FERTILITY LEVELS AND DIFFERENTIALS IN KENYA: EVIDENCE FROM KENYA CONTRACEPTIVE PREVALENCE SURVEY, 1984.

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree award in any university.

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DEDICATION

This work is dedicated to my dear parents, Peterson Ong'uti Momanyi and Mary Oinga Ong'uti who have cared for me since childhood up to now.

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I however remain to bear full responsibility for any shortcomings that may be found in this work.

ABSTRACT

The objective of this study was two-fold. First, to estimate fertility levels using demographic techniques; and second, to evaluate the effect on fertility of some of the socio-economic, cultural and demographic variables using data mostly drawn from the 1984 Kenya Contraceptive Prevalence Survey (KCPS).

The fertility levels have been estimated at national, provincial and district levels in Kenya by applying the Coale-Trussell P/F ratio method and the Gompertz Relational Model. Fertility levels by various variables have also been estimated but only at the national level, since such estimates would not have been possible at other levels due to the smallness of KCPS sample size. The only variable cosidered for all districts is the marital status of women whose data was drawn from the 1979 census. The variables that are used at the national level are: woman's educational level, woman's work status, husband's work status, religion, woman's marital status, polygamous status contraceptive use, ethnicity and place of residence of the woman.

A statistical multiple regression analysis has been used to evaluate the effect of each variable on fertility at both macro and micro level. In this model other variables such as age of the mother and age at marriage are included.

The results on fertility levels show that differences in fertility levels in Kenya between regions still persist. They range from as low as below six (Mombasa, Kwale and Nairobi) to as high as above ten (Meru, Kisii, Nandi, Uasin Gishu, Kericho and Bungoma). Fertility levels by the various variables considered shows that there are still wide variations between the different categories of each variable, especially in education, religion, marital status and place of residence.

The multivariate regression results show that most of the variation in fertility between districts is explained most by the proportions of women who have never worked. The urban place of residence, nine years of education and above, women in unstable unions and polygamy are all found to depress fertility. However the first two have to be accompanied by the use of contraceptives so as to have a significant effect. At the micro level, age of the mother explains most of the variation in fertility. Though most of the results are similar as at the macro level, 5-8 years of education are also found to depress fertility whereas cotraceptive use has an increasing effect.

Therefore, fertility reduction in Kenya may not be a one way approach but varied, and should include ways of reducing economic disparities between regions and individuals.

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CHAPTER ONE

INTRODUCTION.

1.0 INTRODUCTION AND STATEMENT OF THE PROBLEM

Kenya's population is increasing at the rate of 3.9 per cent per year (1979 census). It is one of the highest in the world. Its future projections must therefore, anticipate the time when Kenya will enter the next phase of the demographic transition, that is, when birth rates will begin to decline and thus reduce the potential that is making the population to double in less than twenty years.

The study of fertility levels and differentials among various regions and groups in the country is an important aspect of demographic research. Studies carried out in Kenya indicate that fertility in Kenya has been rising since data started to be collected in 1948. The first estimate using 1948 and 1962 censuses by Som (1968) found the total fertility rate to be 6.4 births. Another study using the 1969 population census by Blacker (1971) found the total fertility for Kenya to be 7.6 births. The National Demographic Survey (1977) and the Kenya Fertility Survey (1977/78) show total fertility rate to be 8.1 births. Mwobobia (1982) used the 1979 census and estimated it at 8.2 births. Fertility in Kenya has therefore been rising over time.There has been a corresponding trend with the annual population growth rates. Estimated at 3.3 per cent between 1948 and 1962, it had risen to 3.9 by 1979 (1979 census). These trends cause serious socio-economic problems in the country especially in the provision of essential services such as health, education and food. Though high fertility is not the primary cause of lack of socio-economic development and low levels of living which characterise most of the developing countries, it nevertheless perpetuates under-development and makes the prospects of development and improvement of living standards much more bleak.

Even though the total fertility rate for the whole country is high, the rates are not uniform across regions and groups in the country. It is therefore important to identify the various factors that contribute to these differences and how they affect the national average. The Kenya Contraceptive Prevalence Survey of 1984 has information on most of these socio-economic and cultural factors that influence fertility levels. The influence on fertility of the following factors has been investigated: place of residence, education of the mother, marital status, work status of both parents, religion, ethnicity and the use of contraception. Since most of this information was unlikely to be found in censuses, a study of this kind at macro-level becomes more appropriate.

1.1 OBJECTIVES OF THE STUDY.

The main objectives of this study are as follows:

(1) To estimate fertility levels and differentials at national, provincial and district level by applying

the Coale-Trussell model to data drawn from the 1984 Kenya Contraceptive Prevalence Survey file. For Comparative purposes the Gompertz Relational model will also be applied in the calculation of fertility levels and differentials.

