show 13) and the y-axis shows the eigenvalues of each component.

Figure A1: Scree plot for results of principal component using household variable in 2000 DHS household questionnaire



Principal components analysis is a technique for extracting from a large number of variables those few orthogonal linear combinations of the variables that best capture the common information. The first principal component is a linear index of variables with the largest amount of information common to all of variables. In the present analysis the first principal component explained almost 20 percent of the original variation of data, and to calculate the household index I will consider only factor score (eigenvectors) of the first principal component. Table A3, column 4 shows results of the principal component of the 38 variable considered.

After having calculated the first eigenvectors with principal components analysis, to calculate the household asset index for the *j*th household considering N variables I used the following formula:

$$A_j = f_1(a_{j1} - a_1)/(s_1) + ... + f_N(a_{jN} - a_{jn})/(s_N),$$

where f_1 is the eigenvector for the first asset as determined by the procedure, a_{j1} is the *j*th household's value for the first asset and a_1 and s_1 are the mean and standard deviation of the first asset variable over all households.

The mean value of the index is zero by construction. The standard deviation in this case is 2.70 since all asset variables (except 'number of household member per sleeping room') take only the values of zero or one: the weights have an easy interpretation. A move from 0 to 1 (if household not owns or owns an asset) changes the index by f_1 / s_1, for example a household that owns a radio has an asset index higher by 0.45 than that one that does not. Owning a car raises a household's asset index by 0.43 units. Sharing toilet facilities with other household lowers the index by 0.24 (see column 5 to see the change in the index due to each asset variable).

Each household was assigned a standardized score for each asset, where the score differs depending on whether or not the household owed that asset. In column 6 of Table A3 below is shown the value of the score if household owned the asset and in column 7 of Table A.3 is shown the value of score if household does not have the asset.

Table A3: Result of household economic index.

(1)	*Mean* (2)	*Standard Deviation* (3)	*Eigenvectors of first principal component* (4)	*Scoring factor/ Std. Dev.* (5)	*Score if they have asset* (6)	*Score if they don't have asset* (7)
1. Has electricity	0.973	0.161	0.112	0.696	0.019	-0.677
2. Has radio	0.818	0.385	0.174	0.452	0.082	-0.370
3. Has television	0.891	0.311	0.152	0.489	0.053	-0.435
4. Has refrigerator	0.660	0.473	0.256	0.541	0.184	-0.357
5. Has bicycle	0.158	0.364	-0.001	-0.003	-0.002	0.000
6. Has video	0.119	0.324	0.191	0.590	0.519	-0.070
7. Has electric fan	0.709	0.454	0.203	0.447	0.130	-0.317
8. Has water heater	0.354	0.478	0.286	0.598	0.387	-0.212
9. Has sewing machine	0.086	0.280	0.090	0.321	0.294	-0.028
10. Has automatic washing machine	0.112	0.316	0.195	0.617	0.548	-0.069
11.Has other washing machine	0.764	0.424	0.086	0.203	0.048	-0.155
12. Has motorcycle	0.018	0.133	0.017	0.128	0.126	-0.002
13. Has car	0.086	0.280	0.12	0.429	0.392	-0.037
14. Has farm/other land	0.206	0.404	-0.106	-0.262	-0.208	0.054
15. Has livestock/ poultry	0.381	0.485	-0.208	-0.429	-0.265	0.163
16. If piped drinking water in residence	0.816	0.387	0.211	0.545	0.100	-0.445
17. If uses public tap	0.064	0.244	-0.126	-0.516	-0.483	0.033
18. If uses open well water in residence	0.008	0.090	-0.040	-0.444	-0.441	0.004
19. If uses public open well water	0.009	0.096	-0.052	-0.542	-0.537	0.005
20. If uses covered well in residence	0.060	0.237	-0.011	-0.046	-0.044	0.003
21. Other sources of drinking water	0.10	0.103	-0.027	-0.262	-0.236	0.026
22. If uses modern flush toilet	0.349	0.476	0.296	0.622	0.405	-0.217
23. If uses traditional flush toilet	0.590	0.491	-0.220	-0.448	-0.184	0.264
24. If uses other types of toilet (latrine, bush, field)	0.060	0.239	-0.137	-0.573	-0.539	0.034
25. If has dirt, sand, dung as a principal floor in dwelling	0.204	0.403	-0.225	-0.558	-0.444	0.114
26. If has tiles as a principal floor in dwelling	0.038	0.192	0.100	0.521	0.501	-0.020
27. If has cement as a principal flooring material	0.672	0.469	0.073	0.156	0.051	-0.105
28. Other types of flooring	0.084	0.277	0.133	0.480	0.440	-0.040
29. How many member of family are per sleeping room	1.587	0.999	-0.123	-0.123	**	**
30. Has telephone	0.291	0.454	0.240	0.529	0.375	-0.154
31. Share toilet with other household	0.059	0.233	-0.057	-0.245	-0.230	0.014
32. Owned dwelling	0.617	0.486	-0.113	-0.233	-0.089	0.143
33. Owned jointly	0.107	0.309	-0.041	-0.133	-0.118	0.014
34. Dwelling rented	0.232	0.422	0.157	0.372	0.286	-0.086
35. Owned by other	0.043	0.203	0.006	0.030	0.028	-0.001
36. Dwelling is an apartment	0.488	0.499	0.278	0.557	0.285	-0.272
37. Dwelling is a free standing house	0.477	0.499	-0.259	-0.519	-0.271	0.248
38. Other types of dwelling	0.033	0.179	-0.052	-0.291	-0.281	0.010
	0	2.7				

