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Introduction

Of the demographic variables, fertility is considered the most important and dynamic in demographic change. In fact, with mortality now fairly well under control in much of the world, fertility and fertility behaviour are shaping the future of most populations. Changes in fertility directly affect the population structure as well as its growth and dynamic. In the case of less developed countries (LDCs) that have high levels of fertility, changes in fertility are of utmost importance for the population as a whole, since these changes modify all the structures of society: social, economic, and political. These structural changes will later affect the population and its behaviour.

In demographic research and literature, the most widely examined question is: What induces people to reduce their fertility? The study of fertility differentials is important, because it may bring to light hidden factors underlying fertility decisions and the analysis of fertility differentials will help to explain fertility change (Singh and Casterline, 1985).

Most of the theories that explain fertility decline can be broadly classified as macrolevel or microlevel theories. One of the more challenging tasks for the social scientist is the integration of these two levels of analysis. After reviewing the demographic literature related to fertility decline in different countries of the Third World, and keeping in mind the information available, the models developed by Bongaarts and Easterlin were seen to provide the basic conceptual framework for the study of fertility and its decline in developing countries (Bulatao and Lee, 1983).

Of course, it is not the countries that cause fertility change, rather it is people from specific groups, whether they are classified according to social, economic, or ethnic characteristics, who are the instigators of fertility change. Therefore, it is very important to study these subgroups in order to understand the variability in their reproductive behaviour, as well as the biological, behavioral, economic, social, and cultural factors that affect fertility.

The Bolivian population as a whole exhibits great socioeconomic heterogeneity. The social and economic changes of the 40 years since the National Revolution of 1952 appear to have influenced primarily the urban, educated, professional groups of the population, while the rural and/or uneducated groups have retained their former socioeconomic characteristics. In heterogeneous societies like Bolivia, which have remarkable distinctions among social strata, it is necessary to examine closely the reproductive behaviour of particular subgroups in order to understand the real meaning of an average fertility measure such as the Total Fertility Rate (TFR).

Very little has been written concerning the evolution of fertility and the factors that determine the high levels of fertility in Bolivia. Because of the lack of adequate data, little has also been written about the biological and behavioural factors through which socioeconomic factors operate to affect fertility. Most fertility research in Bolivia has been oriented towards estimates of levels and trends, sometimes taking into account only socioeconomic differentials. The 1989 Demographic and Health Survey (DHS) of Bolivia *Encuesta Nacional de Demografía y Salud* (ENDESA-89) (INE and IRD, 1990) currently provides data for the study of reproductive behaviour at a more disaggregate level.

Objectives of the Study

In this report data on the determinants of reproductive behaviour and on various related information concerning the community, households, women, mothers, and children gathered by the Bolivia DHS survey are analyzed.

Preliminary reports and initial analyses have been done using the survey data (INE and IRD, 1990; Bicego and Boerma, 1990; Loaiza and Schoemaker, 1991; Guzman et al., 1991; Schoemaker, 1991; Vidal and Ravanera, 1992). However, the wealth of information gathered is such that more in-depth analyses can be made on various demographic phenomena.

The purpose of this paper is to investigate the differentials and determinants of Bolivian fertility from the perspective of the most relevant groups, in order to explain the slowness of the fertility decline. The purpose is not only to study the extent of the differentials in fertility that explain fertility change, but more importantly, to explain the possible basis of variation in the levels of fertility and reproductive behaviour of these groups, as a function of the biological, behavioral, economic, social, and cultural factors that directly and indirectly affect reproductive behaviour, such as nuptiality patterns, contraceptive use, and postpartum infecundability.

Importance of the Study

A study of this type can be very useful to a country such as Bolivia, where fertility is still very high. An estimate for the 1985–1989 period, for example, shows that Bolivia's TFR was 5.05 children per woman (ENPV-88), the highest in South America. The need for disaggregated information on levels of reproductive behaviour in Bolivia for the different subgroups and for knowledge of factors affecting such levels becomes even more crucial because of the extreme diversities in education, occupation, urbanization, and ethnicity of Bolivian society. The levels of fertility and the conditions affecting the reproductive behaviour of women differ according to Upper, Middle, Lower, and Agriculturalist social strata. Differences in education, occupation, and levels of economic development result in variations in fertility and reproductive behaviour among these subpopulations.

From the point of view of policymaking, for a country whose policy target is to increase life expectancy through the reduction of infant mortality and the implementation of programs of reproductive health (Bolivia Ministerio de Planeamiento y Coordinación de la Presidencia de la República), the knowledge of fertility behaviour and its determinants will indeed be valuable.

In addition to providing a better insight into fertility behaviour and an explanation of the observed fertility levels in Bolivia, the present study will contribute to the demographic knowledge of the reproductive behaviour of Bolivian women and its determinants. This will provide a basis for more reliable predictions of fertility patterns and trends in Bolivia.

Description of the Study Population

Bolivia, the fifth largest nation in South America, is located near the core of the continent. This completely landlocked nation covers an area of 1,098,591 square kilometres and has a population estimated at approximately 6,992,000 in 1988 (National Institute of Statistics). Its population density of just over six people per square kilometre is one of the lowest in the world, indicating its underpopulated character.

In Bolivian society, four categories of social strata can be clearly identified: the Upper, the Middle, the Lower, and the Agriculturalist. Each of these social strata categories is different, not only because of the different level of education, occupation, and access to health services and mass media, but also because of important differences in population composition. The Upper and Middle social strata categories are mainly composed of the Spanish descendants and mestizo population, the Lower by the Cholo population and indigenous ethnic groups that live in the urban areas, and the Agriculturalist by the indigenous groups such as the Aymara, Quechua, and Guarani.

In traditional societies such as Bolivia, where men are the principal providers for the household, the man's social strata is used as a proxy for the social strata of the woman. For this study, the variable "social strata" will be constructed using information about the education and occupation of a woman's current husband, if she is still married, or of her former husband if she is no longer married. To construct the "social strata" variable four categories of husband's occupation (Inactive, White Collar, Blue Collar, and Agriculturalist) were combined with three categories of education (12 or more years, 6 to 11 years, and less than 6 years). The combination of these two variables resulted in the four categories of social strata — Upper, Middle, Lower, and Agriculturalist.

The Data

The topics analyzed in this paper use data obtained from the 1989 DHS survey of Bolivia. The DHS was carried out by the Instituto Nacional de Estadística and the Institute for Resource Development/Macro Systems, Inc. as part of an international program that assists developing countries in conducting population and health surveys. A total of 7923 women, 15 to 49 years old, responded to the survey, which included questions on their various socioeconomic characteristics; fertility and fertility preferences; contraceptive knowledge and use; morbidity and mortality of their children; pre- and postnatal practices, including immunization, verbal autopsy and maternal mortality; nuptiality and work history; and weight of their children.

Bolivia has a very limited statistical tradition. With the 1989 DHS survey, highly reliable information about the variables mentioned above is available for the first time and can be used to study the Bolivian population and its reproductive behaviour. The use of in-depth questionnaires allows for detailed analysis of the reproductive behaviour of Bolivian women. The information obtained in the survey will serve adequately for describing and measuring fertility change, as well as for revealing associations between variables that explain fertility behaviour in a heterogeneous society like Bolivia.

Fertility Theories and Fertility Decline

In general, there are three main areas of concentration for the study of fertility: the microlevel determinants of fertility, which are influences that operate at the individual, couple, or household level; the macrolevel determinants of fertility, which operate in the broader social and historical context, and act indirectly through the microlevel determinants; and the link between the macrolevel and microlevel influences.

In the last 20 years, there has not been one dominant theoretical focus to explain the problem of changes in fertility. On the contrary, the period of 1970 to 1990 was characterized by a proliferation of focuses that emphasized different aspects of a wide range of changes in fertility, whether it was the conflict between quality and quantity of children, between family income and opportunity cost, the growing availability and knowledge of birth control, methods of security and pension, or the direction of intergenerational transfers.

Methodology

The framework of analysis is based mainly on the model proposed by Bongaarts (1978, 1983) and on the Easterlin Framework (Easterlin and Crimmins, 1985), thereby linking macrolevel and microlevel analyses.

An important consideration in the study of fertility is the measure of the dependent variable itself. For this purpose, information is classified according to the woman's social strata. To get the differentials in fertility rates, an estimate of the TFR for each category of social strata is computed. Indirect estimates based on techniques proposed by Brass (1964) are used to estimate the levels of fertility. The major objectives are to comprehend the manner in which the social heterogeneity of Bolivia has expressed itself in reproductive behaviour, the influence of social factors on fertility, and how fertility levels can be modified through population policies.

Until recently, studies of the cause of fertility differentials often tried to measure the impact of socioeconomic factors on fertility. The biological and behavioral factors through which socioeconomic, cultural, and environmental factors affect fertility were seldom studied. This is due in part to the fact that socioeconomic variables are easy to collect and readily available, and in part because of the lack of a mathematical framework needed to measure the impact of biological and behavioral variables on fertility.

The link between microlevel and macrolevel influences on fertility was first clearly detailed by Davis and Blake (1956) who made a major contribution to our understanding of the process of fertility determination by introducing the "intermediate variables," later called the "proximate variables" (Bongaarts and Potter, 1983). This led to growing recognition that fertility is determined by a set of 11 biological and behavioral factors through which socioeconomic, cultural, and environmental variables affect fertility indirectly. These intermediate variables influence one of the three biological events necessary for a birth to occur: (1) intercourse, (2) conception, and (3) gestation and parturition.

According to Davis and Blake (1956), each of the intermediate variables may have either a positive or negative effect on fertility, and the differential effects of these variables yield variations in fertility levels. They suggest that in the past, researchers observed inconclusive and confused results when trying to explain the level of fertility in many societies, given their minimal understanding of the intermediate fertility variables.

Microlevel and macrolevel phenomena can influence fertility. For example, personal preferences or microlevel economic concerns may influence the use of contraceptives; these microlevel preferences and concerns may, in turn, be influenced by the social and economic structure of the society, as well as by organizational efforts to promote birth control.

In LDCs, especially where contraception is not widespread, factors that affect exposure to intercourse are very important, especially those that influence age at entry into sexual unions (particularly marriage), and the proportion married. Also important is voluntary abstinence and temporary infecundity associated with breastfeeding (Bongaarts, 1982; Bongaarts and Potter, 1983).

Bongaarts Model

Since the publication of the Davis and Blake (1956) article, the role of the intermediate variables in determining the level of fertility has been well recognized. But the Davis and Blake framework is difficult to put into operation, due to the absence of appropriate data on the intermediate fertility variables. Although several authors have tried to develop mathematical accounting procedures to measure the impact of intermediate variables, it was Bongaarts (1978) who first suggested a comprehensive multiplicative model where all intermediate fertility variables are considered simultaneously. Bongaarts regrouped Davis and Blake's intermediate fertility variables and proposed eight factors in three broad categories, under the title "proximate determinants of fertility." As explained by Bongaarts's "Analysis of the Proximate Determinants" (1978), the socioeconomic, cultural, and environmental variables that affect fertility indirectly act upon it through intermediate variables that can be classified into three groups:

I Exposure factors

1. Proportion married

II Deliberate marital fertility control factors

2. Contraception
3. Induced abortion

III Natural marital fertility factors

4. Lactational infecundability
5. Frequency of intercourse
6. Sterility
7. Spontaneous intrauterine mortality
8. Duration of the fertile period

Bongaarts (1978) described each proximate determinant as follows:

(1) **Proportion married:** This variable measures the proportion of women of reproductive age that regularly engage in sexual intercourse. Therefore, frequent or prolonged spousal separation will have a substantial negative impact on fertility.

(2) **Contraception:** The variable contraception indicates any deliberate parity-dependent practice, including abstention and sterilization, undertaken to reduce the risk of conception and limit family size. Several behavioral and cultural practices, such as breastfeeding and postpartum abstinence, are not counted as contraception, although they affect fertility by increasing child spacing, because the aims of breastfeeding and postpartum abstinence are child nourishment and protection of maternal health rather than limitation of family size.

(3) **Induced abortion:** This includes any practice that deliberately interrupts the normal course of gestation.

(4) Lactational infecundability: Following a pregnancy, the woman remains unable to conceive until the normal pattern of ovulation and menstruation is restored. The period in which the normal pattern of ovulation and menstruation is absent, due to a child's birth, is known as postpartum amenorrhea. The length of lactational infecundability and the length of postpartum amenorrhea are highly correlated. The effects of lactational infecundability are a function of the duration, intensity, and pattern of breastfeeding.

(5) Frequency of intercourse: This variable attempts to measure the normal variation in the rate of intercourse, which includes temporary separation or illness.

(6) Sterility: Refers to the biological inability to produce a child. All women are sterile before menarche and after menopause, but a small proportion of women remain sterile at the beginning of the reproductive years and continue to be sterile during the entire reproductive period. This kind of sterility is commonly known as natural sterility. For a woman who enters her reproductive span as fecund but subsequently becomes sterile during the reproductive period, this is known as "pathological sterility" or secondary sterility.

(7) Spontaneous intrauterine mortality: A proportion of all conceptions may not end in a live birth because of premature spontaneous termination in a miscarriage or stillbirth.

(8) Duration of fertile period: In the middle of the menstrual cycle, approximately 2 days are considered to be the fertile period when a woman can conceive (approximate time of ovulation). The duration of the fertile period is a function of the duration of the viability of the sperm and ovum, since a woman is able to conceive for only a short period when ovulation takes place.

Before the period of demographic transition, variations in fertility were primarily a function of the exposure factors and the natural marital fertility factors. In the period of demographic transition fertility decline has depended principally on voluntary regulation of births, thereby expressing a change in the orientation of reproductive behaviour.

By definition, variations in fertility among countries, among social strata within countries, and among individual women are due to the effects of one or more of the proximate variables. Accurate measures of all proximate variables should explain the total variance in fertility. The impact of each of these proximate variables varies significantly from one society to another. For example, the variable "proportion married," which measures the degree to which women of reproductive age are exposed to the risk of pregnancy, is directly affected by societal marriage norms. Davis and Blake (1956) cite the case of Ireland, where approximately 25 percent of the women of reproductive age remain unmarried at the end of the childbearing period. The equivalent figure for any Lesser Developed Country (LDC) is less than 5 percent. Moreover, each of the proximate variables varies within the society depending on the socioeconomic status of the family.

Although Bongaarts' model proposes eight proximate determinants of fertility, empirical evidence suggests that most of the variations in fertility levels can be attributed to the differential impact of four fertility variables: marriage delay and disruption, contraception, abortion, and post-partum infecundability, including breastfeeding and voluntary abstinence (Bongaarts, 1978, 1982, and 1983; Bongaarts and Kirmeyer, 1981; Bongaarts and Potter, 1983).

The simplified version of the four determinants model proposed by Bongaarts assumes fertility levels to be lower than the maximum biological ceiling, given the constraining effects of the four fertility variables. These factors operate sequentially to reduce the total potential fertility (TF) to the observed value of the TFR. According to Bongaarts and Potter (1983), empirical evidence has established that for almost all populations, observed fecundity rates vary within the range of 13 to 17 children per woman and around an average value of 15.3 children.

The Bongaarts model (1978) has the great advantage that the main immediate determinants of fertility can be measured and their relative effects on fertility quantified. The results of empirical studies confirm that most of the fertility variation in the majority of countries can be explained by marriage, contraception, abortion, and breastfeeding (Bongaarts, 1978, 1982; Bongaarts and Kirmeyer, 1982). The Bongaarts model assumes a closed system to summarize the effect of each factor, reducing fertility from its potential maximum to its actual level. The Bongaarts model, requiring fewer intermediate variables, allows the study of fertility as it responds to social and economic transformations. Like any other model based on retrospective information, the accuracy of the information used depends upon the accuracy of recall of the people interviewed. Failure to record all events as they occur could affect the estimations of the indices. When the model is applied to LDCs, these types of errors are more likely to be present.

The model suggested by Easterlin and Crimmins combines both Bongaarts'(1978) "Proximate Determinants Framework" and Easterlin's (1978) "Supply and Demand Model." According to the model, the number of children ever born to a woman is a function of both her natural fertility variables and her deliberate attempts to control fertility variables.

Easterlin Framework

Economists like Leibenstein (1957), Okun (1958), and Becker (1960), explain fertility behaviour from a microeconomic viewpoint. Early microeconomic fertility theorists focused their analysis on the relationship between fertility and income. Later improvements (Easterlin, 1975,1980; Easterlin and Crimmins, 1981, 1982, 1985) provide a socioeconomic approach to the construction of an economic model of fertility, synthesizing previous socioeconomic analyses with fertility transition.

The Easterlin framework is broader than the Chicago School's microeconomic model in that, along with the demand for children, it implicitly incorporates the potential supply of children. The Easterlin synthesis is an effort to combine the microeconomic model and sociological theories of fertility decline. Easterlin's framework uses the intermediate variables approach and connects it with the mainstream "children as consumer durables" economic approach to fertility. He argues that the Chicago School's emphasis on tastes and "supply" factors severely limits the empirical relevance of their theory.

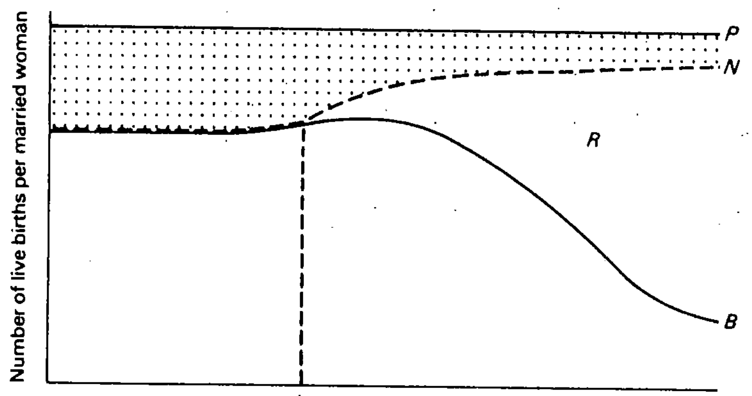
Easterlin and Crimmins' approach seeks to explain fertility decline in the light of a more general societal transformation called the "modernization process." This process consists of structural changes that affect the economic, social, and political structures of the society in which they occur. Modernization on the social and demographic side, according to Easterlin and Crimmins (1985:4), involves:

> Significant alterations in fertility, mortality, and migration, in place of residence, in family size and structure, in the educational system, and in provision for public health. Its influence extends into the areas of income distribution, class structure, government organization, and political structure. In terms of human personality modernization, it is characterized by an increased openness to new experience, increased independence from parental authority, belief in the efficacy of science, and ambition for oneself and one's children.

From a demographic point of view, the major change represented by modernization is the increased ability and will to control fertility. These alterations are very important not only quantitatively but more importantly, qualitatively, in light of the reorganization of family life that they produce, for example, the changing status of women in family and society. The reduced time spent in pregnancy and childbearing will permit women to seek alternative roles.

According to Easterlin and Crimmins, a second feature of the fertility revolution is the mechanism that makes fertility choices possible, "a shift from a situation in which fertility is controlled through various social and biological mechanisms to one of limitation of family size by the conscious decision of individual households." Easterlin and Crimmins call this fertility choice, "fertility regulation." The relationship between the two aspects of the fertility revolution is presented in Figure 1.

Figure 1. Fertility transition



Source: Easterlin and Crimmins (1985:7)

Reproductive potential (P) represents the number of children that would be born, given the most favorable reproductive conditions; natural fertility (N) indicates the number of children that would be born in the absence of deliberate fertility control. The difference between (P) and (N) represents the fact that in any society at any given moment, physiological (i.e., malnutrition) and cultural (i.e., breastfeeding practices) conditions prevent fertility from reaching its biological maximum even in the prevalence of natural fertility. While the reproductive potential remains constant, natural fertility can actually increase with modernization, as a result of shortening the duration of breastfeeding or the deterioration of intercourse taboos, and improvements in child survival.

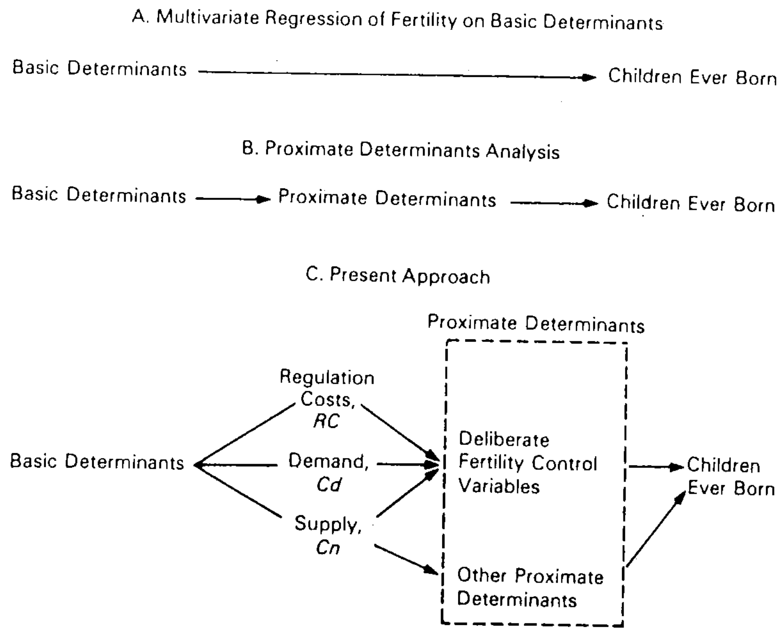
Actual fertility (B) would be the same as N temporarily, but from a certain point onwards in the modernization process, depicted here as "h," actual fertility would begin to fall below the natural fertility, under the impact of deliberate fertility control. The gap between B and N thus represents the extent of conscious fertility control, which is measured in terms of births averted. This representation of fertility decline does not take into account the changes that inevitably occur during demographic transition, such as changes in nuptiality or a shift to a later age at marriage, especially in today's developing countries.