(2) To examine the effects of the predictor variables such as education, place of residence, work status, polygamy status and contraceptive use on fertility.

(3) To find the strengths of the relationships between some of the selected independent variables and total fertility rate.

(4) To give recommendations for further research and future policy.

1.2.0 LITERATURE REVIEW

1.2.1 DEVELOPING COUNTRIES:

For many years demographers have studied fertility levels and differentials at both micro and macro levels. Recent studies have also added light to these issues.

Loebner and Driver (1973) did a multivariate analysis of the relations of several demographic and socio-economic variables to fertility using data drawn from Central India. They found out that most socio-economic factors had only an indirect effect on fertility. The number of children ever born to a woman was largely a direct function of duration of marriage and age at marriage. But the net effect of wife's education on fertility was more direct through age at marriage and indirectly through marriage duration. The use of contraception was affected in order of importance by: wife's education, husband's education and income, and the number of surplus children.

Fernando (1974) did a study in Sri-Lanka using data from 1963 and 1970 censuses. He found out that the traditional pattern of lower urban fertility relative to rural held true in both 1963 and 1970. However a narrowing of the differentials was observed during the period which was consistent with the progress that had so far been achieved in modernization. The regional differentials noted in some areas was due to the fact that the proportion marrying between 1963 and 1970 among younger age groups (15-19 and 20-24 years of age) declined due to the increasing unemployment of men (who do not attract women).

Findley and Orr (1978) studied urban rural variations in fertility using data drawn from World Fertility Survey. They also found that the average total fertility rate was lower for urban areas (4.95 births) and higher for rural areas (6.35 births). They also found out that the larger the city, the lower the level of fertility in Asia and Latin America but not in Africa. Kuznets (1974) did a similar study using also data from World Fertility Survey and found greater urban-rural differences in Latin America than elsewhere in developing countries. However, in Africa, urban fertility was in some cases higher than rural fertility.

Merrick (1974) studied fertility in Brazil and found that regional differences in birth measures (crude and general rates) widened between 1950 and 1970, despite a decline in fertility at the national level and a narrowing of regional differences in important socio-economic variables such as education, urbanization and female activity ratios. This was largely due to migration.

Henin (1973) did a study in Tanzania and found that more years of education results in lower fertility for single women, even when women were classified by religion. When education for all women was considered, those women with 1-4 years of education had higher fertility that women with no education. Fertility only declined after the fourth year of education. However, an uncommon finding in this study is that fertility tends to rise as women moved up the social ladder. For instance professional women had the highest fertility while agricultural paid worker had the lowest level of fertility. When education was controlled, the higher the economic status of the husband the higher the fertility of the wife. These findings seem contradictory since fertility declined after four years of education and the fact that proffessional women are likely to be more educated.

A similar finding as of Henin was that by Taha and Abdelghany (1981) in Egypt. The fertility of women classified as top white-collar group was higher than that of women classified as blue-collar group. Even fertility of the low white-collar groups was higher than that of blue-collar workers, farmers and services. This was attributed partially to the difference in childlessness among occupational groups and partially to defective data. Education was found to be inversely related to fertility of all ever married women in all durations of marriage except for durations under five years. The study also found out that completed family size in urban areas was higher than in rural areas, probably due to the definition of urban areas that was employed and higher under-reporting in rural areas.

Abdel Rahman (1981) did a study in Sudan and attributed the high marital fertility to low age at marriage, low permanent celibacy and quicker rates of marriage of the widowed and divorced women. These are the same factors that contributed to higher fertility in rural than in urban areas. Regionally, fertility was highest in the Central regions of the Sudan and lowest in the South, a difference in total fertility rate of 31.3 per cent.

Little (1984) applied Bongaarts framewrok of the proximate determinants of fertility (marriage, contraception, lactational infecundability and induced abortion) to Dominican republican data. He found that total fertility rate values of the uneducated and rural groups were more than twice those for most educated and urban groups respectively. For the better educated and urban women, lower fertility was due to the drastic decline in potential fertility estimates above age 30 -probably due to high use of induced abortion and contraception.

Lecomte and Marcoux (1976) used data from Morocco and Tunisia and found that the acceptors of contraception married late and had a higher number of living children. Therefore, the family planning programmes did not have a major impact on fertility at the national level. The high number of living children among the acceptors shows that they practiced contraception for terminating childbearing rather than spacing births. Similarly Rizk (1976) found that in Jordan, the fertility of all the contraceptors, regardless of the marriage duration and schooling, was higher than that of the non-contraceptors. However, the highest per cent of contraceptors were university graduates, then secondary graduates, primary graduates and finally the illiterate.