Note: The number of member of family per sleeping room is calculated by considering number of household member divided by the number of rooms in household. The household score for number of family members per sleeping room is calculated as follow : {# family members per room-un-weighted mean)/SD} *score.

These scores were summed by household, and individuals ranked according to the total score of the household in which they resided. These standardized scores were then used to create the breakpoints that define wealth quintiles as follows. The sample of household has been then divided into population quintiles (five groups with same number of individuals each). Table A4 shows the value of the factor score for each quintile. So that individuals living in a household which has a factor score below -2.63 belong to the lowest quintile, whereas an individual residing in a household which has a factor score between -1.27 and 0.38 belong to the middle quintile.

Wealth quintiles are expressed in terms of quintiles of individuals in the population, rather than quintiles of individuals at risk for one health indicator. This approach has the advantage of producing information directly relevant to the principal question of interest, in the present case the relationship between wealth and use of contraception or desired fertility. The household index has been first defined using the household dataset, subsequently the factors score(in a continuous form) derived by the household dataset have been merged with the individual dataset set to derived population quintile (obtaining break point of the five different wealth quintile to allow comparisons of inequalities). Then both the factors score and the quintile have been merged with the sampled population considered in the analysis (in this thesis with the analysis presented in Chapter 3 and 4).

Table A4: Quintile and factor score of asset index.

Quintile	*Factor score*
Lowest quintile	Less than -2.63
Second quintile	-2.63 and -1.27
Middle quintile	-1.27 and 0.38
Fourth quintile	0.38 and 2.61
Highest quintile	More than 2.61

The difference in the average index between the poorest quintiles and the richest quintiles is 7.4 units, whereas the difference between the poorest quintiles and the middle is 3.2 units (see Table A5).