Easterlin's approach involves a three-stage analysis of fertility determination (Figure 2). In each stage, the functional relationship between the dependent variable and independent variables is estimated through a linear regression model.

The first stage includes an individual-level intermediate variable analysis of the proximate determinants of fertility, following the classical approach suggested by Davis and Blake (1956) and later, Bongaarts (1978). The focus is on the impact of intermediate variables on cumulative fertility through their effect on the length of exposure to intercourse, the risk of conception, and the outcome of gestation.

In the second stage, the use of fertility control is selected for analysis. The focus is on the impact of differences in motivation and the cost of regulation of fertility control. Easterlin and Crimmins (1985:14-15) conceptualized motivation and costs of regulation as follows:

Figure 2. Approaches to analyzing the impact of modernization on fertility



Source: Easterlin and Crimmins (1985:13)

> (1) The demand for children (C_d), the number of surviving children parents would want if fertility regulation were costless. This depends on household tastes, income and child cost considerations, including both economic and non-economic returns from children as well as their cost. It is roughly approximated by survey responses on desired family size;
>
> (2) The supply of children (C_n), the number of surviving children a couple would have if they made no deliberate attempt to limit family size. This reflects both a couple's natural fertility and the chances of child survival;
>
> (3) The cost of fertility regulation, which includes the couple's attitudes toward and access to fertility control methods and supplies. It includes both subjective disadvantages of regulation such as distaste for the general notion of family planning and the drawbacks of specific techniques like abortion, and the economic cost of control, such as the time and money required to procure family planning services.

In the third stage, the variables entered in the previous stages are treated as dependent variables to be explained by family background characteristics as well as women's cultural values and practices.

According to the Easterlin and Crimmins model, the immediate determinants of the demand for children are income, prices, and tastes. The demand for children is studied according to the traditional theory of household choice:

> Variations in the basic tastes, prices and income determinants will cause differences in the demand among households at a given time or for a given household over time. Other factors being constant, the number of children desired would be expected to vary directly with household income (assuming children are a "normal" good), directly with the price of goods relative to children, and inversely with the strength of tastes for goods relative to children (Easterlin and Crimmins, 1985).

The potential supply of children depends on natural fertility and the probability of a baby surviving to adulthood. Natural fertility is determined by the period of exposure to intercourse, fecundability, duration of postpartum infecundability, spontaneous intrauterine mortality, and sterility.

The cost of fertility regulation includes the subjective disadvantage of regulation and the economic cost of control.

According to the Easterlin-Crimmins model, the potential supply and demand for children jointly determine the motivation for fertility regulation. For example, if C_d (demand for children) is greater than C_n (supply of children), there will be no family limitation. On the other hand, if C_n is greater than C_d, there will be motivation to limit fertility. In spite of the existence of motivation for fertility regulation, it is necessary to take into account the costs associated with regulation. These costs can be classified into two categories: psychic costs (the displeasure associated with the idea or practice of fertility control) and market cost (the time and money necessary to learn about and use specific techniques). Such costs depend on the positive and negative attitudes in society toward the general notion of fertility control and the degree of access to fertility control (availability and price). The relationship between costs and motivation for fertility control is inverse. Therefore, if the costs of using fertility regulation are lower than the motivation to limit fertility, then fertility control will actually be practised.

Most of the literature that makes reference to the decline in fertility in the developing world indicates that the absence of fertility control is mainly due to two factors: absence of motivation to control fertility or lack of access to services and methods of family planning. From these two factors, the absence of motivation seems to be the most important. Different studies of fertility decline in the developed countries during their demographic transition do not suggest that family limitation was practised at some moderate but constant level prior to the fall in marital fertility rates. Instead, it seems to have been quite minimal and often completely absent and thus family limitation was not a real option for them.

The Easterlin and Crimmins approach sees modernization as influencing fertility via supply, demand, and regulation cost. It does not adopt a particular theory of the relative importance of these variables, viewing this as a matter for empirical determination. "Their theory says simply that the decline may be due to demand, supply, regulation costs or some combination thereof" (Easterlin and Crimmins, 1985).

The Easterlin framework does not consider the effects of the institutional and socio-economic contexts on individual behaviour. Although the Easterlin framework was applied to the World Fertility Survey (WFS) data, the inadequacies of the datasets have brought some problems in the empirical test because of the need for proxies for most of the variables of the framework.

Conclusion

While early theories concentrated on a few aspects of fertility decline, this complex issue needs to be studied in the context of a series of factors that initiate changes in fertility. After reviewing the main theories explaining the process of fertility decline and case studies using the Bongaarts model and Easterlin framework, particularly as applied to Third World countries, these two approaches were found to be the most appropriate and robust for explaining fertility differentials among the social strata categories in Bolivia, with the information that is available at the moment. As mentioned previously, this is the first time that detailed information related to the biological, behavioural, economic, social, environmental, and cultural aspects of Bolivia has been available for study. These factors, affecting fertility both directly and indirectly, will allow understanding of the current levels and differentials in Bolivian fertility and their relative importance in explaining the differences among the subpopulations of Bolivia as well as permitting more accurate decisions regarding population policy.

Past and Current Levels of Fertility in Bolivia

The evolution of Bolivian fertility in the process of its demographic transition, given certain historical and socioeconomic elements, generally has been judged by social scientists to be the most delayed in the Latin American context. The country is classified in the group of countries with the highest indexes of reproduction in the region. Bolivia is a country that initiated its demographic transition very late. As Notestein (1945) indicates, before the demographic transition takes place, countries have high levels of fertility and high levels of mortality. Until 1976 this was the situation in Bolivia. In 1976, the fertility level measured by the TFR was around 6.50 children per woman, and the mortality level measured by life expectancy at birth was around 46 years. Therefore, this study is of fundamental importance in order to understand the social and economic factors that have conditioned the late decline of fertility.

An important consideration in the study of fertility is the measure of the dependent variable itself. In the following pages the current levels of Bolivian fertility and the differentials by social strata will be highlighted. To analyze the differentials in fertility, estimated TFRs for each category are computed. Indirect estimates based on techniques proposed by Brass (1964) are used.

Past Fertility

Bolivia is classified among the Latin American countries that have initiated their fertility decline recently, having begun its fertility transition in the 1980's. Moreover, based on its fertility levels, Bolivia is situated among those countries having the highest indices of reproduction in South America. The Bolivian TFR experienced only a very insignificant decline in the intercensus period of 1950 to 1976, a period in which the decline in fertility in most other South American countries was becoming general and producing dramatic changes.

The changes in fertility levels in the country are examined using TFR values. According to the Bolivian National Institute of Statistics, the TFRs for the quinquennium 1950–55, 1960–65, 1970–75, 1980–85, and 1985–89 were 6.75, 6.63, 6.50, 6.25, and 5.06, respectively. Between 1950 and 1989, two periods in the evolution of Bolivian fertility can be clearly identified. The first period extends until approximately 1980 and is characterized by stability at high levels of fertility. The second period corresponds to the 1980's where the decline in fertility levels is more striking.

In the first period, although fertility seems to be declining slightly, the decline cannot be considered very important, since the knowledge obtained on fertility in the past is extremely precarious. According to the estimates of Bolivian fertility made by INE (1981), Vidal (1980), Gonzales and Ramirez (1981), and CELADE (1988), the different authors agree that around 1950 the TFR reached a value of 6.75 children per woman.

With the information collected in the 1976 census, it was established that the national TFR was around 6.5 children per woman. Comparing the values estimated in 1950 with those obtained in 1976, it is shown that in the intercensus period of 26 years, fertility, measured through the TFR, registered a decline of 0.25 children per woman, a change of 4 percent. This slow decline of the TFR shows that the structural changes in Bolivian society, brought about by the National Revolution of 1952, did not stimulate the desire to limit the size of Bolivian families, particularly among the rural populations of traditional areas that are principally indigenous.

In the period 1950 to 1976, the heterogeneity of fertility levels between urban and rural populations increased, even as the differences between social and economic groups increased. The stability shown in the period 1950 to 1980, according to Gonzales and Ramirez (1981), was principally the result of two opposing tendencies, the decline of fertility in the urban areas and its increase in the rural areas.

In the second period, 1980–1989, the decline in fertility is more conspicuous. According to the results of the National Survey on Population and Housing (ENPV-88), the TFR was estimated at 5.05 children per woman. Between 1976 and 1988, the TFR decreased on the average of 1.5 children per woman, a change of 21 percent. Urban fertility continued to decline but, more importantly, rural fertility also initiated its decline. This decline was a record compared with the previous period.

The decline in fertility has not affected population growth in the short run, because the death rate, particularly the infant mortality rate, has declined at a more accelerated pace than fertility. This mortality decline, along with the young population structure of Bolivian society, has compensated for the fertility decline.

According to several authors, the high level of fertility in Bolivia can be attributed to a combination of biological, behavioral, social, cultural, and economic factors, such as the lack of employment opportunities for married women outside the home, the low level of urbanization, and per capita income, the lack of educational opportunities, particularly for girls in the rural areas, the subsistence economy of the family production unit with the corresponding importance of children in the production process, particularly in the traditional rural areas of the highlands and valleys, as well as attitudes towards reproduction, and the position of the Catholic Church against any form of contraceptive use, especially modern contraceptives.

Current Fertility Levels

This section presents measures of current fertility by social strata. The estimation of the TFR is based on information about children ever born and current fertility (births in the year prior to the survey). The indirect estimations of the TFR were made using the Brass (1974)[1] method, which allows estimation of adjusted age-specific fertility rates and adjusted TFRs.

The TFR can be interpreted as the number of children a woman would have throughout her lifetime had she experienced the same level and pattern of fertility as measured at the time of the survey. The TFR is a synthetic cohort measure and, thus, does not represent the experience of any real cohort. The estimates of the age-specific fertility rates and TFRs for women ages 15–49 are presented in Table 1.

Table 1. Age-specific fertility rates, by social strata, Bolivia 1989

		Age-Specific Fertility Rates						
Social Strata	TFR	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Bolivia	4.970	0.094	0.240	0.243	0.208	0.124	0.067	0.018
Upper	3.370	0.060	0.176	0.179	0.186	0.073	0.000	0.000
Middle	4.625	0.126	0.256	0.244	0.108	0.128	0.023	0.038
Lower	5.315	0.101	0.270	0.278	0.220	0.109	0.077	0.006
Agriculture	6.170	0.125	0.214	0.276	0.310	0.175	0.102	0.032

Overall, by social strata, the TFRs range from 3.4 children per woman in the Upper category to 6.17 in the Agriculturalist, showing obvious differences in fertility among the social strata categories. At the end of their reproductive lives, the women of the Agriculturalist category, on average, will have 2.8 children more than their counterparts of the Upper category.

[1] The Brass method for the indirect estimation of fertility is described in Manual X. Indirect Techniques for Demographic Estimation (United Nations, 1983).

The highest level of teenage fertility is found in the Agriculturalist and Middle categories, with 125 per thousand, which is more than 100 percent higher than for the women of the same age group in the Upper category (60 per thousand). The high teenage fertility of the women of the Agriculturalist and Middle categories are mainly reflecting an early age at marriage and low levels of education in comparison to those of the Upper category. There are also large differences in fertility in the upper age ranges. The Age-Specific Fertility Rates (ASFRs) for women 40-44 are 0, 23, 77, and 102 per thousand for the Upper, Middle, Lower, and Agriculturalist categories, respectively. While women over age 40 of the Upper and Middle social strata categories contribute very little to the level of the TFR, the contribution of this age group in the Agriculturalist category is significant.

The Agriculturalist register the highest fertility level of the four social strata categories. The values of the ASFR of the Agriculturalist under age 30 are lower than those of the Middle category. After age 30, however, fertility in the Agriculturalist category is high, with the women registering the highest levels of fertility in all age groups. These ASFR values confirm that the women of the Agriculturalist marry early and also that their childbearing span is more extended. The values of the ASFR of the Agriculturalist are partially a result of the use of traditional contraceptive methods and their low effectiveness, and partially a result of the high proportion of native rural women in the Agriculturalist population in contrast to that of the Upper and Middle categories. The use of modern contraception is not common among Agriculturalist women.

The ASFR of the Lower category is higher than that of its counterparts in the Upper, Middle, and Agriculturalist categories up to age 30. Over 30 years, the ASFRs decline faster in the Lower category than in the Agriculturalist category, partly because of the use of modern contraceptives, specifically female sterilization over age 30, and partly due to the small proportion of native population (less than 15 percent) and high proportion living in urban areas (80 percent of the population of the Lower category live in urban centres).

Fertility in the Upper category is the lowest of the four social strata categories. Here, the ASFR shows that women in the Upper category not only marry late, but also have their children later in comparison to the other social strata categories. The fertility of women ages 15-19 in the Upper category is the lowest of the four. After age 39, however, women of this category do not contribute to the total fertility of this category. In contrast, for the same age group in the Agriculturalist category, ASFRs for women 40-44 are around 100 per thousand, indicating that almost one out of every two women, on average, has a child during that period of her life.

Up to this point, the current levels of fertility for all women in the reproductive period (15-49) have been studied. However, since the contribution to fertility by currently married women is the most important, fertility levels for this particular group will now be discussed.

Marital Fertility

Marital fertility levels were obtained using current fertility levels and the proportion of currently married women by age. The information for its calculation is presented in Table 2.

The Age-Specific Marital Fertility Rates ($g_{(a)}$) were obtained as the quotient of $f_{(a)}/m_{(a)}$, with the exception of the first age group. Following the recommendation of Bongaarts (1982), for the first age group **$g_{(1)}$ is equal to 0.75 * $g_{(2)}$**. The aggregate values of this method give the Total Marital Fertility Rate (TMFR). The range of variability in the TMFR among the four social strata categories shows that marital fertility varies from 9.84 children per married woman for the Agriculturalist to 5.85 for the Upper category. This difference indicates that married women of the Agriculturalist have an average of 4 children more than those in the Upper category. The variability of TMFR among the social strata is more evident than the variability in the TFR.

Among the four social strata categories, the contributions of currently married women below age 25 to the TMFR show noticeable differences. This contribution is less than 44 percent in the Agriculturalist, though for the other social strata categories, it is more than 53 percent. The contribution of the age group 20-24 to the TMFR is the most important in all four social strata categories (see Table 2).

Table 2. Age-specific fertility rates $f_{(a)}$; proportion of currently married women $m_{(a)}$; and age-specific marital fertility rates $g_{(a)}$, by social strata, Bolivia 1989

	Age group							
Social strata	Total	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Bolivia								
$f_{(a)}$	4.970	0.094	0.240	0.243	0.208	0.124	0.067	0.018
$m_{(a)}$		0.124	0.537	0.749	0.852	0.859	0.831	0.804
$g_{(a)}$	7.975	0.334	0.446	0.324	0.244	0.144	0.081	0.022
Upper								
$f_{(a)}$	3.372	0.060	0.176	0.179	0.186	0.073	0.000	0.000
$m_{(a)}$		0.065	0.514	0.690	0.815	0.869	0.840	0.614
$g_{(a)}$	5.851	0.257	0.342	0.260	0.228	0.084	0.000	0.000
Middle								
$f_{(a)}$	4.621	0.126	0.256	0.244	0.108	0.129	0.023	0.038
$m_{(a)}$		0.187	0.641	0.787	0.852	0.816	0.800	0.739
$g_{(a)}$	6.875	0.300	0.400	0.310	0.127	0.158	0.029	0.051
Lower								
$f_{(a)}$	5.312	0.101	0.270	0.278	0.220	0.109	0.077	0.006
$m_{(a)}$		0.136	0.527	0.743	0.862	0.849	0.814	0.750
$g_{(a)}$	8.798	0.384	0.512	0.374	0.256	0.129	0.095	0.008
Agricultural								
$f_{(a)}$	6.173	0.125	0.214	0.276	0.310	0.175	0.102	0.032
$m_{(a)}$		0.128	0.436	0.712	0.843	0.866	0.873	0.907
$g_{(a)}$	9.849	0.368	0.491	0.388	0.367	0.202	0.117	0.036

The ASMFR of the four social strata categories reach a peak in the age group 20-24. However, the speed of decline differs among the categories. The decline is fastest for the women of the Upper category up to age 25-29, with the decline for the same age group in the Middle and Lower categories being more moderate. Over age 35, the decline in ASMFR is faster in the Upper category than in the other three categories, due in part to the higher prevalence of contraceptive use, particularly IUD and female sterilization, by women of the Upper category currently in union. For the Agriculturalist category, the decline in the ASMFR is slower. It is probable that differential use of contraceptive methods, especially modern contraceptives and the proportion of contraceptive users, by Agriculturalist women accounts for the slower decline.

Summary

The changes in fertility levels in the country are examined using TFR values. According to the Bolivian National Institute of Statistics, the TFRs for the quinquennium 1950–55, 1960–65, 1970–75, 1980–85, and 1985–89 were 6.75, 6.63, 6.50, 6.25, and 5.06, respectively. In the period 1950 to 1976, the heterogeneity of fertility levels between urban and rural populations continued to increase, even as the differences between social and economic groups increased. In the second period, 1980–1989, the decline in fertility is more conspicuous. The urban fertility continued to descend but, more importantly, rural fertility also initiated its decline.

Current fertility levels of Bolivian women are significantly higher than replacement levels, with important inequalities in fertility levels by social strata. The most notable differences are presented between Upper and Agriculturalist fertility. When ASFRs for women 30 years or over are compared between these two populations, the differences are considerable.

Systematically, the fertility of currently married women is higher than that of all women, particularly for the younger cohorts. The decline of marital fertility in the Upper category after age 30 is the most noticeable. The ASMFR for the age groups 30-34 and 35-39 were 0.228 and 0.084, respectively. These values show a decline of around 63 percent between these two groups. This sharp decline among the Upper category women may be the result of the use of modern contraceptives, higher education and urbanization, and more opportunities for activities that compete with fertility.

To have a better understanding of the differentials in the levels of fertility among social strata, it is necessary to study the biological and behaviourial variables that are the direct determinants of fertility. To do this, the Bongaarts model will be applied to the Bolivian data in order to estimate the proximate determinants of fertility.

Proximate Determinants of Fertility at the Aggregate Level

In this section, the focus is on the estimate of the proximate determinants of fertility at the aggregate level and their impact on fertility levels and differentials by social strata. Also, explanations as to why the proximate determinants are at the observed levels are proposed.

As already mentioned, although Bongaarts' model proposes eight proximate determinants of fertility, empirical evidence suggests that most of the variations in fertility levels can be attributed to the differential impact of four fertility variables: marriage delay and disruption; contraception; abortion; and postpartum infecundability, including breastfeeding and voluntary abstinence. If correct, this implies that most variations in fertility levels of populations can be explained by differences in the importance of each of the four intermediate fertility variables to each population.

The first part of this section includes a comprehensive study and estimation of the four main proximate determinants of fertility. In the second part, the model developed by Bongaarts is presented in detail, with emphasis on the measurement of the specified components. The application of Bongaarts' indices to Bolivia and a decomposition of the fertility rate to assess the relative contribution of each of the major proximate determinants to fertility levels and differentials are presented next. Finally, limitations of the proximate determinants model are addressed.

The Main Proximate Determinants

Levels of Marriage Patterns and Marriage Indicators

In almost all societies, the actual fertility of women is substantially lower than what is biologically possible. Studies in fertility behaviour, based on the data of the WFS, have concluded that marital exposure is one of the means through which substantial reductions in potential fertility are achieved. In most cases, 35 to 40 percent of the total reduction in potential fertility is due to age at marriage (United Nations, 1987).

Cultural differences in age at first marriage are important because they affect reproductive behaviour. In many societies, premarital sexual activity is tolerated, but fertility is generally confined to marital unions. Therefore, marriage patterns, age at first marriage, proportion married, and patterns of marital dissolution have an important influence on the overall level of fertility.

Nuptiality patterns can be examined through the study of the proportion of ever-married women at various ages, with particular interest in the reproductive ages of 15 to 49 years. The higher the proportion of ever-married women, the higher the fertility, other things being equal. The proportion of currently married women in each reproductive age group is presented in Table 2.

As expected, the proportion of married women of reproductive age increases as age increases, up to age 30-34, and then declines gradually, with the exception of the Agriculturalist group, where the proportion of married women increases up to ages 45-49.

In fertility studies, age at first marriage is of major interest, since it is inversely related to the duration of exposure to the risk of pregnancy. For example, women who marry early will have a longer period of exposure to the risk of becoming pregnant than those who marry later whereas a later age at marriage eliminates exposure in the highly fertile years of the late teens and early twenties.

Many demographic studies have shown that differences in age at first marriage can account for a substantial proportion of variation in the fertility of different populations. The effects of this variable can be direct as well as indirect. The direct effect of age at first marriage on fertility is significant, especially in societies where there is very little or no voluntary fertility control.

The indirect effect of age at first marriage on fertility is through the educational level attained by the women and other factors related to later marriage, such as attitudes, labor force participation, etc. In most of the LDC's, women who marry early are more likely to drop out of school in order to be able to carry out their childbearing responsibilities. In general, higher education of females is related positively to age at first marriage and negatively to fertility.

In less developed societies, age at marriage is an important intermediate variable, included in most of the models used to estimate fertility, such as Davis and Blake (1956), Bongaarts (1978), and Hobcraft and Little (1984).