Allman (1982) did a study of the levels and trends in fertility in Haiti and found that union patterns, breastfeeding and contraception were the most important determinants of fertility. The average number of children ever born varied considerably by women's current union status (union patterns in Haiti are complex, with women having several types of unions often with different partners). Married women had the highest rates especially after age 35 (7.5 births) and women in unions without cohabitation had the lowest rates. The number of children ever born decreased when the number of partners increased for union durations of 10-19 years over. Allman also found that in areas where breastfeeding period is very short, infant mortality tended to be high and the average number of children ever born was quite high.

1.2.2 KENYA

Studies on fertility levels and differentials in Kenya are quite recent. Kangi (1978) used 1969 census data and recommended that the provision of just primary education for girls is enough to reduce fertility in Kenya even more than secondary education. However, Cochrane (1979) and Henin (1979) argued that just primary education for girls will lead to higher fertility levels. Mwobobia (1982) also used the 1979 census data and concluded that Kenya's move to free primary education would lead to a rise in total fertility rate. The study also found that the mean age at first marriage works in the same direction and magnitude with primary level of education. That is, initial increases in age at first marriage would lead to a rise in total fertility rate in the short run. He also recommended a reduction of illiterate women in urban areas so as to reduce fertility in urban areas. Cochrane

(1983) found that although the effect of female education on fertility is negative, it is not linear. She found that female education reduces fertility by one child, male education by one third as large and urban residence by two thirds. Total fertility for rural areas in Kenya 8.4 births but 6.1 births when all women are considered. But when only ever married women are considered, it is 8.0 births and 6.5 births respectively.

Osiemo (1986) also recommended that secondary education for girls in Kenya is necessary for any substantial reduction in fertility. The study further found that urban fertility is not very much different from rural ferility in Kenya.

Other studies in Kenya include one by Muinde and Mukras (1979) that found that education, female labour force participation and family income were all negatively related to fertility. But polygamy and infant mortality were found to be positively correlated with fertility. In polygamy, they argued, there is competition for children to gain respect. Anker and Knowles (1982) studied the determinants of fertility at district levels at both micro and macro level. They found out that contraceptive use reduced fertility and its use increased with education. Female labour force participation, urbanization, polygamy and separation were all found to be negatively related to fertility.

Ferry, et al (1984) in estimating the proximate determinants of fertility found out that ferility has been rising in Kenya because childlessness is quite rare and the starting pattern of fertility is quite young. The Kenyan women bear their children at age 19, but 10% of them start as early as 14 or 15 years. The more educated and the more urbanised younger women do have a slightly later starting pattern but the differences are small. It was also found that the traditional practices that used to suppress fertility such as birth spacing, breastfeeding, post-partum amenorrhoea and more especially post-partum abstinence have become relatively short by African standards while contraception has not(yet) been widely adopted.

Kalule-Sabiti (1984) found that the proportion married among the population, the level of contraceptive use and post-partum lactational infecundibility account for much of the observed marital fertility differentials. modernization through education and urbanization have offsetting effects on fertility by reducing lactation and increasing contraception. However the proportion using contraception, limited to those with secondary and higher education or metropolitan residence is too small to have an appreciable impact on overall level of fertility.

The literature review is not exhaustive, but it has given a clear picture of some of the relationships between fertility and some of the socio-economic and cultural factors on fertility. However most studies have concentrated on the effect of education, place of residence and marital status on fertility. In addition to these, the present study inludes other factors such as ethnicity, contraceptive use polygamy status and religion.

1.3.0 THEORETICAL FRAMEWORK.

The Economic Theory of Fertility (Becker,1960; T.W. Shultz,1973) is among the most widely tested theories in explaining fertility differentials in developing countries. In this theory,households are seen as rational decision-making units trying to maximize utility given various constraints. Children are seen just like any other commodity when trying to optimize their utility.

This is a demand oriented theory based on particular circumstances facing the individualand looks at the direct benefits of children to parents. In Africa, children are more just goods for economic benefit. Parents may desire some sex preference especially for boys who will finally inherit the father's property and status, give care at old age, perform burial rites and even defend the community incase of danger. Parents may also desire a certain number of girls as they a source of wealth through marriage. The high infant and child mortality is another factor for high fertility if given family size has to be attained.

In Africa also, the value of children is not in terms of good care, good education but the absolute number - a beautiful sight. Children are a source of happiness and companionship to parents. They continue the lineage, kinship group and family unit which a single child family cannot achieve. Thus a woman's value in Africa rests on her childbearing capacity and barren women are often despised (Ocholla-Ayayo, 1987:2).