Table A5: Descriptive statistics of each asset variables by wealth quintiles

	Mean (1)	*Poorest quintile* (2)	*Lower middle quintile* (3)	*Middle quintile* (4)	*Upper middle quintile* (5)	*Richest quintile* (6)
1.Has electricity	0.973	0.863	0.996	0.997	1	1
2. Has radio	0.818	0.452	0.766	0.877	0.945	0.991
3. Has television	0.891	0.611	0.894	0.943	0.975	0.996
4. Has refrigerator	0.66	0.07	0.413	0.749	0.944	0.996
5. Has bicycle	0.158	0.092	0.179	0.236	0.179	0.108
6. Has video	0.119	0	0.002	0.013	0.061	0.45
7. Has electric fan	0.709	0.267	0.571	0.744	0.888	0.984
8. Has water heater	0.354	0	0.009	0.11	0.509	0.977
9. Has sewing machine	0.086	0.007	0.034	0.074	0.1	0.187
10. Has automatic washing machine	0.112	0	0.001	0.0039	0.031	0.459
11. Has other washing machine	0.764	0.405	0.791	0.919	0.948	0.735
12. Has motorcycle	0.018	0.004	0.1	0.027	0.025	0.021
13. Has car	0.086	0.153	0.021	0.037	0.048	0.27
14. Has farm/other land	0.206	0.362	0.354	0.208	0.091	0.069
15. Has livestock/ poultry	0.381	0.739	0.661	0.443	0.152	0.028
16. If piped drinking water in residence	0.816	0.306	0.777	0.945	0.989	0.995
17. If uses public tap	0.064	0.268	0.062	0.011	0.0013	0
18. If uses open well water in residence	0.008	0.031	0.009	0.003	0	0
19. If uses public open well water	0.009	0.039	0.009	0.001	0	0
20. If uses covered well in residence	0.06	0.231	0.066	0.021	0.003	0
21. Other sources of drinking water	0.1	0.21	0.024	0.0063	0.001	0.003
22. If uses modern flush toilet	0.349	0	0.004	0.046	0.532	0.99
23. If uses traditional flush toilet	0.59	0.725	0.949	0.946	0.466	0.009
24. If uses other types of toilet (latrine, bush, field)	0.06	0.273	0.045	0.006	0	0
25. If has dirt, sand, dung as a principal floor in dwelling	0.204	0.74	0.317	0.04	0.003	0
26. If has tiles as a principal floor in dwelling	0.038	0	0.004	0.005	0.017	0.1435
27. If has cement as a principal flooring material	0.672	0.257	0.675	0.937	0.886	0.587
28. Other types of flooring	0.084	0	0.002	0.016	0.091	0.267
29. How many member of family are per sleeping room	1.587	2.065	1.834	1.61	1.38	1.164
30. Has telephone	0.291	0.004	0.041	0.156	0.297	0.828
31. Share toilet with other household	0.059	0.106	0.093	0.081	0.023	0.011
32. Owned dwelling	0.617	0.799	0.757	0.683	0.494	0.415
33. Owned jointly	0.107	0.131	0.133	0.147	0.103	0.036
34. Dwelling rented	0.232	0.0382	0.072	0.121	0.338	0.511
35. Owned by other	0.043	0.31	0.036	0.048	0.063	0.036
36. Dwelling is an apartment	0.488	0.021	0.09	0.376	0.816	0.974
37. Dwelling is a free standing house	0.477	0.92	0.839	0.575	0.18	0.025
38. Other types of dwelling	0.033	0.057	0.07	0.048	0.003	0
Economic Status index	0	-3.734	-1.948	-0.532	1.475	3.669

Although the Egyptian Demographic and Health survey does not provide information on expenditure or income and it is not possible to verify and test the reliability of the asset index, it is possible to assert that the index constructed with the principal component analysis produces clean separation across poor, middle, and rich household for each asset individually. The index produces sharp differences across groups in nearly every asset: for example amongst the poorest quintile almost nobody owned a refrigerator whereas almost everybody amongst the richest owned a refrigerator, amongst the poorest only 30 per cent had piped water in their residence whereas almost all the population belonging to the richest quintiles have so.

One question to ask is whether the asset index loads excessively on variables that are dependent on locally available infrastructure (electricity, piped water) rather than household specific variables. On this score the clean separation between poor and rich on non-infrastructure variables, for example refrigerator (30 percent of poor and 99 per cent of richest), television (61 per cent for poorest and 99 per cent for richest), video (no one of poorest owned a video compare with 45 per cent of the richest) and number of household member per sleeping room (more than 2 persons per room in average for the poorest and just over one persons per room for richest quintiles) is reassuring.

On the other hand, while the first principal components of assets might serve as a reasonable overall index, a remaining question is whether the first component contains all of the relevant information. The second principal component is more difficult to interpret, and the inclusion of information drawn from the second principal component with the first it is not so straightforward as the two components might represent two different aspect of wealth and the first and second components may produces different household ranking for this reasons.

Furthermore creating one index that included all asset variables limits the types of analysis that can be performed. In particular, the use of a unified index does not permit a disaggregated analysis to examine which particular asset variables in the index are more or less important in their association with (in this case) contraceptive use level or fertility desired, a question that can have an important policy implications.

A final remark about this method it is that it does not account for economies of scale. The asset index developed here is calculated assuming complete economies of scale. In other words, the addition of one more person to the household is assumed to not change the weight of a variable for any of the other individuals in that same household. This assumption appears reasonable for many of the asset items, but there are exceptions (such as the number of person per sleeping room). Alternative approaches would be to assume no or partial economies of scale (Wagstaff, Paci and Doorslaer 1991).

Although the economic index calculated with the principal components analysis technique is far from being an exact measure of economic status, it provides a tool to study wealth inequalities as they affect health and demographic indicators (in the present paper modern contraception use level and desired fertility). As such it reduces also the possibility that parameters estimates of other variable included in the multivariate analysis are biased from the fact that a measure of wealth was not included.

References Appendix A

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