In Bolivia, the study of differences in age at first marriage is even more relevant because of the great heterogeneity of its population. In Bolivian society, people who are married, or living together/common-law, are socially accepted as married couples, even though they have not had a civil or religious ceremony. According to the Bolivian family code, the state and the law recognize these two types of marriages as equal. The minimum legal age at marriage for males is 18 years and 16 years for females (Código de Familia, 1978).

The Bolivia DHS survey, like the other DHS surveys, used a broad definition of marriage to obtain some degree of comparability across cultures. The definition of "marriage" included all unions with a recognized social strata, thus including all stable sexual relationships regardless of the legal status of the union. The information on union status and date of entry into first union likely is influenced by the ways unions are formed, and it is likely that information about marriage, like any other retrospective information, suffers the problems of recall. One common error is the understatement of age at marriage by older women who tend to declare their age at marriage to be younger than it really was. According to Blank and Rutenberg (1990), young married women, especially those with children, tend to overstate their age, and young unmarried women tend to understate their age. Although there may be differential errors across subgroups, there is no further information with which to confirm conclusions.

In the Bolivia DHS survey, the current marital status of the interviewed women was divided into six categories: never married, married, living together, widowed, divorced, and not living together. To avoid the problems inherent in consensual unions, the categories of married and living together will be considered as a unit. It will therefore be more appropriate to talk about age at first union.

The proportion of ever-married women in the group age 15-19 years at the time of the survey shows great variability among the Bolivian subpopulations with values of 8.1, 21.3, 15.7, and 14.0 percent for the Upper, Middle, Lower, and Agriculturalist categories, respectively. This indicator gives an overview of the precocity of women's marriages.

Of the four social strata categories, early marriage is most common for the women of the Middle category, where as many as 21 percent of women in the age group 15-19 had entered their first marriage by the time of the survey, i.e., 160 percent more than their counterparts in the Upper category. This may be explained in part by the high percentage of women in the Middle category who live in the Lowlands of Bolivia where age at marriage tends to be earlier. The Agriculturalist category registers a very low percentage of married women in the age group 15-19. This is explained in part by the long marriage process that the native population of Bolivia goes through.

In Bolivia, the ultimate proportion of married women varies notably among the different social strata with values of 94, 91, 96, and 97 for the Upper, Middle, Lower, and Agriculturalist categories, respectively . The most important contrast registered is the fluctuation from 97 percent in the Agriculturalist category to 91 percent for the Middle category.

Marriage is almost universal for the Lower and Agriculturalist categories. By age 40, 95 percent of women in the Lower and 93 percent of those in the Agriculturalist categories are already married. The mean ages at marriage for the four social strata categories are 20.8, 19.6, 19.2, and 19.6 for the Upper, Middle, Lower, and Agriculturalist categories. The most important difference is registered between the Upper and the other three social strata categories. On average, women of the Upper category marry 1.2 years later than their counterparts in the Middle, Lower, and Agriculturalist categories.

Knowledge and Use of Contraceptives

The levels of knowledge and use of contraceptives for women currently in union are presented in Table 3[2]. There is little difference in the level of knowledge and use of contraceptives between all women and those currently in union. However, there is a great difference in the level of knowledge of contraceptives among the social strata categories. Knowledge of at least one contraceptive method is almost universal (96 percent) among the Upper social strata women. Moreover, knowledge of modern methods is more prevalent than that of traditional methods because of the higher percentage of educated women in the Upper category and greater exposure to the mass media, factors that facilitate the dissemination of information about contraceptives. In contrast, in the Agriculturalist category, the level of knowledge is the lowest, with only 56 percent of the women having knowledge of any contraceptive. Moreover, the knowledge of modern methods of contraception (8.3 percent) is less common than knowledge of only traditional methods[3] (19.9 percent) for women currently in union.

Table 3. Percentage of women currently in union by knowledge and ever-use of any contraceptive method, by social strata, Bolivia 1989

Method by social strata	Knowledge of method	Ever use of any method
Bolivia		
Any method	75.0	45.8
Modern method	67.5	21.7
Traditional method	7.5	24.1
Upper		
Any method	95.3	75.2
Modern method	92.4	43.6
Traditional method	2.9	31.6
Middle		
Any method	88.8	57.5
Modern method	84.2	29.7
Traditional method	4.6	27.8
Lower		
Any method	78.3	44.8
Modern method	71.0	21.2
Traditional method	7.3	23.6
Agriculturalist		
Any method	55.7	28.2
Modern method	44.6	8.3
Traditional method	11.1	19.9

However, the use of contraceptives, rather than knowledge of the methods, is what directly influences the levels of fertility (see Table 3). As was expected, the ever-use of any contraceptive method is greater in the Upper social strata than in the Agriculturalist (75.2 percent vs 28.2 percent) for women currently in union. Comparing the difference in ever-use of modern contraceptives, the gap between these two subpopulations becomes almost five times greater (8.3 percent vs 43.6 percent for the Agriculturalist and Upper social strata, respectively).

[2] In Table 3 the information refers only to women currently in union because of the way that the variable social strata was constructed (see description of the study population).

[3] The category "knowledge of traditional methods" corresponds only to those who knew exclusively traditional methods.

In summary, for women currently in union, those of the Upper and Middle social strata not only have greater knowledge of some contraceptive methods, but also have a greater proportion of ever-use of some contraceptive methods than those in the Lower category and much more ever-use than their counterparts of the Agriculturalist social strata. The use of modern methods is more prevalent in the Upper than in the Middle or Lower social strata, whereas traditional methods of contraception are more prevalent among Agriculturalist women.

The current use of contraceptive methods by women in union at the moment of the survey is presented in Table 4. The data show that 54.6, 39.2, 27.9, and 17.6 percent of women currently in union of the Upper, Middle, Lower, and Agriculturalist social strata, respectively, reported that they were using a contraceptive method in 1989. Only 24.4, 16.7, 11.5, and 5.3 percent, respectively, were using a modern contraceptive. Of all the modern and traditional methods, the most prevalent reported among women currently in union at the moment of the survey was periodic abstinence,[4] used by more than 50 percent of women in all the social strata categories (Tables 4 and 6). In the Upper and Middle social strata categories, the IUD was second in importance, while female sterilization and the pill were the other important contraceptive methods. In the Lower and Agriculturalist social strata categories, female sterilization was the second most-used method, but its prevalence was only 28 percent of that of periodic abstinence.

Table 4. Percentage distribution of women currently in union using any contraceptive method by social strata, Bolivia 1989

Type of method and characteristic	Social strata				Total
	Upper	Middle	Lower	Agric.	
Any method	54.6	39.2	27.9	17.6	30.3
Modern method	24.4	16.7	11.5	5.3	12.3
Pill	3.3	4.0	1.6	0.5	1.9
IUD	12.9	5.9	3.7	1.8	4.8
Injection	0.7	0.6	0.8	0.6	0.7
Diaphragm	0.3	0.5	0.0	0.0	0.1
Condom	1.1	0.5	0.2	0.1	0.3
Female steril.	6.1	5.0	5.2	2.3	4.5
Male steril.	0.0	0.2	0.0	0.0	0.0
Traditional method	30.2	22.5	16.4	12.3	18.0
Periodic abstinence	29.1	21.2	14.7	9.6	16.1
Withdrawal	1.0	0.9	0.9	1.1	1.0
Other	0.1	0.4	0.8	1.6	0.9
Not using	45.4	60.7	72.1	82.4	69.7

It is also noteworthy that male sterilization is almost unknown among the Bolivian population. This can be explained in part by the male-dominated orientation of Bolivian society.

Of the women currently in union at the moment of the survey, 82.4, 72.1, 60.7, and 45.4 percent of the women of the Agriculturalist, Lower, Middle, and Upper social strata, respectively, were not using any method at all. These percentages show that contraceptive use among the Bolivian population is not common for various reasons. These include the strong influence of the Catholic Church and its position on the issue of contraceptives, the large proportion of the native population that lives in the countryside without knowledge of or access to contraceptives,

[4] The category of periodic abstinence can include temporary separation of spouses as a result of seasonal migration for reasons of employment. After the land reform of 1953, people from the countryside often owned land in different ecological strata. Therefore, as the seasons changed, they had to travel from one ecological stratum to another to tend the crops being cultivated.

low levels of education and accessibility to medical centres, and, in some cases, the high cost of modern contraceptives, which impedes their use.

The type of contraceptive method used varies with age (see Table 5). On average, 30.2 percent of Bolivian women currently in union are using a contraceptive method. For all women currently in union, the use of any contraceptive method increases with age up to age group 30-34. After this age group, the proportion of users starts to decline sharply. Of the modern methods of contraceptives used by women currently in union the pill and IUD are the most prevalent among the younger age groups 15-29. After age 35, female sterilization is the most important. Of the traditional methods, periodic abstinence is the most prevalent method in all the age groups (Vidal-Zeballos, 1993).

Table 5. Percentage distribution of women currently in union using any contraceptive method, by age group, Bolivia 1989.

	Age group							
Method and social strata	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Total
Bolivia								
Any method	16.0	22.6	34.4	39.2	36.3	28.1	14.8	30.2
Modern method	2.4	7.7	12.3	17.4	15.2	13.0	6.6	12.2
Traditional method	13.6	14.9	22.1	21.7	21.1	15.1	8.2	18.0
Upper								
Any method	21.8	36.8	60.0	61.6	59.6	56.2	38.6	54.6
Modern method	5.7	13.9	27.3	28.9	27.4	27.2	9.7	24.4
Traditional method	16.1	22.9	32.7	32.7	32.2	29.0	28.9	30.2
Middle								
Any method	20.6	33.6	47.2	48.8	43.5	25.1	29.7	39.3
Modern method	5.8	11.4	16.1	20.6	28.7	16.2	12.2	16.7
Traditional method	14.8	22.2	31.1	28.2	14.8	8.9	17.5	22.6
Lower								
Any method	13.3	17.2	30.3	35.0	34.3	30.7	14.0	27.8
Modern method	0.7	5.9	11.7	15.9	13.8	14.1	8.6	11.5
Traditional method	12.6	11.3	18.6	19.1	21.5	16.6	5.4	16.3
Agriculturalist								
Any method	14.6	13.2	17.8	24.0	23.1	15.8	9.8	17.6
Modern method	1.2	3.9	3.3	9.6	5.6	5.7	4.1	5.3
Traditional method	13.4	9.3	14.5	14.4	17.5	10.1	5.7	12.3

Since traditional methods of contraception—periodic abstinence, withdrawal, rhythm, and others—are generally harder to use than the modern methods, it is noteworthy that traditional methods are widespread among all the social strata categories. The use of these inconvenient methods can be seen as an indication of a strong commitment to postpone or to cease childbearing, coupled with an absence of access to more efficient methods. As was mentioned, deficiency of access may be a matter of cost, availability, knowledge, and/or religious opposition, or even fear about safety.

Of the populations under study, the Agriculturalist category registers the highest percentage (69.9 percent) of inefficient methods used; four out of six current users of any contraceptive method are employing inefficient methods (Table 6). In contrast, the percentage of inefficient to total users for the Upper social strata is the lowest, with 45 percent of current users employing efficient methods.

The use of modern contraceptives among Upper social strata women currently in union is 4.6 times greater than among Agriculturalist women, while the use of traditional contraceptive methods in the Upper category is 2.5 times greater than in the rural areas. These values show that natural fertility is more prevalent in the Agriculturalist category than in the Upper social strata.

In summary, these findings strongly suggest that the use of modern contraceptives is not widespread among Bolivian women. Of those using any contraceptive method in 1989, 40 percent were using efficient contraceptives. Moreover, the differentials by social strata are evident, with the Upper status having the lowest percentage of inefficient method use (55.3) and the Agriculturalist having the highest percentage (69.9). The use of inefficient contraceptive methods is widespread, since more than 59 percent of the women in all the subpopulations who are using any contraceptive method are using inefficient methods.

Table 6. Current use of inefficient and efficient contraceptive methods by social strata, Bolivia 1989

Social strata	% Using inefficient methods	% Using efficient methods	% Inefficient to total users
Bolivia	18.0	12.3	59.6
Upper	30.2	24.4	55.3
Middle	22.6	16.7	57.5
Lower	16.3	11.5	58.6
Agriculturalist	12.3	5.3	69.9

The Upper social strata has the highest percentage ever using contraceptives in every age group, whereas the Agriculturalist group has the lowest percentage ever using contraceptive methods.

In all the subpopulations under study, there is a marked tendency for contraceptive use to rise sharply between the age groups 20-24 and 30-34, and then to decrease, slowly in some cases such as in the Upper social strata, or sharply as in the Agriculturalist. The variability according to age in the use of traditional contraceptive methods is less than with modern contraceptives.

Never-use of contraception is more predominant in the Agriculturalist group, where more than 69 percent of the women are not using any contraceptive. The women in this category are mainly an indigenous population, with very low levels of education, almost no exposure to the mass media, and strong traditional values.

Abortion

Induced abortion is one of the oldest and most common methods of fertility regulation, and its role in the reduction of fertility is well established in many countries. Although statistical information on abortion is infrequent and inadequate, it is evident that induced abortions are performed in almost all countries of the developed and developing world.

Abortion is illegal in Bolivia except in cases of risk to the mother's life, incest, or rape. Moreover, persons who break the law can be punished with 1 to 3 years imprisonment. However, its practice is believed to be widespread and highly prevalent in various sectors of the population, particularly among young, single women. Since abortion is illegal, it is often carried out under unsafe circumstances that endanger the health and life of the woman. Obviously, statistics on the practice of abortion are obviously scarce and unreliable.

In a society like that of Bolivia, where the weight of tradition, prejudice, religion, the low status of women, and other factors that influence and create moral and legal sanctions against induced abortion are combined, it is unlikely that the results of interviews will reflect or approach reality, since, in most circumstances, women would prefer to keep induced abortions secret.

In 1984, research on abortion was carried out by the Bolivian Society of Obstetrics and Gynaecology among women hospitalized for complications from abortion in the major city hospitals. Table 7 presents the results of that study.

Table 7. Abortion rates[1] for major cities, Bolivia 1984

City	Population[2]	Women of Fertile Age[3]	No. of Cases in the Study	Rate per 1,000 women
Cochabamba	304,960	79,680	1,077	13.52
La Paz	953,634	260,910	1,230	4.71
Oruro	192,814	49,680	810	14.05
Santa Cruz	419,646	108,225	810	7.48
Sucre	84,505	22,250	556	24.69

[1] The value corresponds to cases treated in the major hospitals because of complications from abortions. Abortion is illegal in Bolivia.
[2] Instituto Nacional de Estadística, 1981
[3] Estimations based on the Censo de Poblacíón of 1976
Source: Sociedad Boliviana de Ginecologia y Obstetricia and Family Health International, 1985.

The same study gave rates of maternal mortality due to induced abortion as 4.9, 10.8, 6.8, and 5.0 per 1,000 for the cities of Cochabamba, La Paz, Oruro, and Santa Cruz, respectively. These rates show that one main cause of death among the women of reproductive age is induced abortion, especially in the cities of La Paz and Oruro (Highlands).

From those estimates of the Bolivian Society of Obstetrics and Gynaecology, considering the likelihood that many abortions occur without complications or are treated in health centres other than the hospital (and further taking into account underreporting and miscarriages), it is safe to assume that the Bolivian rate of abortion is around 16 per 1,000 women. This statistic would be greater in the cities than in the rural areas (Sociedad Boliviana de Ginecologia y Obstetricia and Family Health International, 1985.)

Although evidence suggests that abortion is common in Bolivia, the lack of data makes it impossible to estimate the true rate or have good approximations of it for the country and even less for each social strata. Therefore, for the purpose of calculations for this paper, we have assumed that induced abortion is negligible for each social strata. There is a need for further research on this matter in order to establish the importance of induced abortion on the levels and differentials of fertility among the different social strata.

Breastfeeding

Breastfeeding of infants is an almost universal characteristic of human societies. The importance of breastfeeding is related to its impact on infant health, since the primary purpose of breastfeeding is infant nourishment. However, it also has a fundamental impact on fertility.

Breastfeeding practices vary from one country to another and from one subpopulation to another within the same country. In most societies, women start breastfeeding infants immediately after birth. Traditionally, women of the less developed countries have breastfed in larger proportions and for longer periods of time than women in the most developed countries.

After childbirth, each woman experiences a period of temporary infecundability, called the postpartum nonsusceptible period, during which she does not ovulate. If a woman nurses a child, her hormonal reactions to lactation considerably delay the return of her menstrual cycle, and thus of ovulation and fecundability. This may have considerable impact upon birth intervals.

Various researchers have reported (Potter et al., 1965; Salber et al., 1966; Chen et al., 1974; Leridon, 1977) that, in the absence of breastfeeding, postpartum amenorrhoea lasts an average of about 2 months. With a longer period of intense breastfeeding, average postpartum amenorrhoea can last between 1 and 2 years (Chen et al., 1974; Singarimbum and Manning, 1976; Cantrelle and Ferry, 1979). According to Bongaarts and Potter (1983), women who did not use contraceptives but breastfed continuously added 18 months or more to the average birth intervals.

Moreover, partial breastfeeding could reduce ovulation even for women who were regularly menstruating (Jain and Nag, 1985; Short, 1984). Clearly, through their suppression of ovulation and menstruation, breastfeeding patterns and trends can play a major role in determining the levels and trends of fertility. However, "Although the relationship between duration of breastfeeding and duration of postpartum amenorrhoea is very striking, it is not perfect" (Page et al., 1982:8,9).

To estimate the mean duration of breastfeeding for the total population and for the four social strata categories, the incidence/prevalence method was used (Mosley and Chen, 1984).

$$Y = \frac{B}{N} \tag{1}$$

where

Y = The mean duration of breastfeeding, in months
B = Number of children currently breastfed
N = The average number of births per month.

This equation provides a remarkably simple means of estimating the mean duration of breastfeeding. It is relatively insensitive to errors in the reported dates of birth for the children in question. The numerator requires no information on dates at all. However, the denominator does, and, for this paper, it was estimated from births in the last 5 years preceding the survey. The major assumption is that the number of births per month has been roughly constant.

Breastfeeding in Bolivia is prolonged and almost universal. The main results at the national level and for each social strata are summarized in Table 8. The values were calculated using information on births in the 5 years preceding the survey.

Table 8. Average duration of breastfeeding, amenorrhoea and abstinence, Bolivia 1989

	Postpartum sterility (duration in months)		
Social strata	Breastfeeding	Amenorrhoea	Abstinence
Bolivia	16.70	11.33	6.26
Upper	11.28	6.97	4.39
Middle	16.70	10.58	4.30
Lower	17.10	11.14	5.80
Agriculturalist	17.80	12.62	5.10

In Bolivia, the average duration of breastfeeding is 16.7 months. However, there is substantial variation in average duration among the four social strata categories, being as low as 11.28 months for the Upper social strata or as high as 17.80 months for the Agriculturalist. Similar differences can be observed for amenorrhoea and abstinence. On average, ovulation resumes some 11.33 months after delivery. Intercourse on average resumes 6 months after delivery.

As we have seen, age at marriage differs by social strata, being earlier for the Agriculturalist and Lower social strata and later for the Upper. The use of traditional contraceptive methods is more prevalent in the Bolivian population as a whole than the use of modern methods. However, there are great differences among the four social strata categories in the use of modern contraceptive methods. Differentials in breastfeeding are important by social strata. The longest period of breastfeeding is registered for the Agriculturalist women and the shortest for the Upper women. The differences in these proximate determinants and their impact on fertility levels will be considered next.

Bongaarts Model. Estimation Technique

In this section, the proximate determinants framework of Bongaarts will be applied to explain variations in fertility levels of Bolivian women by assessing their impacts for each social strata category. The four intermediate variables operate sequentially (in terms of his formula, not in terms of reality and time) to reduce the Total Potential Fertility (TF) to the observed value of the Total Fertility Rate (TFR).

According to Bongaarts and Potter (1983), empirical evidence has established that for almost all populations, observed fecundity rates vary within the range of 13 to 17 children per woman, an average value of 15.3 children. Although it can be argued that the value of TF is not constant and can vary among subpopulations within the country, for this analysis, the assumption is that the value of TF is constant at 15.3 children per woman throughout Bolivia.

In Bongaarts' model, the effect of each proximate determinant is measured through indices that can vary from 0 to 1. A value of 1 symbolizes that the determinant under observation exerts no constraining effect on fertility, whereas a value of 0 symbolizes a completely inhibiting effect (Bongaarts, 1982, p. 181). Bongaarts' original model specifies the relationship between intermediate fertility variables and fertility levels as:

$$TFR = C_m * C_i * C_a * C_c * TF \tag{2}$$

where

TFR = total fertility rate.
TF = total potential fertility or total fecundity
C_m = index of marriage (equals 1 in the absence of celibacy and 0 in the absence of marriage)
C_c = index of contraception (equals 1 in the absence of contraception and 0 if all fecund women use 100 percent effective contraception)
C_a = index of induced abortions (equals 1 in the absence of induced abortion and 0 if all the pregnancies are aborted)
C_i = index of postpartum infecundability (equals 1 in the absence of lactation and postpartum abstinence and 0 if the duration of infecundability is infinite).

The intermediate rates in the movement from **TF** to **TFR** can also be expressed in terms of the indices:

Total Natural Fertility Rate:

$$TN = C_i * TF \tag{3}$$

for which the fertility-inhibiting effects of marriage, contraception, and abortion are removed.