This however does not imply that in Africa children are not seen in terms of the economic benefits accruing from them. Children are seen as a source of labour (Oppong, 1978) and parents in most traditional societies expect economic help from their children (Oppong, 1987). Their the desire for children is more socio-cultural in nature than purely economic. The Economic Theory of Fretility would rather be called a social-cultural theory of fertility.

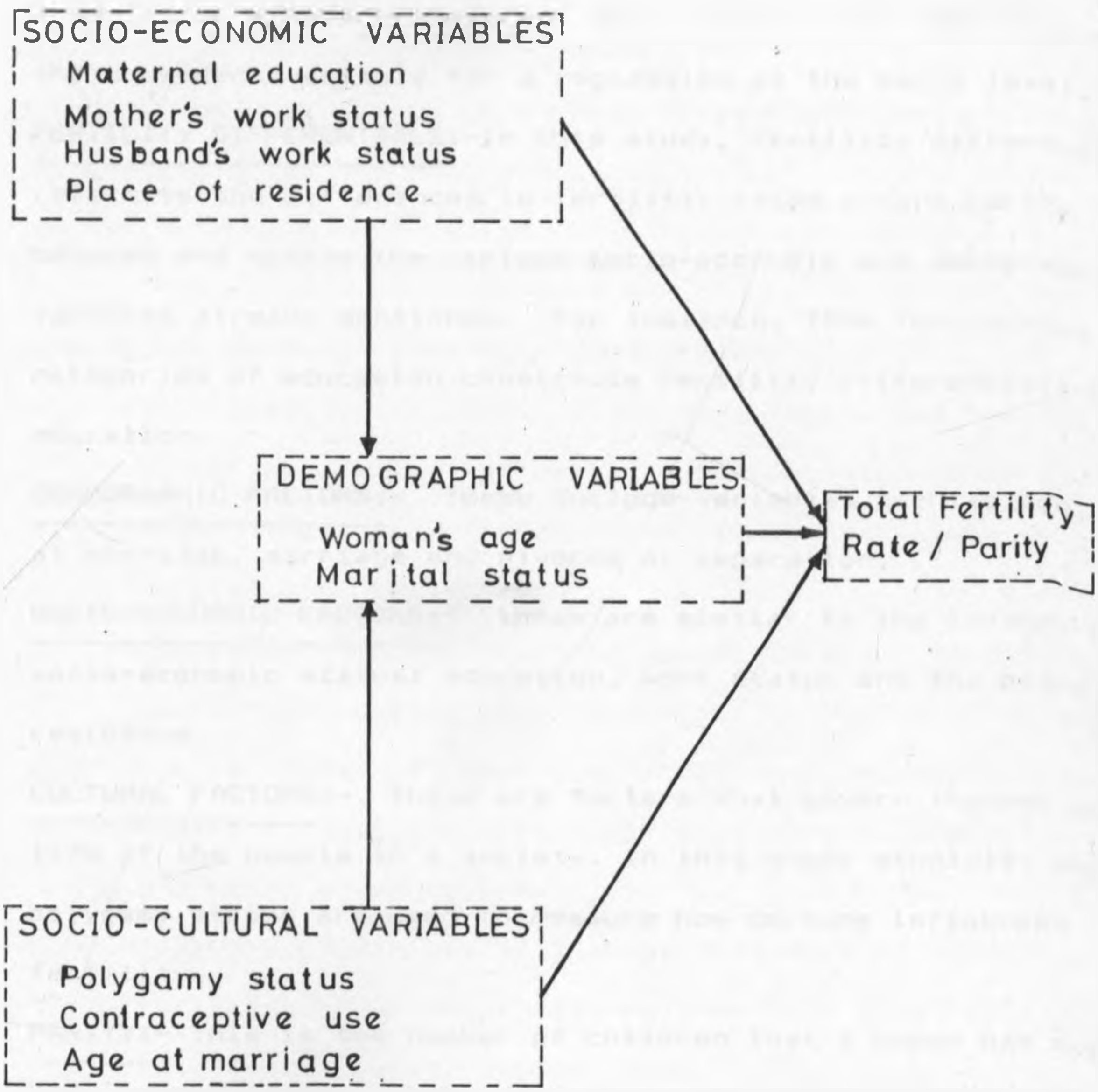
The present study however does not look directly into how contributions by children help in explaining fertility differentials, but indirectly through such background variables as education and work status of the mother, place of residence and work status of the wife's husbnd. From the literature review it has been noted that education is likely to improve the socio-economic status of the parents which may reduce family size through changes in consumption patterns. But high income may also make parents afford more children (Shultz, 1973) and even make them more healthier and fecund through better diet and health care. The urban women may have a smaller family than their rural counterparts because they are likely to be more educated and better placed in the job market.

In Africa, children belong to the lineage rather than parents (Caldwell, 1977). Therefore decisions about children are likely to be related to the social-economic conditions of the family and group norms. In the present study, ethnicity is the most important such factor.