Total Marital Fertility Rate:

$$TMFR = C_i * C_C * C_a * TF \tag{4}$$

for which the effect of marriage alone is removed.

Total Fertility Rate:

$$TFR = C_m * C_i * C_c * C_a * TF. \tag{5}$$

The model refers to a synthetic cohort and is based on the assumptions that the prevailing age-specific fertility pattern will be the same for the young women in the future and that marriage patterns and contraceptive use will remain unchanged throughout the reproductive spans of all cohorts.

Since indices and aggregated rates are known, it is possible to estimate the model through the relations above. However, since the relationship varies with age, it is advisable that age-specific data be used. For the estimation of the Indices of Marriage and Contraception, age-specific data are used, whereas for the Indices of Postpartum Infecundability, aggregate data are used because of the lack of information classified by age. As was mentioned before, there is no reliable information on induced abortion, so the index of abortion is not estimated.

In interpreting index values, it is important to note that, by definition, the complement of each observed value represents the proportional reduction in fertility that may be attributed to the determinant under observation.

The Measurement of Bongaarts' Model Components

Bongaarts' model assumes a closed system to summarize the effect of each factor that reduces fertility from its potential maximum to its actual level. The calculation of each of the indices is presented next.

The Index of Proportion Married, C_m. The estimation of this index is based on the estimations of the Age-Specific Fertility Rate and the Age-Specific Marital Fertility Rate.

The Index of Proportion Married is defined as:

$$C_m = \frac{TFR}{TMFR} = \frac{\sum f_{(a)}}{\sum \frac{f_{(a)}}{m_{(a)}}}. \qquad (6)$$

Table 9 presents the figures for C_m. Among the four social strata categories, C_m varies significantly, from 42.4 to 32.8 percent between the Upper and Middle social strata, respectively. Its value of 0.623 for the country implies that marriage delay and disruption reduces marital fertility by 38 percent. By social strata, marriage delay and disruption reduces marital fertility by 42.4, 32.8, 39.6, and 37.3 for the Upper, Middle, Lower, and Agriculturalist women, respectively. It is clear that the inhibiting effect of marriage is greater for the Upper category than for the Middle category.

Table 9. Estimation of the index of marriage, C_m, by social strata, Bolivia 1989

Rates index	Bolivia	Social strata			
		Upper	Middle	Lower	Agricul.
TMFR	7.975	5.851	6.875	8.798	9.849
TFR	4.970	3.372	4.621	5.312	6.173
C_m	0.623	0.576	0.672	0.604	0.627

The Index of Contraception, C_c. The estimation of C_c is by means of Age-Specific Marital Fertility Rates ($g_{(a)}$) and the proportion of users by age among women in reproductive ages (p_a).

For most of the populations, the use-effectiveness varies according to the characteristics of methods and uses. The use-effectiveness ($e_{(m)}$) for each social strata for Bolivia was obtained by using the pattern derived from the Philippines (Laing, 1979). The values are presented in Table 10.

The general effectiveness for Bolivian women is estimated as the ratio e = 24.04/30.20 = 0.796, implying that contraceptive use is at a level of 79.6 percent effectiveness. General effectiveness by social strata varies slightly. It is noteworthy that the Upper category has the highest effectiveness at 81 percent. This is due to the high use of IUD's and the incidence of female sterilization. On the other hand, the high incidence of the use of traditional contraceptive methods by the Agriculturalist category is reflected in the lowest effectiveness of contraceptives (77 percent). However, in both subpopulations, the use of traditional methods is significant.

Table 10. Estimates for use-effectiveness, e_m, and prevalence, u_m, by social strata, Bolivia 1989

Method (m)	Use-effectiveness, e_m	Prevalence, u_m	e_m*u_m
Bolivia			
Sterilization	1.00	4.40	4.40
IUD	0.95	4.80	4.56
Pill	0.90	1.90	1.71
Other	0.70	19.10	13.37
Total		30.20	24.04
Effectiveness (e)			**0.796**
Upper			
Sterilization	1.00	6.10	6.10
IUD	0.95	12.90	12.26
Pill	0.90	3.30	2.97
Other	0.70	32.30	22.61
Total		54.60	43.94
Effectiveness (e)			**0.805**
Middle			
Sterilization	1.00	5.00	5.00
IUD	0.95	5.90	5.61
Pill	0.90	4.00	3.60
Other	0.70	24.30	17.01
Total		39.20	31.22
Effectiveness (e)			**0.796**
Lower			
Sterilization	1.00	5.20	5.20
IUD	0.95	3.70	3.52
Pill	0.90	1.60	1.44
Other	0.70	27.90	12.18
Total		39.10	22.33
Effectiveness (e)			**0.801**
Agriculturalist			
Sterilization	1.00	2.30	2.30
IUD	0.95	1.80	1.71
Pill	0.90	0.50	0.45
Other	0.70	13.00	9.10
Total		17.60	13.56
Effectiveness (e)			**0.770**

The choice of contraceptive methods is age-related, implying that similar variations in use-effectiveness estimates will be seen when the data are disaggregated by age group. Use-effectiveness and degree of protection provided by contraception, age, and social strata, are presented in Table 11.

In general, among the currently married women who use modern contraceptive methods, there is a tendency towards increased IUD and pill usage with age, up to the point when these are replaced by sterilization. These modern methods are used side by side with the traditional methods, which have low effectiveness. This combination of methods results in average use-effectiveness values that cannot be determined on an *a priori* basis.

Use-effectiveness increases with age among the different age groups, but not linearly, dropping slightly for women in age group 45-49 in some cases. For example, for the Agriculturalist, use-effectiveness increases for the younger cohorts due to the increased use of the IUD and pill with age. However, after age 25, the use-effectiveness drops up to age 30 and then increases again. This fluctuation may be explained by the use of mainly traditional methods.

Table 11. Use-effectiveness and degree of protection provided by contraception, age, and social strata, Bolivia 1989

Social strata	Proportion users (u_i)	Proportion protected $u_{im}*e_m$	Effectiveness users $u_{im} * e_m/u_i$	Proportion fecund ft_i	Proportion fecund users $u_{im}*e_m/ft_i$
Bolivia					
15-19	0.160	0.116	0.730	0.99	0.117
20-24	0.226	0.173	0.766	0.99	0.175
25-29	0.344	0.268	0.780	0.98	0.273
30-34	0.392	0.313	0.799	0.95	0.329
35-39	0.363	0.293	0.808	0.91	0.322
40-44	0.281	0.232	0.826	0.78	0.297
45-49	0.148	0.120	0.816	0.52	0.231
Upper					
15-19	0.218	0.161	0.737	0.99	0.163
20-24	0.367	0.286	0.780	0.99	0.289
25-29	0.599	0.476	0.795	0.98	0.486
30-34	0.617	0.498	0.807	0.95	0.524
35-39	0.596	0.487	0.817	0.91	0.535
40-44	0.562	0.464	0.825	0.78	0.595
45-49	0.386	0.297	0.770	0.52	0.571
Middle					
15-19	0.206	0.156	0.756	0.99	0.158
20-24	0.336	0.259	0.770	0.99	0.262
25-29	0.472	0.369	0.782	0.98	0.377
30-34	0.487	0.382	0.785	0.95	0.402
35-39	0.434	0.372	0.858	0.91	0.409
40-44	0.251	0.224	0.894	0.78	0.287
45-49	0.295	0.230	0.778	0.52	0.442
Lower					
15-19	0.133	0.095	0.712	0.99	0.096
20-24	0.174	0.130	0.752	0.99	0.131
25-29	0.303	0.238	0.785	0.98	0.243
30-34	0.350	0.283	0.810	0.95	0.298
35-39	0.353	0.284	0.806	0.91	0.312
40-44	0.307	0.255	0.829	0.78	0.327
45-49	0.152	0.132	0.866	0.52	0.254
Agriculturalist					
15-19	0.146	0.105	0.716	0.99	0.106
20-24	0.132	0.100	0.759	0.99	0.101
25-29	0.178	0.133	0.749	0.98	0.136
30-34	0.240	0.185	0.772	0.95	0.195
35-39	0.231	0.176	0.761	0.91	0.193
40-44	0.158	0.126	0.796	0.78	0.162
45-49	0.097	0.079	0.819	0.52	0.152

It is also very important to take into account the proportion fecund by age. Vaessen (1984) presents an estimation of the mean proportion of infecund women by age for 28 countries. According to his results, the proportion fecund tends to decline with age. For the age group 15-19, the proportion fecund was estimated at 99 percent, but for the age group 45-49 the proportion was estimated at 52 percent. Using the values of the proportion fecund, it is possible to estimate the proportion of protected women among all fecund women. The results are presented in the last column of Table 11.

The index of contraceptive protection for each age group can be developed as the ratio of the proportion of protected women ($\Sigma u_{im}*e_m$) over the proportion of protected women who effectively need contraception (ft_i). The last column of Table 11 presents the indices. These values show that protection has its lowest value for the youngest age group of each social strata category increases systematically with age, reaching the maximum value for the age group 35-44, and then declines slightly for the last age group.

The results of the estimation of the Index of Contraception are presented in Table 12. There is significant variability in values among the social strata categories. For the Agriculturalist, C_c is 0.858, implying that contraception reduces fertility by 14.2 percent, whereas for the Upper category, reduction is 40.1 percent.

Table 12. Estimation of the index of contraception, C_c, by social strata, Bolivia 1989

		Social strata			
Index	Bolivia	Upper	Middle	Lower	Agricul
Σg_a	1.595	1.171	1.375	1.758	1.969
$\Sigma g_a/\Sigma(1-p_a)$	2.084	1.954	2.008	2.212	2.295
C_c	0.765	0.599	0.685	0.795	0.858

Differences in the use of contraceptives by social strata are quite pronounced. In the Upper, 54.6 percent of currently married women of reproductive age are contraceptive users, whereas in the Agriculturalist, the proportion drops to 17.6 percent. This difference is largely due to variations in the incidence of use of the IUD, pill, and sterilization. Whereas in the Upper category, more than 12 percent of these women use the IUD, for the Agriculturalist, the proportion is only 1.8 percent.

The Index of Postpartum Infecundability. The Index of Postpartum Infecundability was calculated using the formula:

$$C_i = \frac{20}{18.5 + i} \qquad (7)$$

where i, the mean duration of postpartum infecundability, was calculated from the mean duration of breastfeeding (see Table 8).

Estimates of the duration of postpartum infecundability were difficult to obtain, so indirect estimation procedures were applied through the following equation (Bongaarts, 1982):

$$i = 1.753 \exp.^{(0.1396 * B - 0.001872 * B^2)} \qquad (8)$$

where B is the average duration of breastfeeding and i is the average duration of postpartum infecundability. The results of these indirect estimations are presented in the third column of Table 13. The mean duration of postpartum infecundability for the Bolivian population is 10.7 months.

Table 13. Estimation of postpartum infecundability by social strata, Bolivia 1989

Social strata	Average breastfeeding (in months)	Postpartum sterility (in months)	Index of Postpartum Infecundability
Bolivia	16.70	10.70	0.685
Upper	11.28	6.68	0.794
Middle	16.70	10.70	0.684
Lower	17.10	11.03	0.677
Agricultural	17.80	11.62	0.664

According to the results of the Index of Postpartum Infecundability presented in Table 13, there is great variability among the social strata categories in the percentage of reduction in fertility attributable to postpartum infecundability. The inhibiting effect of postpartum infecundability is greater for the Agriculturalist (33.6 percent) than for the women of the Upper social strata (20.6 percent).

Integrated Results of the Bongaarts Indices

The indices required for Bongaarts' model are presented by social strata in Table 14, along with the model estimates of the Total Fertility Rate and the Total Fertility Rate Observed.

Table 14. Estimates of the indices of the intermediate fertility variables and the model estimates of the total fertility rate (TFR) by social strata, Bolivia 1989

		Social strata			
Concept	Bolivia	Upper	Middle	Lower	Agric.
Model estimate of TFR	4.995	4.191	4.817	4.974	5.465
Index of marriage, C_m	0.623	0.576	0.672	0.604	0.627
Index of contraception, C_c	0.765	0.599	0.685	0.795	0.858
Index of postpartum infecundability, C_i	0.685	0.794	0.684	0.677	0.664
Total fertility rate observed	4.967	3.370	4.620	5.310	6.170
Difference between the two rates	-0.028	-0.821	-0.197	0.336	0.705

According to the indices obtained, C_m is the most important factor in reducing potential fertility in each social strata. On average, the C_m values imply a reduction of 37 percent from Potential Fertility levels due to marriage-related effects. For Agriculturalist and Lower social strata women, C_i is the second most important, implying a reduction of 34 and 32 percent, respectively, from Potential Fertility levels due to postpartum infecundability. The second most important factor for women of the Upper and Middle social strata is C_c, implying a reduction of 40 and 32 percent, respectively, from Potential Fertility levels due to contraception.

A comparison of the model estimates with the observed TFRs discloses good agreement between these two fertility rates. The model estimates of TFR, which use three intermediate factors—proportion married, contraception, and postpartum infecundability—explain 97 percent of the variation in the observed fertility rate. The average difference between the estimated and observed TFRs is 0.417 births per woman. The greatest differences are registered for the women of the Upper and the Agriculturalist categories—0.821 and 0.705 births per woman, respectively. Other factors, such as induced abortion or secondary sterility may not have been included.

The findings of Bongaarts' model for each social strata of Bolivian women support that proportion married, contraception, and postpartum infecundability are the most important proximate determinants of Bolivian fertility. Different researchers who have applied Bongaarts' model to other countries and regions have arrived at similar conclusions (Bongaarts, 1978, 1982; Bongaarts and Kirmeyer, 1982).

The findings of the indices of contraception and postpartum infecundability have the predicted direction. Populations with low values for the index of contraception exhibit high values for the infecundability index and vice versa. This same tendency is presented in the case of the four social strata categories. In other words, the transition from a regime of natural fertility to one of controlled fertility, where contraceptive use is increasing and postpartum infecundability is shortened, is consistent (Bongaarts, 1982) for the subpopulations of Bolivia. The index of contraception for the Upper category is the lowest in Bolivia, suggesting that this subpopulation is moving towards a more controlled reproductive process.

The intermediate rates in the movement from total potential fertility to the TFR are presented in Table 15.

Table 15. Estimates of the levels of fertility measures by social strata, 1989

Measures model estimates	Bolivia	Social strata			
		Upper	Middle	Lower	Agricul.
Total fecundity rate	15.30	15.30	15.30	15.30	15.30
Total natural marital fertility rate	10.48	12.15	10.47	10.36	10.16
Total marital fertility rate	7.86	7.28	7.17	8.23	8.72
Total fertility rate	4.90	4.19	4.82	4.97	5.47

Table 15 provides a clear picture of the differences in the fertility measures of the four social strata. The Total Natural Marital Fertility of the Upper category is the highest. It is expected that, on average, the women of the Upper category will have 2 children more than their counterparts in the Agriculturalist category. This is partly explained by the strong impact of an extended period of breastfeeding for the Agriculturalist as compared to the Upper category. The difference is expressed by the index of Postpartum Infecundability. Among the other subpopulations, the variation in the Total Natural Marital Fertility is not large.

Even though the Upper category registers the highest levels of Natural Marital Fertility, the strong prevalence of contraceptive use among these women makes the Total Marital Fertility Rate of the Upper social strata to be lower than that of the Agriculturalist. The late marriage of the women of the Upper category as compared to that of the Lower and Agriculturalist categories causes the move from TMFR to TFR in the Upper category to be faster than in the other two social strata categories.

Limitations of the Proximate Determinants Model

The variance in fertility within the country that is not explained by the three principal intermediate fertility variables is due to several factors. First, it has been assumed that the value of the TF is the same in each social strata. However, differences in several biosocial factors could lead to a higher or lower TF level. A higher level of TF will provide higher levels of fertility in the Upper category, thus reducing the gap between observed and expected fertility rates.

Second, the frequency of intercourse is not included in the reduced version of Bongaarts' model. Although frequency of intercourse has a negligible effect on fertility at the national level, it may have an impact at the social strata level. If there is a difference in the frequency of intercourse among the social strata categories, it is probable that the fertility rates for the social strata category with higher frequency of intercourse may have been underestimated by not considering it.

Third, some types of errors may exist in the measurement of the intermediate fertility variables by social strata.

Fourth, since methods for measuring fertility are not perfect, it is possible that errors exist in the observed Total Fertility Rate. Therefore, the best available fertility estimates differ somewhat from the true rates.

Conclusions

The results presented in this section allow us to have a better understanding of Bolivian fertility as a whole, as well as for each subpopulation under study. These results not only reveal the levels of fertility but, more importantly, indicate the effect that each determinant has individually upon fertility.

The principal finding of this section is that the three main intermediate fertility variables—proportion married, contraception, and postpartum infecundability—account for most of the variation in fertility levels for the four social strata categories of the Bolivian population. These results are similar to those found in previous studies where Bongaarts' model was applied.

The observed fertility rate of 4.9 children per woman for Bolivia is the result of the inhibiting effects of the proximate fertility determinants. If all Bolivian women of reproductive age were married, none practised contraception or abortion, and none breastfed their babies, they would have 15 to 16 children on average at the end of their reproductive period.

The variables proportion married, contraception, and postpartum infecundability explain 97 percent of the variance in the TFR obtained by Bongaarts' model and the observed Total Fertility Rate.

Age at marriage plays an important role in the determination of fertility levels, having great variability between the Upper, Lower, and Agriculturalist social strata categories. The late age at marriage in the Upper category accounts to a large extent for its low TFR as compared to the other social strata categories, all other factors being equal.

Postpartum infecundability resulting from breastfeeding has a strong fertility-inhibiting effect for the women of the Lower and Agriculturalist categories, where the average breastfeeding duration is 17.1 and 17.8 months respectively. As a result, the Natural Marital Fertility in these subpopulations is much lower than that for the Upper category.

Although Natural Marital Fertility for the Upper category is higher than in the other subpopulations its Total Marital Fertility Rate is relatively lower than in the Lower and Agriculturalist subpopulations, because contraceptive prevalence is high. In 1989, more than 54 percent of the currently married women were using contraception. Furthermore, the use of modern contraception in the Upper category is widespread. Therefore, the high prevalence of contraceptive use and its effectiveness are principal reasons for the low fertility rate in this subpopulation.

In the Lower and Agriculturalist categories, the extended period of breastfeeding, together with the lateness of marriage, contribute to the decrease of the TFR of these subpopulations.

Although the Bongaarts model is used at the aggregate level to calculate the different indices, it is the experiences of individual women that are added together to estimate the different rates, thus integrating the macro- and microlevel factors of fertility.

Easterlin, with his model of three equations, integrates the proximate determinants of fertility with microeconomic variables that determine contraceptive use. He explains fertility decline as affected by structural changes in society brought about by the modernization and cultural variables.

Determinants of Fertility at the Individual Level: The Easterlin Framework

The Easterlin framework not only uses the proximate determinants of fertility, but also incorporates microeconomic variables such as the demand for children, supply of children, and cost of regulation. These variables, in turn, determine contraceptive use. Moreover, as Easterlin and Crimmins (1985) explain, fertility declines in terms of the "modernization process" reflecting structural changes in society.

Analytical Method of Easterlin's Framework

Easterlin's approach involves a three-stage analysis of fertility determination. In each stage, the functional relationship between the dependent variable and the independent variables was estimated through a linear regression model. According to Easterlin and Crimmins (1985), the first two equations correspond to the analysis of links from individual-level intermediate variables to fertility, measured by the number of children ever born, and from fertility to demand, supply, and regulation cost. The third equation links fertility to modernization and other factors.

Equation One: Model and Methods

This equation, which corresponds to the first stage of the theoretical and conceptual description of the Easterlin framework, includes an individual-level intermediate variable analysis of the proximate determinants of fertility. In this model, all the intermediate fertility variables are considered simultaneously. The focus is on the impact of intermediate variables on cumulative fertility, expressing a woman's total births over her reproductive career, as a function of length of exposure to intercourse, fecundity, contraceptive use, and the outcome of gestation.

The first equation provides the basis for estimating natural fertility, a principal component of the potential supply of children, as well as yielding a specific quantitative estimate of the effect of fertility control on fertility. The equation for the estimation of a model of the proximate determinants of individual parity for the Bolivian case is given by:

$$B = \alpha_0 + \sum_{i=1}^{i=7} \alpha_i * X_i + \alpha_8 U + \epsilon \tag{9}$$

where

B	=	Children ever born (CEB)
X_1	=	Duration of marriage in years
X_2	=	Age at marriage
X_3	=	First birth interval in months
X_4	=	Second birth interval in months
X_5	=	Not secondarily sterile
X_6	=	Months of breastfeeding in last closed interval
X_7	=	Proportion of child mortality
U	=	Use of contraception
ε	=	Random disturbance.

Following Easterlin and Crimmins (1985), with regard to the parameters of Equation 9, it can be hypothesized that the parity of a continuously married woman would be higher:

- the more infrequently deliberate fertility control is used by one or both members of the couple ($\alpha_8 < 0$)
- the longer the length of exposure, that is, the longer the duration of marriage ($\alpha_1 > 0$)
- the younger her age at marriage ($\alpha_2 > 0$)
- the greater the couple's fecundability, that is, the shorter their first birth interval ($\alpha_3 < 0$)
- the shorter her period of secondary sterility ($\alpha_5 > 0$)
- the shorter her period of postpartum infecundability, that is, the shorter her second birth interval ($\alpha_4 < 0$)

- the shorter the last child's lactational period ($\alpha_6 < 0$), and
- the higher the proportion of child mortality ($\alpha_7 > 0$).

In Equation 9 the variable children ever born (CEB) is an endogenous variable and there are eight exogenous variables—duration of marriage, age at marriage, first birth interval, second birth interval, not secondarily sterile, breastfeeding duration, child mortality, and use of contraception. These variables can be described as follows:

Marriage duration in years. This variable includes common-law marriages or consensual unions and is obtained as the difference between current age and age at first marriage. Because the analysis will refer to intact marriages, this variable should have no computational bias (McHenry, 1985). It corresponds to the exposure factor variable proportion married in the Bongaarts model.

Age at marriage in years. This variable has been included in order to separate the pure marriage duration effect.

First birth interval in months (X_3). This variable excludes premarital births. It can be used as a proxy for the fifth proximate determinant of Bongaarts model—fecundity—under the assumption that the more fecund a couple is, the more rapidly they will reproduce after marriage. Therefore, the first birth interval should be shorter in the absence of the use of contraception. This variable is obtained as the difference between date at first birth and date at marriage.

Second birth interval in months (X_4). This variable examines the effects of postpartum amenorrhoea, a couple's fecundity, waiting time to conception, and the time from conception to live birth, which should cause the second birth interval to be longer than the first. This variable is obtained as the difference between date at second birth and date at first birth.

For X_3 and X_4, respondents who used contraception prior to the first and/or second birth will create some problems. To deal with this situation, Easterlin and Crimmins (1985:47) recommend the following:

> For these women, the second, and possibly, first birth interval variables are flawed as indicators of fecundability and postpartum infecundability. For lack of an alternative, the observed birth interval values for these users are replaced by the mean values for these intervals of those who did not regulate in that interval.

In this way, Easterlin and Crimmins remove the child-spacing effect of using contraception.

Absence of secondary sterility (X_5). The prevalence of permanent sterility is measured by absence of secondary sterility. This variable indicates that the women are not yet menopausal. The following measure of secondary sterility has been adopted, a two-category variable using dummy coding: one if the woman is fecund and zero if the woman is sterile. If the respondent is currently pregnant, she is considered fecund. If the respondent either reports fertility impairment or is not currently a user of contraception and reports no births in the past 5 years, she is considered sterile. The measure of secondary sterility established in this way, as noted by Easterlin and Crimmins, is likely to have an upward bias in calculating the fecundity of current women using contraceptives, since it is possible that secondary sterility may be unknown to some current users.

Duration of breastfeeding in the last interval. This variable is a proxy for the length of breastfeeding in previous birth intervals. Since the ENDESA questionnaire (INE and IRD, 1990) only asked retrospective questions on breastfeeding for each child born since 1984, the duration of breastfeeding in the last interval is used. Generally speaking, postpartum infecundability depends primarily on the length of breastfeeding (Bongaarts, 1983), which, in turn, extends the birth interval.

Proportion of child mortality. Child mortality is included since the premature death of a child can shorten the length of breastfeeding and indirectly affect postpartum infecundability. It also affects expectations of child survival, perhaps with a lag. This variable is measured as the difference between the number of children ever born and the number currently living, divided by the number of children ever born. According to Easterlin and Crimmins (1985:49):

> Because the denominator includes a dependent variable, a criticism of possible bias might again be raised, in this case with regard to equation (1a). The empirical results reported in Chapter 4 contradict this charge. If bias were a problem, one would expect a negative coefficient on X_7, but in fact, we obtained a positive coefficient. Moreover, the effect on the results of including X_7 in the analysis is small.

Fertility control or use of contraception. It should be observed that this variable includes both the so-called "efficient" and "inefficient" methods, including female and male sterilization. However, it does not include lactation as a method of deliberate fertility control, since the basic motivation for breastfeeding is usually not fertility reduction.

The variable "use of contraception" (U) was measured in two different ways. In each case, women who reported never having used a contraceptive method had their fertility control value fixed at zero, whereas users were coded as 1. Users were also classified by the length of time (in months) that they had been using any particular method. The age of the respondent when contraceptive methods were first used was recorded. The length of time since first use was estimated by means of the date of interview and the date at first use, adding 12 months whenever the reference point was parity before first use. If fertility was controlled before the first birth, the reference point for measuring length of time since first use was age at marriage. The contraception use and effectiveness of Bongaarts model is replaced here by the "use" variable.

This measure of contraceptive use clearly overestimates the duration of fertility control because it fails to take into account lapses from use. However, according to Easterlin and Crimmins (1985:47), "the measure does provide at least a rough measure of differences among users in the extent of use."

Equation Two: Model and Methods

The second equation corresponds to the second stage of the theoretical and conceptual description of the Easterlin framework. The "use of fertility control" (U) is selected for analysis as a dependent variable and is explained as a function of the "demand for children", "supply of children", and "regulation cost." This equation is referred to by Easterlin and Crimmins (1985) as "determinants of use," which is the key in testing the theory of the Easterlin framework.

As Bongaarts suggests, variable U is employed as a measure of deliberate fertility control. The X_3 through X_7 variables combine as determinants of natural marital fertility and, with X_1 added, of natural total fertility. Thus, Equation 9 can be redefined as follows:

$$B = N + \alpha_8 U + \epsilon \qquad (10)$$

where N, total natural fertility, is given by

$$N = \alpha_0 + \sum_{i=1}^{i=7} \alpha_i X_i \qquad (11)$$

implying that differences in natural fertility among couples result only from their respective differences in variables X_1 through X_7.

This section, therefore, discusses and estimates deliberate fertility control as a function of the motivation for and cost of fertility regulation. The second equation is given by[5]:

[5] See Easterlin and Crimmins (1985:38).

$$U = B_0 + \delta\ (C_n - C_d) + \gamma RC + \mu \qquad (12)$$

where

C_n	=	$(1 - X_7)$ N, the potential supply of children
C_d	=	the demand for children
RC	=	the cost of fertility regulation, and
μ	=	random disturbance.

With the parameters in equation 5.4, it is hypothesized that the coefficients related to motivation for fertility control ($C_n - C_d$), must be positive ($\delta > 0$), whereas the coefficient related to "cost of regulation" (RC) should be negative ($\gamma < 0$). Theoretically, C_n and C_d should have the same coefficient (δ). According to Easterlin and Crimmins (1985:39), "The difference in behaviour of two couples differing on $C_n - C_d$ by some given magnitude, and in other respects identical, should be unaffected by whether the source of the difference in motivation is C_n, C_d or both."

These variables can be described as follows:

Demand (C_d). This variable was measured by reporting desired family size, using the respondent's answer to the question, "If you could choose exactly the number of children (surviving) to have in your whole life, how many would that be?" This type of question may raise some problems as a disputable question. However, according to Easterlin and Crimmins (1985:49):

> The present framework views desired family size as only one of a number of fertility determinants, and there is no necessity for desired size alone to be highly correlated with fertility.

The validity of the measurement of desired family size has been debated because it tends to rationalize past behaviour and considers a subsequent rather than prior situation concerning reproductive control decisions. The implication is that desired or ideal family size becomes biased by actual parity, so that women report as desired those births which, at the time of their occurrence, were in fact undesired. However, evidence indicates that this is a relatively modest bias, and the traditional measure used here is quite consistent with estimates regarding the point of completion for preferred family size (Easterlin and Crimmins, 1985:49). Furthermore, Lightbourne (1985:186) concludes that:

> ...in spite of the persuasive objections that have been raised against the conventional estimate of average number of children preferred, it becomes obvious that the conventional mean for all women does offer a reasonably good approximation to the mean number of living children that women would have if (i) they were to succeed in stopping at the family size at which they report no further desire for additional children; (ii) they do not suffer fecundity impairments; and (iii) they do not permanently postpone desired births.

Following Easterlin and Crimmins' recommendation (1985:14-15), one can make a comparison between regulators and nonregulators, which will indicate whether the information available exhibits real differences regarding family size preferences. The bias in desired family size is expected to be smaller among couples who have fewer children than their reported ideal.

Given that regulators reported a smaller number of children than nonregulators, it follows that not only is there a genuine difference in preferences between the two populations, but that this difference is probably underestimated. Despite differential bias about desired family size between nonregulators and regulators, the use of "desired family size" as a proxy for "demand for children" can be viewed as a reasonable measure. After an extensive study of the subject, McClelland (1983:319) concludes that "it is not unreasonable to treat family size desires as measures of demand."

Potential Supply of Surviving Children (C_n). Theoretically, this variable measures the number of surviving children that a household would have if they did not practice fertility control. Although not directly observable, this variable can be calculated as the product of a couple's natural fertility (N) times its child survival rate (S). The child survival rate can be established as $S = 1 - X_7$ (child mortality) and $C_n = S * N$, so $C_n = (1 - X_7) * N$, which is an estimation of potential supply.

The empirical analysis of the data for Colombia and Sri Lanka carried out by Easterlin and Crimmins (1982:13-14) shows some bias in the calculations of "natural fertility" and "potential supply." However, they concluded that the upward bias of the survival rate of the regulators will be offset by the downward bias of natural fertility for nonregulators. Although the bias of these two measures may not completely offset one another, it can be presumed that the bias of the potential supply should not affect the substantive results. Moreover, the microlevel estimates of natural fertility for Colombia and Sri Lanka, reported by Easterlin and Crimmins (1985) are generally of reasonable magnitude; the overstated rate of survival, according to them, seems unlikely to be a serious quantitative problem.

Cost of Fertility Regulation (RC). There are two categories of costs that can be related to the regulation of fertility: psychic cost and economic cost. The costs involving attitudes and feelings toward fertility regulation are grouped under the psychic cost, while the economic, or market, cost is the time and money needed to learn and effectively use some form of fertility control. Assuming that the determination to use a method of control probably influences a positive change both in attitudes and knowledge, a measure of the costs of fertility regulation should consider the situation prior to that decision. This assumption is required in order to avoid the bias derived from the reciprocal causation of cost and fertility control decisions.

The DHS survey in Bolivia in 1989 did not include direct measures of psychic and economic costs, but included questions concerning knowledge and attitudes toward fertility regulation that could serve as proxies. The principal variable to be used as a proxy for "regulation cost" is the "number of methods known" or, alternatively, the "sum of methods known," weighted by their efficacy.

The measure used here falls short of the ideal, not only because it excludes the psychic dimension of "regulation cost," but also because it refers to a situation following the decision to use contraception, hence reflecting the effect of that decision upon the attitudes and knowledge levels of the population regulating fertility. In other words, the knowledge may be determined by, rather than be independent of, the use of contraception. In order to diminish the problem posed by the endogenous nature of regulation costs, the population of regulators will be analyzed separately as a means of controlling for the differential bias resulting from knowledge of control methods.

Equation Three: Model and Methods

The third equation corresponds to the third stage of the framework. The variables entered in the previous stages are treated as dependent variables to be explained by family background characteristics as well as women's cultural values and practices. In the third equation, "children ever born" (B) and "fertility control" (U), plus the independent variables relating to natural fertility (X_1 through X_7), the "demand for children" (C_d), and "cost of regulation" (RC), in turn, become dependent variables, functions of socioeconomic and cultural determinants.

$$W_j = K_j + \pi_j Y_k + \rho_j Z_m + \eta_j \tag{13}$$

where

W_j = Vector for each of the independent variables, X_1 through X_7, C_d and RC
Y_k = Vector of modernization variables
Z_m = Vector of cultural and other variables
η = Random disturbance.

According to Easterlin and Crimmins (1985:39):

> ...the specific Y and Z variables would be expected to differ among the various dependent variables; the determinants of breastfeeding, for example, are not the same as those of the demand for children. Also, even when a given determinant may be common to several dependent variables, it may exert its effect in different directions, for example, education may enhance child survival and reduce breastfeeding. Thus, the expected nature of the independent variables and their hypothesized effects differ depending on the dependent variable under consideration.

The variables that are selected to form a set of predictors used in all regressions include:

Ecological strata, a categorical variable with three categories: Highlands, Valleys, and Lowlands

Spatial context, a dichotomous variable: Urban and Rural

Social strata, a categorical variable with three categories: Upper-middle class, Lower class, and Agriculturalist

Wife's education, a continuous variable measured in completed years of schooling

Husband's education, a continuous variable measured in completed years of schooling

Family wealth, a dichotomous variable indicating the availability/nonavailability of car, tractor, motorcycle, bicycle, or any combination thereof in the household

Childhood place of residence, a categorical variable with two categories: Urban and Rural

Language spoken at home, a categorical variable with two categories: Spanish and a native language

Availability of basic services, a dichotomous variable indicating the availability/nonavailability of running water and sewer systems

Media exposure, a categorical variable with two categories: exposure and nonexposure, measured by TV watching and radio listening

Age, a continuous variable, varying from 30 to 44 years of age.

Finally, since socioeconomic and cultural conditions, as well as fertility behaviour, have been experiencing rapid changes during the past two decades, the variables tend to be related to the respondent's age. Thus, a statistical control for this variable is introduced.

The Sample

In order to estimate the total number of "children ever born" to a woman, the study population should ideally include those women who have completed their reproductive period, in other words, women older than 44 years. However, in many countries, women tend to terminate childbearing before menopause, and social norms regarding childbearing at older ages play a major role in the decision-making process.

The study population used to illustrate and evaluate the Easterlin framework includes females in the age groups 30-34, 35-39 and 40-44, who are near the end of their reproductive lives, although the study population used by Easterlin and Crimmins included women ages 35-39 and 40-44. To deal with this, the variable age was introduced as a control. This modification was included because, in the ENDESA (INE and IRD, 1990), the question on breastfeeding duration in the last closed interval was asked of women who had had children in the 5 years prior to the survey, which greatly reduces the sample size. The inclusion only of these women in the analysis introduces an upward bias in favour of women with high fertility.

Other restrictions have been imposed on the sample to minimize conceptual and measurement problems. The sample does not include women who have been married more than once, women who are not currently married, and those who have had multiple births. The sample only includes women who have had at least two births and those who have had no births prior to the start of their marriage or consensual union. In addition, the restriction of continuous marriage is applied to deal with the problem of marital disruption. Another restriction is imposed on women with only one child since there will be no observations on second birth interval and breastfeeding in the last closed interval (X_4 and X_6). Also, for childless women, there will be no observations on "first birth interval" (X_3). Moreover, because of inadequate data on duration of exposure and first birth interval, women with premarital or preconsensual-union births are omitted. These restrictions generate a cohort of women who have stable marital unions.

In general, unstable marital unions provide inaccurate information on the duration of marriage, because women who are married more than once cannot always correctly remember the dates of separation as well as the dates of new unions. (In Bolivia, a great proportion of women are illiterate and therefore are unable to record dates of vital events, including marriage.) Similarly, women who have been widowed at early ages have a shorter exposure to childbearing than women who remain married throughout their reproductive lives.

Excluding women who have had multiple births may lead to an underestimation of natural fertility. But since only a small fraction of women reported multiple births in the original sample, their exclusion should have little impact on the results.

Out of an original sample of 7923 cases, the women included in the study with the Easterlin framework had to be ages 30 to 44, married only once and currently married, having at least two births but no multiple births, and having no births prior to the start of their marriage or consensual union. This limited the sample size to 1722 cases. Further restricting the sample to women who had a birth in the last five years reduced the sample size to 508 cases, or 30 percent of the subsample of women who had met all the other criteria. Because of the great reduction in the sample size, it is not possible to carry out the analysis for each social strata category for the regulator and nonregulator populations. Therefore, the analysis will classify Bolivian women only as regulators or nonregulators, and the social strata categories will be included in the third stage of the Easterlin model as one of the modernization and cultural variables.

The Results and Data Analysis

In this section, the main idea is to express a function that describes the reproductive behaviour of individuals, that is, the total number of children a woman can be expected to have during her reproductive period. The estimation of the proximate determinants of fertility is exhaustive, since its determination is essential for the estimation of "natural fertility" and the "potential supply of children" in the second stage. In the third stage, the paths through which socioeconomic and cultural variables influence the number of children ever born to a household will be described.

Individual Level Analysis of the Proximate Determinants of Fertility

In the Easterlin framework, the first phase is the estimation of an equation that will allow "children ever born" (CEB) to be estimated as a function of the proximate fertility determinants.

The mean and standard deviation for each variable used in the analysis of the proximate determinants of cumulative fertility are presented in three separate sets in Table 16. The first includes the total of married women between the ages of 30 and 44 at the time of the survey with two or more live births the second refers to those women of the first set who use contraceptives (regulators), and the third corresponds to those women of the first set who do not use contraceptives (nonregulators).

Table 16. Means and standard deviations for proximate determinants of fertility of continuously married women, with two or more live births, age groups 30-34,35-39 and 40-44, Bolivia 1989

Variable	Total		Regulators		Nonregulators	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Children ever born	4.92	2.30	4.36	2.00	5.57	2.44
X_1, Marriage duration[1]	16.31	5.36	15.71	5.01	16.99	5.66
X_2, Age at 1st marriage[1]	19.83	3.89	20.04	3.80	19.59	3.99
X_3, 1st birth interval[2]	17.74	17.71	16.61	16.06	19.01	19.35
X_4, 2nd birth interval[2]	31.91	22.79	31.49	21.10	32.38	24.57
X_5, No secondary sterility	0.82	0.38	0.91	0.29	0.72	0.45
X_6, Duration breastfed[2]	13.94	6.20	13.15	5.79	14.35	6.38
X_7 Child mortality	0.13	0.18	0.10	0.15	0.16	0.20
U_1, Use	0.39	0.49	0.73	0.44	0.00	0.00
U_2, Contraceptive use[2]	71.94	80.49	135.46	59.94	-	-

[1] In years
[2] In months

The mean number of CEBs for the regulator population is, on average, 1.2 children per woman less than for the corresponding nonregulators. There is no noticeable difference between the breastfeeding practices of regulators and nonregulators, since the average length of breastfeeding among nonregulators is only around 1.2 months more. The difference in marriage duration is 1.28 years in favour of the nonregulator population. This can be explained in part by their earlier age at marriage as compared to the regulators. It is noteworthy that the first birth interval for the regulators is shorter than for the nonregulators by 2.4 months. Although the regulators marry an average of half a year older than the nonregulators, the first birth arrives faster, possibly due to socioeconomic differences between the two groups or differences in pregnancy waste. With respect to the second birth interval, the data show no significant difference between the subpopulations. This may suggest that, in many cases, the contraceptive use of the regulators does not start until after the second birth. Moreover, there is no difference in length of breastfeeding between the two groups. In addition, nonregulators register a child mortality rate 60 percent higher than the regulators. Overall, the gap in the number of CEB between regulators and nonregulators is not great, showing once more the high level of fertility of the Bolivian population.

For the variable "contraceptive use," two sets of results are presented. One includes the variable U defined as "duration of contraceptive use" in months. The other has the same variable defined as a dichotomous variable "contraceptive use/nonuse." According to the data, the regulating population on average has 63.5 months longer contraceptive use than the total population.

The first-order correlations between the dependent variable (CEB) and the independent variables are modest, with the exception of "duration of marriage" and, to a lesser extent, "age at marriage," "child mortality," and "second birth interval." The signs of the correlations are in the hypothesized direction and they are significant, except for the correlation of CEB with "duration of breastfeeding" (X_6), which has the incorrect sign (see Table 17).

Table 17. Correlations of proximate determinants of fertility for continuously married women in age groups 30 to 44 having two or more live births, Bolivia 1989

Variables[1]	Correlations									
X_1	1.000									
X_2	-.721	1.000								
X_3	.217	-.166	1.000							
X_4	.085	-.119	-.025	1.000						
X_5	-.018	-.024	-.032	-.016	1.000					
X_6	.080	-.042	-.031	-.035	.034	1.000				
X_7	.179	-.199	.039	-.139	.024	-.189	1.000			
U_1	-.143	.067	-.038	-.024	.028	-.110	-.105	1.000		
U_2	.024	-.059	-.046	.083	-.008	-.088	-.086	.570	1.000	
CEB	.841	-.619	-.037	-.204	.022	.025	.301	-.160	- .065	1.000
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	U_1	U_2	CEB

[1] The variables were identified on page 37

The 36 correlations among the independent variables are generally very low, with the exception of "duration of marriage" and "age at first marriage." As expected, these show a negative sign. Furthermore, all three indicators of postpartum infecundability (X_4, X_5, and X_6) show low intercorrelations, indicating little or no measurement redundance. Also, there is a virtual absence of correlation between variable X_5, "no secondary sterility," and almost all the other variables, including the dependent variable CEB, due to its small variability. The "no secondary sterility" mean value shows that about 82 percent of the total women in the sample are not menopausal—a fact that limits the space for correlation with other variables.

With respect to the very high intercorrelation between "marriage duration" and "age at marriage," the situation is partially conflicting. On the one hand is the desire to obtain the pure effect of marriage duration, because age at marriage varies greatly in Bolivia. However, it is necessary to use multiple indicators for one variable, "marriage duration," which leads to a high intercorrelation between these two indicators. However, the correlation (-.721) is not so high as to cause problems of multicollinearity.

The Ordinary Least Squares regression coefficients are presented in Table 18. Two sets of coefficients are presented, according to the definition used for variable U (contraceptive use). For both regressions, all coefficients display the expected sign of the relationship, and most are significant at conventional levels. When variable U is defined as "duration of contraception in months," most of the regression coefficients are significant at conventional levels, except for the coefficient related to the variable "no secondary sterility." The same is true when variable U is defined as "use/nonuse." In both equations, this can be partially explained by the low variability of variable X_5.