Therefore, fertility differentials are related to a multiple of factors that either directly or indirectly affect fertility. A theoretical statement may thus read: "The socio-economic, socio-cultural and demographic processes are likely to influence the fertility of any community".

1.3.1

CONCEPTIAL MODEL



1.3.2 DEFINITION OF CONCEPTS

TOTAL FERTILITY RATE:- this is the average number of children born to women during their entire life span. It can be either a period or a cohort measure. This variable has been used as the dependent variable for a regression at the macro level.

FERTILITY DIFFERENTIALS:-in this study, fertility differentials refers to the differences in fertility rates or/and parity between and within the various socio-economic and demographic varibles already mentioned. For instance, TFRs for various categories of education constitute fertility differentials by education.

DEMOGRAPHIC FACTORS:- these include variables such as age, age at marriage, marriage and divorce or separation.

SOCIO-ECONOMIC FACTORS:- these are similar to the indices of socio-economic status: education, work status and the place of residence.

CULTURAL FACTORS:- these are factors that govern the way of life of the people in a society. In this study ethnicity and polygamy status are used to measure how culture influences fertility.

PARITY:- This is the number of children that a woman has ever had irrespective of those dead including current pregnancy. Parity is taken as the dependent variable in the multiple linear regression analysis at the individual (micro) level because total fertility rate for individuals cannot be calculated.

MARRIED PEOPLE:- refers to persons living together as man and wife, whether or not they have been through any civil, religious or customary ceremonies.

URBAN:- Urban centres were defined as places with a population of 2,000 or over in the 1979 census.

ETHNICITY:- this refers to a group of people the same cultural values and speak the same language.

1.3.3 OPERATIONAL HYPOTHESES

The following hypotheses have been tested:-

1. The fertility of women in the the urban areas is likely to be lower than the fertility of women in the rural areas. Thus urban residence is likely to be negatively related with fertility.
2. The women with 5-8 years of education are likely to be positively related with fertility.
3. The fertility of women with 9 years of education and over are likely to have lower fertility than those with 5-8 years of education.
4. From the hypothesis in 3 above, 9+ years of education is likely to be negatively related with total fertility rate or the parity of the woman.
5. The women in unstable unions (divorced, separated and widowed) are likely to be negatively related with fertility.
6. The use of contraception is likely to be positively

related with fertility.

7. The women who marry by the age of seventeen are likely to be positively related with fertility.
8. Polygamy is likely to be negatively related with the fertility women.
9. Currently working women are likely to be negatively related with fertility.
10. Women with husbands not working are likely to positively related with fertility.
11. The women not working are likely to be positively related with fertility.
12. Women with husbands that are in paid employment are likely to be positively related with fertility.

1.4 SCOPE AND LIMITATION OF THE STUDY:-

The study focuses on women in the reproductive age groups (15-49 years) as given in the survey. This is because reproduction outside this age bracket is generally insignificant.

The study covers both the provinces and the districts. Although there are 41 districts in Kenya only 27 rural strata were created. Several of the less populated districts were merged to form one stratum (e.g. Kilifi, Lamu and Tana River in Coast province; Narok and Kajiado, Baringo and Laikipia, Elgeyo Marakwet and West Pokot in Rift Valley province). The whole of Samburu and Turkana in Rift Valley province, Isiolo and Marsabit in Eastern Province were excluded from the frame. These form about one half of Kenya's land area but contain only five per cent of the total population, most of which still retains a nomadic way of life and therefore did not lend itself to a sample involving fixed geographical areas. The study at district level is in line with the need for information for the current strategy of making the districts the focus of development.

At the provincial level, seven provinces have been studied as they were divided according to the NASSEP (Kenya's National Sample Survey and Evaluation Programme) frame. These are Nairobi, Coast, Eastern, Central, Rift Valley, Nyanza and Western.

The data on fertility does not give the timing of births. Though this reduces the chances of data distortion by dating errors, the age patterns or time trends of fertility can not be established. And since information on children ever born was collected in form of numbers rather than yes' or no' answers the data is subject to some reporting errors.

1.5 DATA SOURCE

The major source of data is the 1984 Kenya Contraceptive Prevalence Survey (KCPS) by Central Bureau of Statistics (CBS). The intention of the survey was collect information on knowledge, availability and attitude in family planning methods in the country. The survey has also substantial data on fertility. The rest of the data has been collected from Government publications.