Overall, the model represented by Equation 9 can explain about 86 percent of the variance in cumulative fertility, when variable U is either defined as the duration of contraceptive use or when it takes a dichotomous form use/nonuse. In other words, the explanation levels of R square are very high for both equations. It seems clear that "duration of marriage," "second birth interval," and "first birth interval" are the principal proximate determinants of fertility in Bolivia. At the individual level, "duration of marriage," which taps the length of exposure to the risk of conception, is the main determinant of completed fertility.

The coefficient for the "duration of marriage" variable indicates a frequency of births of about one birth every 2.5 years, hence a completed fertility of some 12 children after 30 years of marriage. This shows that Bolivia demonstrates the characteristics of a population having natural fertility.

Table 18. Ordinary Least Squares regression for proximate determinants of fertility of continuously married women, with two or more live births, age groups 30-34, 35-39 and 40-44, Bolivia 1989

Parameter	U = Duration of contraception		U = Use/nonuse	
	β metric (std error)	β[a] standardized	β metric (std error)	β[a] standardized
X_1, Marriage duration	0.393062 (0.01103)	0.871472	0.389803 (0.01122)	0.864015
X_2, Age at 1st marriage	-0.030015 (0.01396)	-0.052421	-0.028347 (0.01412)	-0.049462
X_3, 1st birth interval	-0.037111 (0.00254)	-0.250337	-0.036578 (0.00256)	-0.246532
X_4, 2nd birth interval	-0.036520 (0.00228)	-0.273552	-0.037283 (0.00231)	-0.27901
X_5, Not secondarily sterile	1.020675[a] (0.74553)	0.022858	1.096187[a] (0.75460)	0.024524
X_6, Duration breastfeeding	-0.020917 (0.00664)	-0.054381	-0.019862 (0.00673)	-0.051589
X_7, Child mortality	1.275835 (0.25254)	0.089842	1.319383 (0.25571)	0.092830
U, Deliberate fertility control	-0.003068 (0.00006)	-0.074806	-0.263594 (0.09978)	-0.045532
Constant	1.882270 (0.87931)		1.760930 (0.88917)	
R^2	0.86182		0.85866	
F	388.89280		379.28705	

[a] Not significant at the 5-percent level

With regard to the coefficient of the variable "fertility control" U, it is also possible to establish that a couple that initiates contraception 10 years earlier (other things being equal) would reach a cumulative fertility of 0.4 fewer births than a comparable couple that does not regulate its reproductive behaviour. Therefore, after 30 years of any contraceptive use, a couple would have 1.2 fewer births than a nonregulating couple. These values in part reflect the use of inefficient contraceptive methods by Bolivian women, since more than 75 percent of users use only traditional methods.

The standardized coefficients suggest a clear hierarchy in fertility determination. In descending order of importance, the coefficients are "marriage duration"—by far the most important, "second birth interval," "first birth interval," "child mortality," "fertility control," "duration of breastfeeding," "age at first marriage" and, finally, "absence of secondary sterility."

Child mortality plays an important role in fertility, indicated by the fact that the sign is positive and the standardized regression coefficient is statistically significant. This finding gives a foundation for the estimation of motivation for control, especially the estimate of the "potential supply of children," which takes child mortality into account.

In the first-order correlation, the sign of the bivariate coefficient of "length of breastfeeding" with "children ever born" was positive. However, in the multivariate analysis, its coefficient is negative, which is theoretically suitable. This coefficient indicates that the longer average duration of breastfeeding will lead to fewer births.

The Determinants of Contraceptive Use

The second stage of the Easterlin framework is the calculation of an equation that will allow the estimation of "use of fertility control" (U) as a function of the motivation and cost regulation factors.

Estimates of Potential Supply of Surviving Children (C_n). The potential supply of surviving children (C_n) was estimated as the product of a couple's natural fertility times its child survival rate ($1 - X_7$).

The proximate determinants equation estimated in the first stage provides the foundation for estimating the proxy for natural fertility,[6] which is obtained for each couple by replacing the actual values of X_1 through X_7 in the proximate determinants equation,[7] finding the sum of the results, and adding the constant term. (The coefficients are presented in Table 18.)

In Table 19, the mean levels of natural fertility are compared with the actual fertility levels for the regulating and nonregulating subpopulations separately.

For the nonregulating population (the couples who never initiated deliberate control of fertility), the estimated natural fertility is slightly higher than actual fertility (by an average of 0.69 children), by definition the true natural fertility of this population group (the actual number of children ever born). Although the fit of the model based on Equation 9 is quite good, it cannot account entirely for variations in "children ever born."

Table 19. Means and standard deviations of estimated natural fertility (N) and present children ever born (CEB) by fertility regulation, Bolivia 1989

	Regulators		Nonregulators	
	Mean	Standard deviation	Mean	Standard deviation
Children ever born	4.364	2.000	5.571	2.446
Natural fertility	5.387	1.953	6.269	2.294

As would be expected, for the regulating population (couples who have tried deliberate fertility control at least once), the mean of "children ever born" is below their estimated natural fertility by an average difference of one child, which is the number of births averted by the use of contraception.

It is important to recognize that calculated natural fertility is lower for regulators than for nonregulators by an average difference of 0.88 children (see Table 16). The decomposition of this difference through the application of the means to the coefficients (presented in Table 18) for each group indicates that the nonregulators' higher fertility is largely due to the average duration of their marriages. This factor accounts for 57 percent of the difference between the two groups.

A second factor, which accounts for about 11 percent of the estimated difference, is the higher proportion of child mortality among the nonregulator couples. The mean child mortality of nonregulators is 60 percent higher than that of the regulators. The differences in natural fertility between regulator and nonregulator populations as a result of longer marriages and higher child mortality is probably socioeconomic, since both factors tend to covary with individual life situations. It is important to stress, however, that the higher incidence of child mortality among nonregulators can be, at least in part, attributed to the higher parity typical of that population.

[6] Henry (1953:135) defined natural fertility as "fertility of a human population that makes no deliberate effort to limit births." In 1961, Henry refined the concept to refer to fertility in the absence of parity-dependent birth control.

[7] The coefficients are derived from the estimation model, which defines the duration of contraceptive use in months.

The validity of the estimated "potential supply" (C_n) was evaluated using the criterion-related validity[8]. This was done by correlating the C_n with the variable "number of living children" (C) that was used as a criterion variable of interest for the non-regulator population, under the assumption that C_n has little bias and is therefore not very different from the actual number of living children. As was expected, the correlation between these two variables is very high 0.9438 ($p < 0.001$). Although the results of the validation are supportive, the estimated supply C_n still has certain differences when compared with the actual surviving children. Therefore, the extension of such estimates to further analyses should be done with caution.

The differences between the "potential supply" of children C_n and the "actual family size" C for the regulating and nonregulating populations are .812 and .631, respectively. This difference could be interpreted as follows. When natural fertility is converted into potential surviving family size, the upward bias is offset by the downward bias of the survival rate for nonregulators.

Demand for Children (C_d). The reported desired family size was used as a proxy for the demand for children. As suggested by Easterlin and Crimmins (1982:13,14), the comparison between regulators and nonregulators indicates whether the information reflects real differences in family size preferences. In general, one should expect that the bias in desired family size is less among couples who have fewer children than their reported ideal. In the present study, the proportion of women with fewer surviving children than the number they consider ideal is smaller among regulators (17.2 percent) than among nonregulators (24.9 percent). In other words, the bias associated with response about desired family size is larger in the population of nonregulators than among regulators. Given that nonregulators reported a smaller desired number of children (2.91) than regulators (3.04), it can be concluded that there is a genuine difference in preference between the two populations (see Table 20).

Table 20. Means and standard deviations of duration of contraceptive use and several measures of motivation to regulate fertility, Bolivia 1989

Variable	Total		Regulators		Nonregulators	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Duration of use[1]	71.94	59.94	135.46	59.94	-.-	-.-
(C_n - C_d)	2.08	2.40	1.73	2.21	2.28	2.48
Wants no more	0.85	0.36	0.86	0.35	0.84	0.37
(C - C_d)	1.17	2.42	0.77	2.18	1.64	2.60
C_n	4.99	1.93	4.65	1.78	5.17	1.99
C_d	2.98	1.78	3.04	1.66	2.91	1.92
C	4.17	1.86	3.84	1.66	4.54	2.01

[1] In months

To evaluate the validity of "desired family size," C_d, criterion-related validity was used. For this purpose, two variables were used as criterion variables of interest, "wants no more children" and "duration of contraceptive use", (Table 21).

Theoretically, it is expected that the "excess of living children" (C - C_d) will be highly correlated with the variable "wants no more." The correlations between these two variables are statistically significant with values of .32 and .28 for the total and regulating populations, respectively. According to Cohen (1969:77), these values would be considered tentatively meaningful.

[8] Criterion-related validity concerns the correlation between a measure and a criterion variable of interest. It is solely determined by the degree of correspondence between the measure and its criterion. If the correlation is high, the measure is considered to be valid for that criterion (Carmines and Zeller, 1979).

Table 21. Correlations between duration of contraceptive use and several measures of motivation to regulate fertility for the total population and the population of regulators, Bolivia 1989

	Duration of use	$(C_n - C_d)$	Wants no more	$(C - C_d)$	C_n	C_d	C
Duration of use		.060	.006	-.162	.077	.063	-.148
$(C_n - C_d)$	.351		.276	.951	.687	-.620	.608
Wants no more	-.040	.274		.315	.223	-.134	.284
$(C - C_d)$	-.034	.933	.276		.660	-.650	.680
C_n	.431	.771	.187	.709		.144	.928
C_d	.091	-.612	.103	-.670	.033		.115
C	.033	.677	.263	.652	.902	.127	

Note: The values in the upper triangle of the correlation matrix correspond to the total population; those in the lower triangle correspond to the population of regulators.

The correlations between "desired family size" (C_d) and "wants no more" are statistically significant, although the explanation level is lower. These correlations are -.13 and -.10, respectively, for the total and regulating populations.

For the total and regulating populations, the correlations between "desired family size" (C_d) and "duration of use of contraception" are statistically significant. These correlations are 0.06 and 0.09 for the total and regulating populations with a small explanation level. The values of the different correlations of "desired family size" are relatively valid in terms of their correlations with the variables "wants no more" and "duration of contraceptive use," assuming that these variables are themselves valid measures.

The correlations between "desired family size" (C_d) and "actual living children" (C) are also significant, with values of .11 and .13 for the total and regulating populations, respectively. The implication is that there is a possibility of rationalizing actual family size as desired size. Because it is difficult to settle this ambiguity with the present data, the variable "desired family size" should be used with caution.

Use of Fertility Control. The theory hypothesizes that the use of fertility control varies directly with the motivation for control (the excess of the supply of children over demand) and inversely with regulation cost. In Bolivia, the mean times since first use of fertility control are 72 and 135 months (6.0 and 11.3 years) for the total and regulating populations, respectively.

The hypothesis to be tested here is that higher levels of motivation result in the use of contraception for longer periods of time. The motivation to control fertility is measured here as the difference between potential family size and "desired family size" ($C_n - C_d$). The average differences are 2.28 for the total population and 1.73 for the regulating population (see Table 20).

The greater the motivation, the greater the expected use of fertility control. As an initial measure of the association between use of control and motivation, the correlation between these two variables are 0.060 and 0.351 for the total and regulating populations, respectively (Table 21). Both values are significant at conventional levels, in addition to having the expected positive sign. The association between the "use of control" and "motivation" is by far greater for the regulating population than for the total population. The percentage of the variance in "years since first use of fertility control" that is explained by the C_n-C_d measure of motivation in a simple bivariate analysis is around 26 and 17 percent for the total and regulating populations, respectively (see Tables 22 and 23).

Table 22. Ordinary least square regressions for duration of contraceptive use for the total population, Bolivia 1989

	Total population							
Coefficients	1	2	3	4	5	6	7	8
Motivations								
C_n - C_d	2.313 [.069]	2.257 [.067]						
Wants no more			5.486* [.024]	4.936* [.022]				
C_n					4.140 [.099]	3.995 [.095]	4.093 [.098]	3.951 [.094]
C_d							.339* [.007]	.316* [.007]
Cost of regulation								
No. of methods	25.228 [.508]		25.211 [.507]		25.383 [.511]		25.350 [.510]	
Efficiency		27.952 [.496]		8.453 [.201]		28.100 [.498]		28.064 [.498]
Constant	35.941	37.609	36.140	38.154	19.906	22.213	19.168	21.523
R^2	.261	.249	.257	.245	.266	.254	.266	.254
F	85.553	80.296	297.282	278.987	92.045	86.256	58.510	54.829

Note: The variables are identified on p. 44. Each column represents a different regression
[ ] = Standardized coefficients * Coefficients are not significant at the 5-percent level

Table 23. Ordinary least square regressions for duration of contraceptive use for the population of regulators, Bolivia 1989

	Regulators							
Coefficients	1	2	3	4	5	6	7	8
Motivations								
C_n - C_d	9.437 [.348]	9.445 [.348]						
Wants no more			- 5.233* [-.030]	- 5.414* [-.032]				
C_n					14.679 [.439]	14.628 [.434]	14.610 [.434]	14.563 [.432]
C_d							2.106* [.058]	2.046* [.057]
Cost of regulation								
No. of methods	6.789 [.193]		6.943 [.198]		7.324 [.209]		7.138 [.203]	
Efficiency		7.772 [.197]		7.925 [.201]		8.224 [.209]		8.004 [.203]
Constant	105.588	105.856	126.050	126.533	52.922	53.351	46.832	47.815
R^2	.161	.162	.041	.042	.229	.229	.232	.263
F	16.094	16.276	19.265	19.949	25.736	25.748	16.953	16.943

Note: The variables are identified on p. 44. Each column represents a different regression
[ ] = Standardized coefficients * Coefficients are not significant at the 5-percent level

Some alternative measures of motivation were tested, following Easterlin and Crimmins (1982:17). The rationale for their use is as follows:

- "Wants no more." Answers to the question asking if an additional child was desired were coded 1 to mean that no more children were desired and 0, otherwise. It is hypothesized that respondents who reported that they did not want more children were more motivated to control their fertility.

- (C-C_d). The difference between "actual family size" and "desired family size" leads to the hypothesis that respondents who already had a larger than desired number of children were more motivated to control their fertility.

- (C_n). The potential number of surviving children implies a direct relationship to motivation to regulate fertility.

- (C_d). Desired family size should be inversely related to motivation to regulate fertility.

- (C). Actual family size should be directly related to motivation to regulate fertility.

The present measure of motivation (C_n-C_d) and the alternative measures of motivation can be compared in Table 21, which shows the correlation between duration of contraceptive use and several measures of motivation to regulate fertility, both for the total population and the population of regulators (first row and first column, respectively).

The basic measure of motivation is positive and significantly correlated with duration of contraceptive use. Its value is larger than any other alternative measure with the exception of C_n (the potential number of children) for the regulating population. For the total population, although the basic measure of motivation is positive and significantly correlated with "duration of contraceptive use," its value is small. Contrary to expectations, C_d, the "desired family size" variable, is positively related to "duration of use." This result can be explained by the variable's correlation to C_n (the potential number of surviving children) and to C (actual number of surviving children). It follows that the direct effect of this variable can only be assessed in a multivariate context in which the other variables would be held constant.

The subjective report on "wanting no more children" for the total and regulating populations is weak. This variable has no explanatory power and the values are not significant at conventional levels. This may be explained in part by the measurement of the variable as a dichotomous variable, leaving no room for variability in the answers. Contrary to expectations, the bivariate association of "duration of contraceptive use" with the C - C_d (excess of children) is negative. Moreover, the coefficient is low and not significant for the regulating population, whereas for the total population, the coefficient is moderate and significant.

Cost of Regulation. The hypothesis to be tested here is that the variable "years since first use of fertility control" is expected to vary inversely with the "cost of adopting control." As was mentioned before, the cost measures actually available are proxies. Although they are not ideal, they give a clear indication of the regulating costs.

Results for the total population indicate that, on the average, respondents spontaneously report knowing about 1.5 methods of fertility control. Nonregulators report knowing of 0.4 methods, whereas the regulators report knowing more than two methods. All women reported knowledge of the methods without prompting. The nonregulating population mainly reported knowledge of traditional contraceptive methods, whereas reports of the regulating population generally included one modern method.

From the measure of knowledge and efficiency of methods, one would expect a positive association with "duration of use of fertility control," since greater knowledge or more favourable attitudes would imply fewer obstacles to acceptance. In the case of the Bolivian population, this positive association between the two variables exists for the total and regulating populations.

The results suggest that the number of methods known and their efficiency, which are proxies for cost regulation, show the effects of regulation cost on the duration of contraceptive use.

The correlation between the variables "number of methods known" and "duration of contraceptive use" are 0.5066 and 0.1992 for the total population and the population of regulators, respectively. This association is strong for the total population. When the variable "efficacy of methods known" is used, the correlation values are 0.4948 and 0.2025 for the total and regulating populations, respectively. Once again, the association between these variables is strong for the total population. It is clear that higher levels of contraceptive knowledge are associated with higher levels of contraceptive use. It is expected that knowledge of more efficient methods is associated with higher levels of fertility control (see Table 24).

Table 24. Correlations between measures of motivation and cost of regulation for the total population and the population of regulators, Bolivia 1989

	Total population		Regulators	
Variables	Number of methods known	Efficiency of methods	Number of methods known	Efficiency of methods
Duration of use	.5066	.4948	.1992	.2025
(C_n - C_d)	-.0181	-.0152	.0165	.0147
Wants no more	-.0363	-.0322	-.0444	-.0384
C_n	-.0440	-.0382	-.0218	-.0147
C_d	.0811	.0851	.0899	.0983

Multivariate Analysis. In the previous sections, the different variables to be used in the second stage were examined in detail. Now let us examine how the measures of motivation and costs of control combined determine the duration of contraceptive use (see Equation 12).

It has been hypothesized that contraceptive use is associated positively with a couple's motivation to regulate fertility and negatively with the cost of regulation. Thus, the correct test of this hypothesis involves the simultaneous consideration of relevant variables in the determination of the duration of contraceptive use.

Two variables for measuring regulation cost, "number of known methods" and "efficiency of known methods," as well as four motivational variables—the "basic motivational variable" (C_n - C_d), "wants no more children," "potential supply of children" (C_n), and "demand for children" (C_d)—were introduced.

The multivariate analysis yields results that were anticipated by the correlations. Tables 22 and 23 show that the percentage of the variance in the duration of contraceptive use explained by motivational factors and regulation costs is around 24 to 27 percent for the total population and 16 to 26 for the regulating population. The motivational variable "wants no more children", which is measured as a dichotomy, underperforms in comparison with the other variables. In fact, the basic motivational variable, C_n - C_d, shows a much superior performance, with coefficients displaying the expected sign and higher significance. Moreover, all the coefficients in the multiple regressions are statistically significant at the conventional levels, with the exception of the coefficients for the variables "wants no more" and "demand for children" (C_d) for the total and regulating populations.

As was already indicated at the bivariate level, the most decisive motivational variable is the "potential supply of children" (C_n). When this variable is introduced, the fit of the model increases from about 16 percent variance explained by C_n - C_d to 23 percent for the regulating population. For the total population, the increase is not noticeable. In other words, the use of C_n for the regulating population increases the predictive power of the model by more than 42 percent (from 16 to 23 percent). In the presence of C_n, the "demand for children" (C_d) does not display the expected negative sign. The regression coefficients for the regulating and total populations are not significant at the conventional levels.

The results of the regression for the total population (see Table 22) show that, other things being constant, a one-unit increase (one child) of unwanted children in motivation (C_n - C_d) leads to a 2-month increase in start of contraceptive use, whereas for the regulating population, the increase in start of contraceptive use is more than 9 months (see Table 23).

Concerning the measures of regulating cost, the multivariate analyses show that the number of contraceptive methods known and their efficiency are legitimate measures of regulating costs. The coefficients of "cost of regulation" variables are significant at the conventional levels but are less important than the motivational variables for the regulating population. For the total population, the "cost of regulation" variables are more important than the motivational costs.

According to the standardized coefficients in Tables 23 and 24, cost of regulation plays a more important role in the determination of the duration of contraceptive use for the total sample, whereas the role played by motivational cost is more important for the regulating sample. The implication is that, for the regulating sample, oversupply of children plays a more important role than knowledge or efficiency of methods in duration of contraceptive use. This may be because of the prevalence of the use of traditional contraceptives among the couples. However, when the results for the total population are analyzed, the knowledge and efficiency of contraceptive methods play more important roles in the duration of contraceptive use. In short, it can be concluded that the potential supply of children is the principal determinant of contraceptive use in Bolivia for the regulating population, whereas for the total population, the cost of regulation is the most important. Moreover, the different measures of motivational cost used in the study for the total population have little variability.

The Determinants of the Supply and Demand of Children, Demand and Costs of Fertility Regulation

Following the Easterlin and Crimmins approach, the third stage of the "synthesis framework" examines the relationship of modernization variables and cultural determinants of fertility control to the cost of regulation (RC) (number of contraceptive methods known) and the two motivational variables, "desired family size" (C_d) and potential supply (C_n). The variable "potential supply" was broken down into its own "determinants" — marriage duration, age at first marriage, first birth interval, second birth interval, absence of secondary sterility, duration of breastfeeding, and child mortality — which were then analyzed using the same modernization and cultural analysis applied to the "cost of regulation" and the "demand for children." In other words, the independent variables of stages 1 and 2 become the dependent variables in stage 3 of the framework, each individually being estimated as a function of the modernization and cultural variables.

The 1989 Bolivia DHS survey includes several background variables that deal with diverse aspects of the modernization process, reflecting the process of socioeconomic development. These include education, urbanization, occupation, social strata, consumption levels, increased exposure to mass media, and availability of basic services, as well as more specific cultural determinants, such as ecological strata and language spoken at home.

Finally, because modernization, cultural conditions, and fertility behaviour have been changing since the National Revolution of 1952, the variables tend to be linked to the respondents' ages. Thus, a statistical control for the age variable was introduced, completing a set of 12 predictors as independent variables for the analysis of the third stage of the Easterlin framework. The multivariate regression results are presented in Table 25.

The range of variability of the proportion of explained variance is as high as 52.5 percent for the dependent variable "duration of marriage" X_1 to as low as 1.7 percent for the variable "second birth interval." Comparing the fit of each model including the variable "age," with the corresponding model without this variable, the overall fit in some cases is considerably reduced. Excluding the variable "age," the range of variability for the variance explained is from 33 percent for the variable "cost regulation" (measured in the equation by the "number of contraceptive methods known") to 1.7 percent for the variable "second birth interval."

Table 25. Ordinary least squares regression of supply and demand for children and cost of regulation on modernization and cultural variables for women in age groups 30 to 44 having two or more children, Bolivia 1989

Variables	C_d	RC	C_n	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Spatial context	-0.177	0.181	-0.338	0.123	-0.119	2.374	2.777	-0.006	-0.920	0.006
	(-.050)	(.055)	(-.087)	(.011)	(-.015)	(.068)	(.060)	(-.009)	(-.072)	(.018)
Wife's education	-0.037	0.086*	-0.179*	-0.215*	0.086	-0.660*	-0.275	0.008	-0.375	-0.004
	(.036)	(.089)	(-.157)	(-.027)	(.037)	(-.063)	(-.020)	(.035)	(-.099)	(-.037)
Husband's education	0.000	0.104*	-0.074*	-0.088*	0.214*	0.204	0.235	0.002	-0.161	-0.007*
	(.002)	(.347)	(-.209)	(-.216)	(.295)	(.062)	(.055)	(.026)	(-.137)	(-.224)
Family wealth	0.137	0.212*	0.143	0.378	-0.376	-1.110	-1.668	0.022	1.262	0.004
	(.038)	(.064)	(.036)	(.035)	(-.047)	(-.031)	(-.036)	(.028)	(.098)	(.012)
Childhood place of residence	0.269*	0.282*	-0.126	0.393	-0.389	2.021	-1.017	-0.052	0.111	-0.007
	(.073)	(.083)	(-.031)	(.035)	(-.047)	(.054)	(-.021)	(-.064)	(.008)	(-.018)
Valleys	0.699*	0.492*	-0.334*	-0.737*	0.738*	0.120	-2.452	0.040	-2.716*	-0.003*
	(.173)	(.132)	(-.075)	(-.060)	(.081)	(.003)	(-.046)	(.045)	(-.186)	(-.006)
Lowlands	1.170*	0.482*	0.554*	1.183*	-1.183	2.751	-0.914	0.047	-3.438*	-0.030*
	(.282)	(.126)	(.122)	(.093)	(-.128)	(.066)	(-.017)	(.051)	(-.230)	(-.070)
Native language	0.165	-0.201	-0.804*	-1.056*	1.054*	4.772*	-1.627	0.030	-1.656	-0.002
	(.042)	(-.055)	(-.186)	(-.087)	(.119)	(.120)	(-.032)	(.034)	(-.116)	(-.004)
Basic services	0.210	0.124	0.659*	0.220	-0.218	-2.319	1.902	-0.036	-0.545	-0.016
	(.054)	(.035)	(.155)	(.018)	(-.025)	(-.059)	(.037)	(-.042)	(-.039)	(-.039)
Exposure to mass media	0.067	-0.003	0.327	-0.121	0.124	-0.871	-1.946	0.038	0.362	-0.038*
	(.016)	(-.000)	(.070)	(-.009)	(.013)	(-.020)	(-.035)	(.041)	(.024)	(-.088)
Upper & middle social strata	-0.191	0.576*	-0.499	-0.812	0.811	0.202	2.269	0.011	-4.085*	-0.012
	(-.051)	(.167)	(.122)	(-.071)	(.097)	(.005)	(.047)	(.133)	(-.304)	(-.031)
Lower social strata	0.047	0.047	-0.419	-0.233	0.232	2.077	0.057	0.026	-3.109*	0.011
	(.012)	(.013)	(-.105)	(-.021)	(.028)	(.056)	(.012)	(-.032)	(-.236)	(.017)
Age	0.036*	-0.004	0.240*	0.859*	0.141*	0.491*	0.267	-0.029*	0.075	0.001
	(.086)	(-.010)	(.524)	(.671)	(.150)	(.116)	(.049)	(-.319)	(.050)	(.034)
Constant	0.767	-0.254	-2.805	-13.08	13.093	-0.877	22.208	1.827	16.055	0.186
R^2	0.099	0.328	0.400	0.525	0.111	0.039	0.017	0.117	0.115	0.104
F	10.043	44.373	16.184	100.4	11.391	3.714	1.661	12.108	3.137	10.505
R^2 excluding age	0.092	0.327	0.135	0.089	0.089	0.026	0.016	0.019	0.112	0.102

Note: See pages 30 and 33 for identification of variables; figures in ( ) denote standard error.
* Significant at 5-percent level

The predictive power of the set of modernization and cultural variables varies widely among the different dependent variables. On the one hand, several variables, including "regulation cost," the motivation variables, and "duration of marriage," have a significant relationship in the regression. At the other extreme, no variable appears to be significantly related to some dependent variables, such as "second birth interval" and "not secondarily sterile," the latter only having a significant relationship with "age."

In the equation "demand for children," the significant regression coefficients are "ecological strata" (Valleys and Lowlands), "childhood place of residence", and "age." The variable "demand for children" (C_d) is significantly related to the "ecological strata" variable as a whole. Controlling for all the other independent variables, women in the Lowlands have a greater demand for children than women of the Highlands (1.17 children more). The same tendency is true for the Valleys, where the demand for children is 0.70 more than in the Highlands (see Table 25, Column 1).

"Demand for children" is not significantly related to "wife's education" and "husband's education." The negative sign of the regression coefficient for these variables may indicate that women and men with more education want fewer children than their counterparts with less education. Then again, the negative sign may be meaningless.

Controlling for all the other variables, "language spoken at home" is positively related to the "demand for children." Those who speak a native language at home have a greater demand for children (0.165 more) than those who speak Spanish at home. The variable "age" has a positive sign with the coefficient significant at conventional levels. This indicates the presence of an autonomous process of change in the demand for children, implying an estimated average reduction of about 1.33 desired children since the National Revolution of 1952.

For "cost regulation" (measured here by the number of contraceptive methods known), the regression equation shows that the coefficients for "Upper social strata," "ecological strata", "wife's and husband's education," "place of residence during childhood," and "family wealth" variables are significant at the conventional level of 5 percent. Controlling for all other independent variables, women of the upper social strata, have a greater knowledge of contraceptive methods. On average, these women know 0.576 contraceptive methods more than their counterparts of the Agriculturalist social strata. Controlling for the other independent variables, "ecological strata" has a statistically significant effect upon "cost regulation" ($p<0.000$). Women of the Lowlands know on average 0.483 contraceptive methods more than their counterparts of the Highlands, and women of the Valleys know 0.492 contraceptive methods more than women of the reference category (Highlands). In addition, the regression coefficients for the variables of "wife's and husband's education" are positive and significant, which indicates that the higher the level of education, the larger the number of contraceptive methods known. The coefficient for the variable "language spoken at home" is negative. This in part can be explained by the lack of access to information in the native languages and the cultural resistance to contraceptive knowledge by the native populations, but even more by the strong influence of the Catholic Church and its position on contraception among these couples.

The regression coefficients of the "family wealth" and urban "childhood place of residence" variables are positive and significant at the 5-percent level. These values indicate that, controlling for all the other independent variables, couples who have durable goods at home and women who spend their childhood in the cities have greater knowledge of contraceptives.

In the equation "supply of children," the regression coefficients of the variables "ecological strata," "language spoken at home," "wife's education," "husband's education," "presence of basic services" (measured here by the existence of running water and sewer systems) and "age" are significant. Furthermore, "age" is the most important factor in determining potential family size, which increases with the wife's age. This finding is understandable given that many of the variables used in the estimation of the supply are also related to the variable "age." The variables "wife's education" and "husband's education" are negatively related to "potential family size" as was expected. Their effect is much stronger here than on the "demand for children." For example, it is expected that the potential supply of children of women with 10 years of education will be 1.79 fewer surviving children than those with no education, since their natural fertility is lower than that of women with less education.

The variable "ecological strata" as a whole is significant. Controlling for all the independent variables, the women of the Lowlands have a potential supply of surviving children larger than that of the other strata (0.553 children more than the women of the Highlands, and 0.889 surviving children more than the women of the Valleys), indicating the differences in the people's conditions of life among the ecological strata due to differing access to natural resources. The coefficient for the variable "language spoken at home" is negative. This can be explained in part by the low survival probability of the children of the native populations as compared to those who speak Spanish. The regression coefficient for the availability of basic services is positive, indicating that women who have access to them increase their potential supply of children, probably due to a reduction in child mortality.

In the equation "duration of marriage" (X_1), the regression coefficient of the variables "ecological strata," "language spoken at home," "wife's education," "husband's education," and "age" are significant. As the husband's and wife's education increases, the total duration of marriage is significantly reduced. As was expected, the "duration of marriage" is positively related to the women's age, by far the most important variable explaining this variance. By ecological strata, women of the Lowlands have 1.18 years longer duration of marriage as compared to the women of the Highlands, whereas women of the Valleys have an average 0.737 fewer years of duration of marriage as compared to the women of the Highlands. These values in part reflect the different patterns of age at marriage among the ecological strata. With reference to the variable "language spoken at home," the "duration of marriage" of those who speak any native language is 1.056 years shorter than those who speak Spanish. This can be explained by the difference in the marriage process of the native population.

In the equation "first birth interval" (X_3), the significant regression coefficients are for the variables "age," "language spoken at home," and "wife's education." The positive effect of "age" supports the view of the changes in marital fertility already addressed. Bolivian women have slowly started to have fewer children, earlier and with shorter spacing between births than before. Controlling for all the other independent variables, the coefficient of the variable "language spoken at home" indicates that those who speak a native language on average have their first children 4 months later than those who speak Spanish. Moreover, the coefficient of the variable "wife's education" has a negative sign, which indicates that women with higher education not only marry later than those with less education, but on average they have their children faster. Controlling for all the other independent variables, a woman with 10 years of formal education is expected to have a child 6 months sooner after marriage than a woman with no education; this can be explained in part by the higher rate of pregnancy wastage among the women with no education.

No regression coefficient of the independent variables is significant at conventional levels for the equation "second birth interval" (X_4).

The equation "duration of breastfeeding" (X_6) shows that the regression coefficients for the variables "social strata" and "ecological strata" are significant. Differences in duration of breastfeeding by social strata indicate that, after controlling for all other independent variables, women of the Upper and Middle social strata on average breastfeed 4 months less than their counterparts of the social strata Agriculturalist. Moreover, women of the Lower social strata on average breastfeed their children 3 months less than their counterparts of the social strata Agriculturalist. It is noteworthy that the category Agriculturalist is made up entirely of the native populations living in the countryside, which present a pattern of natural fertility and have a long duration of breastfeeding.

Controlling for all the independent variables, it is expected that the average duration of breastfeeding for the women of the Lowlands will be 3.4 months shorter than for their counterparts of the Highlands, while for the women of the Valleys, the difference is 2.7 months shorter than for the women of the Highlands. The differences in breastfeeding by ecological strata show that the regions inhabited by the majority of the native populations have longer periods of breastfeeding.

Although the regression coefficients for the variables "wife's education" and "husband's education" are not significant, their negative sign may indicate that the duration of breastfeeding is shorter as the level of education of the woman increases. It is expected that a woman with more than 10 years of formal education on average will breastfeed 3.7 months less than a woman with no education. As mentioned before, women with less education tend mainly to be part of the native populations in the countryside.

In the equation "child mortality" (X_7), the regression coefficients that are significant at conventional levels are for the variables, "husband's education," "ecological strata," and "exposure to mass media." As was expected, "husband's education" emerges as the strongest determinant of child mortality, indicating that as the level of formal education of the father increases, the risk of high child mortality decreases. This result is confirmed by the conclusions obtained in the study of infant mortality by Vidal and Ravanera (1992).

As a whole, the variable "ecological strata" is significant. Controlling for all the independent variables, it is expected that, on average, the women of the Lowlands and Valleys will have lower child mortality than the women of the Highlands. Women who have been exposed to the mass media are expected to have lower child mortality possibly because of the communication of information concerning hygiene and the greater proximity of medical services.

The application of the Easterlin framework to the Bolivian data produces results similar to those of their studies of Sri Lanka and Colombia. The modernization variables consistently dominate the cultural variables "language spoken at home" and "exposure to mass media." In some cases when the cultural variables were excluded from the regression, the R square declined moderately.

The education variables (measured as wife's or husband's education) and the "ecological strata" variable are by far the most consistent in significance. These results also coincide with the findings reported by Easterlin and Crimmins in the empirical application of their framework.

Some general conclusions can be presented from the multivariate analysis carried out in stage 3. It is expected that higher socioeconomic status, expressed as having higher education, living in the urban areas, exposure to mass media, and social strata, lead to smaller desired family size, a greater knowledge of contraceptive methods, and shorter duration of marriage, as well as shorter duration of breastfeeding, later age at marriage, and lower child mortality. This type of generalization is partially valid, especially for the equations where the variance explained by the socioeconomic variables is small, such as the case of age at marriage, duration of breastfeeding, and infant mortality.

In conclusion, the Easterlin framework applied to the Bolivian data yields consistent results, despite some problems with the measurement of some variables such as "regulation costs" and "absence of secondary sterility." This approach enables us to a) estimate the potential supply of children in the absence of fertility control and b) break down the different paths through which modernization and cultural variables are linked to fertility.

Integrating the Component Parts: The Impact of Modernization on Fertility

The objective of this part is to illustrate how the various socioeconomic and cultural variables affect the "supply of children" (through a set of proximate determinants), the "demand for children," and the "cost of regulation." These three variables, in turn, determine the propensity for use of fertility control. Finally, the use of contraceptives and the other proximate determinants explain the actual fertility. In this paper, the variable "years of education" is used to illustrate how increased education affects cumulative fertility. The objective is to outline the various channels (demand, supply, and regulation cost) through which 10 years difference in education between two groups of married women might be expected to affect their cumulative fertility by age 30 - 44, with other factors remaining constant.

First, the impact of 10 years of education on natural fertility is estimated by multiplying the regression coefficients of specific variables (duration of marriage, proportion not secondarily sterile, months of breastfeeding, and child mortality) by differences in years of education (see Column 3, Table 26).

Table 26. Estimated differences in natural fertility due to effect of ten years' difference in education on specific proximate determinants, Bolivia 1989

Variable	(1) Difference in years of education	(2) Regression coefficient of specified variable on education (Table 25)	(3) Difference in specified variable due to difference in education (col. 1 * col. 2)	(4) Regression coefficient of children ever born on specified variable (Table 18)	(5) Difference in natural fertility due to effect of education on specified variable (col. 3 * col. 4)
1. Duration of marriage, years	+10	-0.215	-2.150	0.393	-0.845
2. Proportion not secondarily sterile	+10	0.008	0.080	1.021	0.082
3. Months of breastfeeding	+10	-0.375	-3.750	-0.021	0.079
4. Proportion of child mortality	+10	-0.004	-0.040	1.276	-0.051
5. Difference in natural marital fertility (sum of lines 2-4)					0.110
6. Difference in total natural fertility (sum of lines 1-4)					-0.735

Second, the regression coefficients of "duration of marriage," "proportion having no secondary sterility," "months of breastfeeding," and "child mortality", which were obtained in the proximate determinants analysis (see Table 18) allow the estimated differences in the proximate determinants to be transformed into estimated differences in natural fertility.

The results of these conversions are presented in Table 26 in columns 3, 4, and 5. In row 1, the last column shows that the effect of increased education on natural fertility through shorter marriage duration will reduce the natural fertility of the more educated group by 0.845 children as compared to the less educated group. Comparing the effects of education on the "absence of secondary sterility," "months of breastfeeding," and "child mortality" variables, the positive contribution of the first two variables nullifies a negative contribution from reduced "child mortality." However, the effects of increased education through shorter duration predominates, reducing natural fertility among educated women.

Taking all four variables—duration of marriage, absence of secondary sterility, months of breastfeeding and child mortality—into account, 10 years of education reduces natural fertility by 0.735 children. In other words, more educated women have lower natural fertility than less educated women.

The second step is to estimate the effect of differences in 10 years of education on potential supply (C_n). According to Easterlin and Crimmins (1985:94), analytically, the basis for the estimate is given by:

$$\Delta C_n = \Delta S\,\overline{N} - \Delta N\,\bar{s} + \Delta s\,\Delta N \qquad (14)$$

where

- Δ refers to the differences between the more and less educated groups on the indicated variable
- $\bar{N}$ is mean natural fertility
- $\bar{s}$ is the mean child survival rate.

Applying the formula above, a negative net effect of increased education on relative supply is obtained. In Bolivia, the higher child survival rate of the more educated group tends to raise the relative supply, whereas the lower natural fertility rate of the more educated tends to lower their relative supply (see Table 27). The estimated negative effect of increased education is to reduce relative supply by 0.429 fewer surviving births.

Table 27. Estimated difference in supply (C_n) due to effect of 10 years' difference in education on child survival rate and natural fertility, Bolivia 1989

Variable	
1. Difference in proportion of children surviving (Table 26, col. 3 sign reversed)	0.040
2. Mean natural fertility (Table 19, weighted average)	5.965
3. Effect of difference in survival rate on supply (line 1 * line 2)	0.239
4. Difference in natural fertility (Table 26, line 6)	-0.735
5. Mean child survival rate (Table 16 complement of child mortality)	0.870
6. Effect of difference in natural fertility on supply (line 4 * line 5)	-0.639
7. Effect of interaction effect on supply (line 1 * line 4)	-0.029
8. Difference in supply (C_n) due to all sources (sum of lines 3, 6, and 7)	-0.429

The third step is to estimate the effect of differences in education on fertility control. To accomplish this, in addition to the effect of education on supply, it is necessary to estimate the effects of education on "demand and cost of regulation." A 10-year increase in formal education is accompanied by a reduction in demand of 0.370 children—a smaller desired family size—and an increase of about 0.860 in the number of fertility control methods known (see Table 28, col. 3, lines 2 and 4).

Table 28. Estimated difference in months since first use of fertility control due to effect of ten years' difference in education on specific proximate determinants, Bolivia 1989

Variable	(1) Difference in years of education	(2) Regression coefficient of specified variable on education (Table 25)	(3) Difference in specified variable due to difference in education (col. 1 * col. 2)	(4) Regression coefficient of fertility control on specified variable (Table 18)	(5) Difference in months since first use of fertility control due to effect of education on specified variable (col. 3 * col. 4)
1. Supply, C_n (Table 27)	-	-	-0.429	-	-
2. Demand, C_d	+10	-0.037	-0.370	-	-
3. Motivation C_n - C_d	-	-	-0.059	2.313	-0.136
4. Cost of regulation	+10	0.086	0.860	25.228	21.696
5. Difference in duration of fertility control (sum of lines 3 and 4)	-	-	-	-	21.560

With reference to "the motivation for fertility control," it was confirmed that the combined effect of the difference in "potential supply of children" and "demand for children" is to increase the "motivation for fertility control" (C_n - C_d) among the more educated as compared to the less educated women (see Table 28, col. 3, line 3). The weak effect of differing educational levels on changing motivation for fertility control may be explained largely by the weak effect on different educational levels of changing desired family size, which is partly due to the high intercorrelation between education and urban residence.

The estimated difference in motivation and cost of regulation can be transformed into differences in months since first use of fertility control, by means of the regression coefficients obtained in the fertility control equation (see Table 28, cols. 4 and 5). The finding is that a 10-year increase in schooling is estimated to lead to 21.6 months earlier use of fertility control.

The effects of a 10-year increase in education on fertility arising from fertility control were estimated by using the regression coefficient of "children ever born" on "contraceptive use" (See Table 18). A 10-year rise in education is accompanied by a reduction in fertility of about 0.1 births (see Table 29, line 3). This small reduction in fertility due to fertility control in the case of the Bolivian women could be explained as follows: first, by the small proportion of women using any contraceptive method (52 percent) and second, by the high proportion (75 percent) of those contraceptive users using traditional methods of contraception, which are less efficient and less reliable. This is related to the strong position of the Catholic Church against the use of modern contraceptives, which are more reliable. Although the Catholic Church permits the use of traditional methods of contraception, e.g., the rhythm method, its effective use requires a level of education and knowledge not found among the majority of the Bolivian population. For this reason, the difference in "children ever born" between more educated and less educated women due to fertility control is very small.

When the overall effect on fertility of 10 more years of schooling through natural fertility and fertility control is calculated, the result is about 0.80 fewer births among Bolivian women. Education reduces fertility mainly through duration of marriage, whose effect is the most important (see Table 19, line 5).

In summary, while the positive effects through reduced secondary sterility and breastfeeding tend to outweigh a negative effect from reduced child mortality, the analysis presented above suggests that education tends to increase natural fertility within marriage. However, the positive effect of education on natural marital fertility is considerably outweighed by its negative impact on duration of marriage, reducing natural fertility overall among the more educated as a result. In addition, when the effect of education on fertility control is considered, fertility is reduced slightly more.