Using the probability sample, two questionnaires were administered. The first was a household schedule which was to identify women who were eligible for an individual interview using the second questionnaire. The expected size was 6,240 rural households and 2,223 urban households. Out of the total 8,463 households, a target population of about 6,400 women between the ages of 15 and 49 years old was expected to be interviewed. The sampling procedure adopted was a stratified mutli-stage cluster design based on Kenya's National Sample Survey and Evaluation Programme (NASSEP) frame which clustered seven provinces: Nairobi, Coast, Eastern, Central, Rift Valley, Nyanza and Western. Each province was allocated 1,150 households, each of which was divided into urban and rural areas. A fixed sample per selected cluster was used: 30 households per rural cluster and 15 households per urban cluster. In the case of urban areas where changes occur more frequently, a fresh listing was conducted within a period of three months prior to the field work so as to update the frame.

From the total population of the sampled households, 6,807 eligible women were identified and 6,581 were interviewed for a response rate of 97 per cent. The major reason for non-response was the failure to find the respondent at home. Eligibility of the individual interview was defined on a _de facto_ basis for all women aged 15 to 49 years, who stayed in the house the previous night.

The information collected from individual questionnaire included background characteristics of the respondent: Place of residence(at childhood and survey time); educational level; tribe, religion, work status and marital status. Respondents were asked whether they were in polygamous or monogamous unions; age at first marriage; contraception use and availability and about the husband's educational attainment, occupation and employment.

The information collected also included children ever born; the number of children that were still living including current pregnancy; date of the last birth; children dead by sex; breast feeding and parental care of the last born and desire for more children.

The Data that has been used.

From the KCPS data file, the following data has been used for analysis:-

(1) Children ever born classified by five-year age group of mother.

(2) Number of children born in the last 12 months before the survey by five-year age group of mother.

irrespective of marital status and childless or not.

(4) The data in 1,2 and 3, has been cross-tabulated by province (7 provinces), district (29 districts), major towns and rural areas.

(5) The information in 1, 2, and 3 above by differentials at the national level has also been assessed. These are: maternal education. marital status, place of residence, contraceptive use, work status of both parents, polygamy status and ethnicity.

These are categorised as follows in the KCPS file:

<u>Education</u>:- has been divided into four categories: (a) 0 years of schooling, (b) 1-4 years of schooling, (c) 5-8 years of schooling and (d) 9+ years of schooling.

<u>Place of residence</u>:- Classified into:- (a) other urban (b) Nairobi/Mombasa and (c) rural.

Data on province and district level is also available.

<u>Marital status</u>:- classified into: (a) single, (b) married, (c) divorced and (d) widowed.

<u>Religion</u>:- women interviewed are classified into five groups:- (a) catholics, (b) protestants and other christians, (c) moslems, (d) none and (e) others.

<u>Ethnic group</u>:- respondents are grouped into ten major ethnic groups namely:- Kikuyu, Luhya, Luo, Kamba, Meru-Embu, Kisii, Mijikenda, Kalenjin, Taita-Taveta and others.

<u>Work status</u>:- all women are classified into:- (a) currently working, (b) worked in the past and (c) never worked.

<u>Work status of husband</u>:- all currently married women are classified by the work status of their husbands and are given as follows:- (a) own farm, (b) other farm, (c) own business, (d) other business and (e) not working.

Contraception:- women were classified into:- (a) ever use of contraception and (b) none ever use of contraception.

.6 JUSTIFICATION OF THE STUDY

This study has been based on data from the 1984 Kenya Contraceptive Prevalence Survey (KCPS). This source had the latest information on fertility levels and much more detailed information on fertility levels by various differentials than the census or other earlier surveys could give.

Since the Kenya Fertility Survey of 1977/78 and National Demographic Survey of 1977 were conducted, there is a difference of at least seven years before the KCPS was carried out. The last national census was in 1979. This is a long period of time in a country like Kenya where fertility is very high and mortality falling. The use of contraception has never been measured with fertility levels in detail in Kenya. This has been done in this study which among others has tried to confirm the earlier estimated levels of fertility and identify the influence and magnitude of each of the background variables such as education, place of residence, marital status, ethnicity and work status of both wife and husband.

Thus knowing what factors have the largest effect on childbearing performance may allow policy makers and implementers to allocate scarce resources in the most efficient way. This is especially more important where resources are scarce and at the same time fertility is very high as in Kenya- and is being debated whether fertility reduction can be obtained by concentrating limited resources in family planning.

CHAPTER TWO

DISCUSSION OF TECHNIQUES

2.0 Introduction

In this chapter, the computational procedures of the techniques used in the analysis of data are discussed and and shown. There are two types of techniques used which are: (1) demographic techniques and (2) statistical techniques. The demographic techniques used are the Coale-Trussell P/F ratio method (of the Brass type) and the Gompertz Relational Model. The statistical model used is the multiple linear regression model. The quality of the 1984 KCPS data has also been analysed.

2.1 Demographic Techniques

Kenya, like any developing country, data derived from vital registration is often of poor quality to permit the evaluation of fertility rates. Therefore the estimations have to be done using the census data or survey data with the use of indirect techniques of estimation. The indirect techniques of estimation are based on the information of children ever born by mother's age and also children born in the last twelve months before the census or survey which measures current fertility.

The first of such method used is the Coale-Trussell P/F ratio method. The strengths and weaknesses of the model hav already been well documented in earlier studies. Mwobobia (1982) and Osiemo (1986), have both used the method using census data. However only Osiemo has used the Brass type method based on the Coale-Trussell coefficients. The major weakness of this method that needs mention is that it exaggarates the fertility values. This was found to be true, hence necessitating the use of the Gompertz Relational model which also detects and corrects some errors in the data so that the results can be comparable.

The suggestion that a relational Gompertz model would be useful in fertility analysis was made by Brass (1974). Brass (1977) elaborated the idea further by giving the main application. However, the basic work that provided empirical scale transformation was done by Booth (1979). Booth's model represents a pattern of fertility that is typical of populations with high fertility. He examined the goodness of fit to observations and investigated the estimation problems. Zaba (1981) made a major breakthrough by providing the methods of separating the examination of fertility pattern from the estimation of level. Brass and Rashad (1980) have explored how the model can be used for detecting and adjusting errors in the retrospective birth histories. But Wunsch (1966) and Martin 1967 were the first to represent the fertility rates using the Gompertz function. In Kenya, the model has been used by Brass (1981) and Osiemo (1986).

The computational procedures of the two methods are shown below.

2.2: The Coale-Trussell P/F Ratio Method.

2.2.1 : The Theory Part.

The P/F ratio method or Brass method seeks to adjust the level of observed age-specific fertility rates, which are assumed to represent the true age patterns of fertility. P(i) stands for the reported average parities and F(i) stands for average parity equivalents. Ratios of average paritiess, P(i), to the estimated parity equivalents, F(i), are calculated age group by age group, and an average of the ratios obtained for younger women is used as an adjustment factor by which all the observed fertility rates are multiplied as done in United Nations, Manual X, chapter II.

If we let f(i) be the fertility rate of women who are in age group i that is obtained by dividing the number of births occuring to women in age group i during the year preceding the interview by the total number of women (childless or not, ever married or not) in that age group, then the cumulated fertility schedule is given by:-

$$Q(i) = 5[f(i)] \qquad (1)$$

The average parity equivalents, F(i) then will be estimated by interpolation using the period fertility rates f(i) and the cumulated fertility values Q(i). Coale and

Trussell proposed a second-degree polynomial to three consecutive values of Q(i) and estimating the average parity of women of an age group within the range by evaluating the integral of the polynomial. In an actual application, the F(i) is obtained as:-

$$F(i) = Q(i-1) + af(i) + bf(i+1) + c(i)\ Q(7) \qquad (2)$$

where a(i), b(i), and c(i) are constants given in table 2.0 below and where:-

i = 1, 2, 3, 4, 5 and 6

and

$$F(7) = Q(6) + Q(7)\ f(6) + b(7)f(7)$$

The values of the coefficients (parameters) a, b and c were estimated using least squares regression method to the data based on the Coale-Trussell fertility model (1974). The values of the coefficients are shown below.

Table 2.0 Coefficients for interpolation between cumulated fertility rates to the estimated parity equivalents.

Age Group	Index i	a(i)	b(i)	c(i)
15-19	1	2.531	-0.188	0.0024
20-24	2	3.321	-0.754	0.0161
25-29	3	3.265	-0.627	0.0145
30-34	4	3.442	-0.563	0.0029
35-39	5	3.518	-0.763	0.0006
40-44	6	3.862	-2.481	-0.0001
45-49	7	0.392	2.608	

Source: U.N. Manual X, 1983, p.34.

When the age-specifc fertility rates have been calculated from births in a 12-month period classified by age of mother at the end of the period, they are specifc for unorthodox age groups that are shifted by six months. A fertility schedule for conventional five year age groups, $f^{+}(i)$, can be estimated by weighting the rates referring to unorthodox age groups according to following formula:-

$$f^{+}(i) = (1-w(i-1))f(i) + w(i)f(i+1) \qquad (3)$$

where f(i) and $f^{+}(i)$ are the unadjusted and adjusted age-specific rates respectively, and w(i) is the weighting factor calculated as:-

$$w(i) = x(i) + y(i)f(i)/Q(7) + z(i)f(i+1)/Q(7) \qquad (4)$$

The values of x(i), y(i) and z(i) were obtained by fitting equation (4) by least squares regression to the same model cases that were used in deriving coefficients for table 1 above. There is no weighting factor that is needed for i = 7 because childbearing is assumed to cease after age 50 and therefore;

$$f^{+}(7) = [1-w(6)]f(7) \qquad (5a)$$

Table 2.1 Coefficients for calculation of weighting factors to estimate age-specific fertility rates for conventional age-groups, from age groups shifted by six months.