Table 29. Estimated difference in children ever born, due to effect of 10 years' difference in education on fertility control and natural fertility, Bolivia 1989

Variable	
A. Difference in children ever born due to fertility control.	
1. Difference in fertility control (Table 28)	21.5600
2. Regression coefficient of children ever born on fertility control (Table 18)	-0.0031
3. Difference in children ever born due to fertility control (line 1 * line 2)	-0.0668
B. Difference in children ever born due to natural fertility (Table 26)	
4. Due to natural marital fertility	0.1100
5. Due to duration of marriage	-0.8450
6. Due to total natural fertility	-0.735
C. Difference in children ever born due to all sources	
7. Due to marital fertility (sum of lines 3 and 4)	0.044
8. Due to duration of marriage (line 5)	-0.845
9. Due to all sources (sum of lines 7 and 8)	-0.801

The results of the present study are comparable to the results obtained by Easterlin and Crimmins in their study of Sri Lanka and Colombia, which supports the theoretical hypothesis that "education stimulates greater fertility control by increasing knowledge of methods of control and raising the motivation for control. Increased motivation occurs because education reduces the demand for children" (Easterlin, 1985:95).

Summary

In the first equation (Equation 9), the analysis indicates that the relative contribution of the intermediate variables to the number of "children ever born" to Bolivian women is most strongly influenced by marriage patterns, whereas the difference in the use of contraception seems to be less important. Table 18 shows the relative contribution, indicating that "duration of marriage," "second birth interval," and "first birth interval" are the principal proximate determinants of fertility in Bolivia. The single most important variable is "duration of marriage" and "deliberate fertility control" is less important. The coefficient for the "Duration of marriage" variable indicates a frequency of about one birth every 2.5 years, hence a completed fertility of some 12 children after 30 years of marriage. This shows that Bolivia demonstrates the characteristics of a population with natural fertility.

The main purpose of the second equation (Equation 12) is to provide an explanation of contraceptive use by the women. The interest is to understand how the measures of motivation and costs of regulation combined determine the duration of contraceptive use. Although the regression equations based on the C_n - C_d proxy provide relatively good estimates for the total population, for the regulating population, the substitution of that proxy by C_n, "potential supply of surviving children," provides a better estimate. Some of the findings described in the sections above permit those factors for fertility control that are the most important to be identified. In the case of the regulating population, the basic motivational variable (C_n - C_d) shows superior performance, with coefficients displaying the expected sign and significance, whereas for the total population, cost of regulation plays a more important role in the determination of fertility control.

The third equation of Easterlin's framework (Equation 13) yields knowledge of the mechanisms through which the modernization and cultural variables affect fertility and its behaviour. The results presented in this chapter provide some indication of how fertility and the modernization and cultural factors interrelate. In the case of the Bolivian population, "education,"" language spoken at home," and "ecological strata" seem to be the most important variables.

The variables "education" and "language spoken at home" show the importance of the different opportunities that people have and their effects on ideational change and the process of fertility transition.

Conclusions

Most of the past research on fertility differentials in Bolivia has focused only on the estimation of fertility levels. In this paper we have examined the differentials and determinants of fertility for the Bolivian population. Although our aim has been to document the differentials in fertility that would explain fertility change, our interest has gone beyond that to explain the possible basis of variation in the levels of fertility and reproductive behaviour and the factors that underlie fertility decisions among the four social strata categories (Upper, Middle, Lower, and Agriculturalist).

This study has focused on the biological, behaviourial, economic, social, and cultural factors that directly and indirectly affect the reproductive behaviour of the population. Moreover, the measurement, description, and explanation of these factors at the individual and aggregated levels, and the link between the two levels of analysis has examined the interrelationship among proximate determinants, microeconomic variables, and modernization and cultural variables to understand the differentials in fertility.

In the second section the link between microlevel and macrolevel influences on fertility, which was first clearly detailed by Davis and Blake (1956), is considered. Later, Bongaarts (1978) developed a comprehensive multiplicative model called the "proximate variables," where all the intermediate determinants of fertility were considered simultaneously. As explained by Bongaarts' (1978) "Analysis of the Proximate Determinants," the socioeconomic, cultural, and environmental variables that affect fertility indirectly, act upon it through intermediate variables that can be classified into three groups: exposure factors, deliberate marital fertility control factors, and natural marital fertility factors. The analysis was done at the aggregated level. In Bolivia, the exposure factor "age at marriage" and the natural marital fertility factor "length of breastfeeding" proved to be the most important factors.

The Easterlin framework, which combines both Bongaarts' (1978) "proximate determinants framework" and Easterlin's (1978) "supply and demand model" in an effort to combine the microeconomic model with sociological theories of fertility decline, also is discussed. Easterlin and Crimmins' (1985) approach explains fertility decline in the light of a more general societal transformation called the "modernization process." This process consists of structural changes, which affect the economic, social, and political structures of the society in which they occur. The most important modernization variables in the case of Bolivia are "education" and "language spoken at home."

The literature reviewed earlier indicates that, for an exhaustive study of fertility differentials and the factors that underlie these differences, an approach on both the macro- and microlevel should be applied to the Bolivian data. The link between these two approaches provides the most appropriate framework for the study of Bolivian fertility decline and differentials as well as the basis for the formulation of population policies, particularly as they apply to fertility.

The evolution of Bolivian fertility in the last 40 years is studied in the third section, through an analysis of fertility levels, trends, and tendencies in past and current fertility. The fertility transition in Bolivia was found to begin in the early 1980's. Between 1976 and 1988, the TFR decreased an average of 1.5 children per woman (from 6.5 to 5.0), a 21 percent change. The most important characteristic is that while urban fertility continued to descend, rural fertility also began to decline.

Comparing the actual levels of fertility by social strata, we found that the Agriculturalist category as a group had the highest. The TFR estimates in 1989 by social strata were 6.17, 5.32, 4.62, and 3.37 for the Agriculturalist, Lower, Middle, and Upper categories, respectively. At the end of their reproductive lives, the women of the Agriculturalist category have on average 2.8 children more than their counterparts in the Upper category.

The slow decline of the TFR throughout the period shows that the structural changes of 1952 in Bolivian society did not stimulate the desire to limit the size of Bolivian families, particularly among the Lower and Agriculturalist populations, which are principally indigenous.

The current values of the ASFR show that the largest differences among the social strata categories generally are found in the youngest age groups (15-29). Of the four social strata categories, the Middle and Lower categories have the highest ASFR for these three age groups. These women marry very young and have very high fertility up to the age of 30, in contrast to the Upper category. The high teenage fertility of women of the Middle and Agriculturalist categories reflects the early age at marriage of these women as compared to those of the Upper and Lower categories. The ASFR indicate that Agriculturalist women not only marry early, but also have children throughout their entire reproductive lives.

The current values of the Total Marital Fertility Rate show that variability among the social strata is more evident than variability in the Total Fertility Rate. Married women of the Upper category have an average of 4 children less than their counterparts of the Agriculturalist category.

In the fourth section, the aim was to estimate and explain the proximate determinants, their impact on fertility levels, and differentials by social strata at the aggregate level. The main proximate determinants of fertility were estimated and explained. First, "age at first marriage" can account for a substantial proportion of the variation in fertility by social strata. Examining the percentage of ever-married women in age group 15-19, early marriage is more common for the women of the Middle category, with 160 percent more women of this age group being married than their counterparts in the Upper category. This may be explained in part by the high percentage of Middle category women who live in the Lowlands of Bolivia where age at marriage tends to be early. Moreover, early age at first marriage is strongly associated with a lower level of education and rural residence. As in the other LDCs, Bolivian women of the Upper category with urban residence and nine or more years of education are least likely to be married in the 15-19 age group (8.1 percent), thus reducing the reproductive period and decreasing the levels of fertility for Upper category. Second, the ultimate proportion married in Bolivia varies greatly by social strata. Whereas in the Agriculturalist category, marriage is universal; in the Middle category, more than 8 percent remain single, illustrating differences in social and cultural characteristics.

The second variable studied was "knowledge and use of contraceptives" among Bolivian women by social strata. Comparing the results for knowledge of contraceptives, women of the Upper category have an almost universal knowledge (96 percent) compared to only 56 percent in the Agriculturalist category. The values for the women of the Middle and Lower categories are 89 and 78 percent, respectively. If the "ever-use of any contraceptive method" is compared, the differences among social strata are even greater. In 1989 in the Upper category, 73 percent of the women declared that they had used any method, compared to only 28 percent for the Agriculturalist category.

The differences in knowledge and use of contraceptives are significant. Comparing the results by social strata, women of the Upper category not only have a greater knowledge of some contraceptive methods, but also have a greater proportion of ever-use of some contraceptive methods than those in the Agriculturalist category. Furthermore, the use of modern methods (IUD, female sterilization, and pill) is more prevalent in the Upper category than in the Lower and Agriculturalist categories where traditional methods of contraception (such as periodic abstinence) are more prevalent.

As regards the values for using any contraceptive method for women currently in union in 1989, 45, 61, 72, and 82 percent of the women of the Upper, Middle, Lower, and Agriculturalist categories, respectively, were not using any method at all. These percentages show that contraceptive use among the Bolivian population is not common. Reasons for this could be the strong influence of the Catholic Church and its position on contraceptives; the large native population that lives in the countryside without knowledge of or access to contraceptives; low levels of education and accessibility to medical centres; and, in some cases, the high cost of modern contraceptives.

The type of contraceptive method used varied with age. Of the modern methods of contraceptives used by women currently in union, in the younger age group 15-29, the pill and IUD were the most prevalent. After age 35, female sterilization was the most common. Of the traditional methods, periodic abstinence was the most prevalent method in all age groups. Differences by social strata were maintained, with the Upper category having the highest use of contraceptives and the Agriculturalist category having the lowest.

Of women using any contraceptive method in 1989, 40 percent were using efficient contraceptives. Differentials by social strata are evident, with the Upper status having the lowest percentage of inefficient method use (55.3 percent) and the Agriculturalist having the highest percentage (70.0 percent). The use of inefficient contraceptive methods is widespread; more than 59 percent of the women in all the subpopulations who are using any contraceptive method use inefficient methods.

The third variable studied was "abortion," which is illegal in Bolivia except in cases of risk to the mother's life, incest, or rape. Although its practice is believed to be widespread and highly prevalent in various sectors of the population, particularly among young, single women, statistics on the practice of abortion are obviously scarce and unreliable. The lack of data makes it impossible to estimate the true rate or have good approximations of it for the country. It is even harder to do so for each social strata.

The fourth variable studied was "breastfeeding." In Bolivia, the average length of breastfeeding is 16.7 months, but there is substantial variation among the four social strata categories, from a low of 11.28 months for the Upper category to a high of 17.80 months for the Agriculturalist category. The length of breastfeeding for the Agriculturalist category has a negative effect on fertility, whereas its shorter duration for the Upper category decreases its inhibiting effect in that subpopulation. Similar differences can be observed for amenorrhoea and abstinence.

Further on, Bongaarts' proximate determinants framework was applied to explain variations in the fertility levels of Bolivian women. To do this, the impact on fertility of marriage delay and disruption, contraception, and postpartum infecundability, including breastfeeding and voluntary abstinence, were assessed for each social strata.

The three intermediate variables operate sequentially to reduce the Total Potential Fertility (TF) to the observed value of the Total Fertility Rate (TFR). First, the index of marriage is estimated. Among the four social strata categories the Index of Marriage has significant variation, and it is clear that the inhibiting effect of marriage is greater for the Upper category women (42.4 percent) than for the Middle category (32.8 percent). The value of C_m of 0.623 for the country implies that marriage delay and disruption reduces marital fertility by 38 percent.

Second, the values of the index of contraception among the social strata categories show significant variability. For the Agriculturalist category, contraception reduces fertility by 14 percent; for the Upper category, the reduction is 40 percent.

Third, the results of the Index of Postpartum Infecundability demonstrate that there is great variability among the social strata categories in the percentage of reduction in fertility attributable to postpartum infecundability. The inhibiting effect of postpartum infecundability is greater for the Agriculturalist category (36 percent) than for the women of the Upper category (21 percent) who have a 33 percent shorter length of breastfeeding.

According to the indices obtained, the Index of Marriage is the most important factor in reducing potential fertility in each social strata. On average, the C_m values imply a reduction of 37 percent from Potential Fertility levels due to marriage-related effects (age at marriage and proportion married). For rural Lower and Agriculturalist women, the Index of Postpartum Infecundability is the second most important, implying a reduction of 34 and 32 percent from Potential Fertility levels due to postpartum infecundability, respectively. The second most important factor for women of the Upper and Middle categories is the Index of Contraception.

A comparison of the model estimates with the observed TFRs discloses that there is good agreement between these two fertility rates. The model estimates of TFR, which use three intermediate factors (proportion married, contraception, and postpartum infecundability) explain 97 percent of the variation in the observed fertility rate. One could speculate that other factors that were not included, such as secondary sterility and induced abortion, account for part of that 3-percent difference.

The findings of Bongaarts' model for each social strata category of Bolivian women support the conclusion that "proportion married," "contraception", and "postpartum infecundability" are the most important proximate determinants of Bolivian fertility.

The intermediate rates in the movement from total potential fertility to the Total Fertility Rate present a clear picture of the differences in the fertility measures of the four social strata categories. The total natural marital fertility of the Upper category is the highest of the social strata categories. It is expected that, on average, the women of the Upper category will have 2 children more than their counterparts of the Agriculturalist category. This is partly explained by the strong impact of an extended period of breastfeeding on the Agriculturalist category as compared to the Upper category. The difference is expressed by the Index of Postpartum Infecundability. Among the other subpopulations, the variation in Total Natural Marital Fertility is not large.

Even though the Upper category registers the highest levels of Natural Marital Fertility, the strong prevalence of contraceptive use among these women makes the Total Marital Fertility Rate of the Upper category to be lower than that of the Lower and Agriculturalist categories. The late marriage of the women of the Upper category as compared to that of the Middle, Lower, and Agriculturalist categories causes the difference between TMFR and TFR in the Upper category to be larger than in the other three social strata categories.

The different indices calculated by this model show that the "proportion of marriage" captured by the index of proportion married and postpartum infecundability are by far the most important factors quantitatively among the several "proximate determinants" for the Bolivian level of fertility. The index of contraception plays a smaller, yet still substantial role.

The purpose of the previous section was to estimate and explain the determinants of fertility and their impact on fertility levels and differentials by social strata at the individual level. This was done with the help of the Easterlin framework (1978, 1985), which not only uses the proximate determinants of fertility, but also incorporates microeconomic variables such as the "demand for children," "supply of children," and "cost of regulation." These variables, in turn, determine contraceptive use. Moreover, as Easterlin and Crimmins explain, fertility declines in terms of the "modernization process," reflecting structural changes in society.

The study has focused on the analysis of data for subpopulations of regulators and non-regulators. It is probable that the regulator subpopulation will be made up mainly of women from the Upper and Middle social strata categories, whereas the nonregulator subpopulation will be made up mainly of women from the Lower and Agriculturalist social strata categories.

The section opens with a description of the empirical hypotheses, mathematical model, and variables used by the Easterlin framework. This approach involves a three-stage analysis of fertility determination. In each stage, the functional relationship between the dependent variable and the independent variables was estimated through a linear regression model.

Next, the results of the individual level analysis of the proximate determinants of fertility demonstrate that, for both regressions, all coefficients display the expected sign of the relationship, and most are significant at conventional levels. When variable U is defined as "duration of contraception in months," most of the regression coefficients are significant at conventional levels, except for the coefficient related to the variable "not secondarily sterile." The same is true when variable U is defined as "use/nonuse" (see Table 18).

The next topic is an examination of the determinants of contraceptive use, which are functions of the motivation and cost regulation factors. The results show that there are significant effects of motivation and regulation cost on fertility regulation. The transition to deliberate fertility control is a consequence of growing motivation and regulation cost.

According to the standardized coefficients in Table 22, knowledge and efficiency of contraceptive methods (cost of regulation) play a more important role in the determination of the duration of contraceptive use for the total sample than motivational measures. Moreover, the different measures of motivational cost used in the study for the total population have little variability.

The results for the population of regulators demonstrate that the motivation measure (C_n - C_d) shows a statistically significant regression coefficient having the expected positive sign, implying an effect on fertility control that is more important than that related to the cost of regulation. However, "the potential supply of surviving children" (C_n), an alternative measure of motivation, performs better than the difference (C_n - C_d) as a predictor of the use of fertility control. The proportion of variance explained increases from 16 to 23 percent (see Table 23). In conclusion, when stage 2 of the Easterlin framework is applied to the Bolivian data, the results are similar to those of Easterlin and Crimmins' study of Sri Lanka and Colombia.

In the last section, the third stage of the "synthesis framework" was investigated. The aim was to examine the relationship of modernization variables and cultural determinants of fertility control to the cost of regulation (RC) (number of contraceptive methods known) and the two motivational variables, "desired family size" (C_d) and "potential supply" (C_n). The variable "potential supply" was broken down into its own "determinants" — marriage duration, age at first marriage, first birth interval, second birth interval, absence of secondary sterility, duration of breastfeeding, and child mortality — which were then analyzed using the same modernization and cultural analyses applied to the cost of regulation and the demand for children.

The predictive power of the set of modernization and cultural variables varies widely among the different dependent variables. On the one hand, several variables, e.g., regulation cost, the motivation variables, and "duration of marriage," have a significant relationship in the regression. At the other extreme, some dependent variables, e.g., "second birth interval" and "not secondarily sterile," the latter of which only has a significant relationship with age (see Table 25), appear to have no variables that are significantly related to them.

The main modernization and cultural factors that emerge from analysis of the Bolivian data are "wife's education," "ecological strata," and "language spoken at home." The first indicates the effect of the modernization variables; the others reflect the cultural factors in the process of fertility transition. Since our interest is to know the differences by social strata, our conclusion will refer to it.

The difference in social strata and its consequence in reproductive behaviour can be depicted by the variable "level of women's education." "Wife's education" operates through a more complex causal flow. The effect of increased education on natural fertility through shorter marriage duration will reduce the natural fertility of the more educated group by 0.845 children as compared to the less educated group. Comparing the effects of education on the variables "absence of secondary sterility," months of breastfeeding," and "child mortality," the positive contribution of the first two variables nullifies a negative contribution from reduced child mortality. However, the effects of increased education through shorter duration of marriage predominates, reducing natural fertility among educated women. Taking all four variables ("duration of marriage," "absence of secondary sterility," "months of breastfeeding," and "child mortality") into account, 10 years of education reduce natural fertility by 0.735 children. In other words, more educated women have lower natural fertility than less educated women.

When calculating the differences in potential supply caused by 10 years of education, increased education is seen to have a negative effect on relative supply. In Bolivia, the higher child survival rate of the more educated group tends to raise their relative supply, whereas the lower natural fertility rate of the more educated tends to lower their relative supply (see Table 27). The estimated negative effect of increased education is to reduce relative supply by 0.429 fewer surviving births.

The effect of differences in education on fertility control shows that the combined effect of the difference in "potential supply of children" and "demand for children" increases the motivation for fertility control (C_n - C_d) among the more educated women (see Table 5.13). The weak effect of differing educational levels on changing motivation for fertility control may be explained largely by the weak effect on different educational levels of changing desired family size, which is partly due to the high intercorrelation between education and urban residence.

The effect of increased education on fertility arising from fertility control shows that a 10-year rise in education is accompanied by a reduction in fertility of about 0.1 births (see Table 5.14). This small reduction in fertility among Bolivian women due to fertility control could be explained by the small proportion of women using any contraceptive method (52 percent) and by the high proportion (75 percent) of those contraceptive users using traditional methods, which are less efficient and less reliable. For this reason, the difference in children ever born between more educated and less educated women due to fertility control is very small.

The above conclusions indicate that the formulation of policies related to fertility requires great caution because of the complex paths through which the mechanisms operate. However, one of the most important factors is marriage duration, which is shortened by increasing education, thus reducing natural fertility. On the other hand, favourable attitudes toward greater use of contraceptives, specifically modern ones, will play a major role in the decline of fertility. A smaller but substantial role will be played by increasing the length of breastfeeding in those subpopulations where it is short, by encouraging lactation. Moreover, it is likely that the continuous decline in infant and child mortality in all the social strata categories at varying rates will reduce natural fertility, assuming that patterns of breastfeeding remain the same. Thus, fertility will decline even though the other factors remain the same.

The results obtained in stage 3 of the Easterlin framework show that "education" and "language spoken at home" are important factors in the spread of fertility-related norms, values, and ideas. An increase in the education of women and their active participation in decisionmaking, particularly of decisions related to education, health, labour force participation, and other social spheres, will allow women to play a major role in the decline of fertility because of the corresponding modifications to their fertility behaviour.

To accelerate the decline in fertility, special emphasis should be placed on rural women, particularly those of the Lower and Agriculturalist categories. It is necessary to improve their status and condition at the familial and community levels, not only by improving their socioeconomic conditions, but also by permitting them access to sources of information and contraceptive methods. This would permit them to have greater control over their own lives and decisions, particularly decisions concerning reproductive behaviour.

The results of this study constitute an exhaustive analysis of reproductive behaviour and fertility differentials by social strata in Bolivia explaining the reasons for and causes of the late initiation of the demographic transition and the dynamics of the decline that has occurred until now. The differentiation among the social strata categories with the contrast among the Upper, Middle, Lower, and Agriculturalist categories provides a better understanding of the social heterogeneity found in Bolivian society.

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