Age Group	Index (i)	x(i)	y(i)	z(i)
15-19	1	.031	2.287	0.114
20-24	2	.068	0.999	-0.233
25-29	3	.094	1.219	-0.977
30-34	4	.120	1.139	-1.531
35-39	5	.162	1.739	-3.592
40-44	6	.270	3.454	-2.492

Source: U.N. Manual X, p.34

After this, ratios P(i)/F(i) will be calculated. If the P(2)/F(2) and P(3)/F(3) will be reasonably consistent, either of them will be used as an adjustment factor for the period fertility rates. If they will not be very similar, a weighted average of the two will be used. However, if the ages of women are believed to have been pushed up or down, then the mean of all the P(i)/F(i) rates can be used.

Once an adjustment factor has been chosen, only an adjusted fertility schedule will be computed by multiplying the fertility rates for conventional age groups, $f^{*}(i)$:-

$$f^{*}(i) = kf^{*}(i) \qquad (5b)$$

Then the total fertility rate will be calculated as:-

$$TFR = 5[\sum f^{*}(i)] \qquad (6)$$

An estimate of the adjusted crude birth rate will then be obtained by multiplying each of the adjusted fertility rates by the number of births, adding these results for all ages and then dividing their sum by the total population of women.

2.2.2 Application of the Model using the KCPS Data, 1984, for Kenya.

Table 2.2 shows data on children ever born and children born in the twelve months preceding the survey by all women that were interviewed in 1984.

Table 2.2 FEMALE POPULATION(FPOP), CHILDREN EVER BORN(CEB), BIRTHS IN THE PAST YEAR, BY AGE OF MOTHER,KENYA, 1984.

Age Group (1)	FPOP (2)	CEB (3)	Births in past year (4)
15-19	1329	472	219
20-24	1468	2881	612
25-29	1154	4564	479
30-34	948	5404	341
35-39	728	5102	209
40-44	578	4518	84
45-49	376	3032	23

From Table 2.2 reported average parities,P(i), are obtained by dividing entries in column (3) by those in column (2), and period fertility rates, f(i), are obtained by dividing entries in column (4) by those in column (2)-(see Table 2.3 below).

The values of the cumulated fertility schedule are obtained by adding the values of f(i) beginning with i=1 to i=j and then multiplying this sum by five (because five year age groups are used). The results are shown in column (4) of Table 2.3. Since period fertility rates were calculated from births in the twelve months preceding the survey, coefficients in Table 2.0 are used to estimate the average parity equivalents, F(i).

Table 2.3
AVERAGE PARITIES (P(i)), PARITY EQUIVALENTS (F(I)),
CUMULATED FERTILTY SCHEDULE (Q(i)), AND P/F RATIOS.

Age Group (1)	Index (i) (2)	Average Parity P(i) (3)	Period Fertility Rate f(i) (4)	Cumulated Fertility Q(i) (5)	Parity Equiva- lent F(i) (6)	P/F Ratios P(i)/F(i) (7)
15-19	1	0.355154	0.164785	0.823927	0.360896	0.984088
20-24	2	1.962534	0.416893	2.908396	2.044391	0.959959
25-29	3	3.954939	0.415077	4.983786	4.172219	0.947922
30-34	4	5.700421	0.359704	6.782309	6.087084	0.936478
35-39	5	7.008241	0.287087	8.217749	7.686949	0.911706
40-44	6	7.816608	0.145328	8.944392	8.62632	0.906134
45-49	7	8.063829	0.06117	9.250243	9.179027	0.878505

e.g. F(2)=Q(1)+a(2)f(2)+b(2)f(3)+c(2)Q(7)

=.823927+(3.321)*(.416893)+(-.754)*(.415077)

+(.0161)*(9.250243)

=2.044391

Full results are shown in Table 2.2 above.

To get a fertility schedule for conventional five year age groups, f(i), are estimated using weighting factors, w(i), in Table 2.1 in page 5 above as follows:

w(i)=x(i)+y(i)f(i)/Q(7)+z(i)f(i+1)/Q(7)

e.g. w(2)=x(2)+y(2)f(2)/Q(7)+z(2)f(3)/Q(7)

=(0.068) + (0.999)*(0.416893)/9.250243

+(0.114)*(0.415077)/9.250243

=0.102568

The other weighting factors are as follows:

w(1)=0.076878, w(3)=0.110707 w(4)=0.116775

w(5)=0.159537 w(6)=0.182109

There is no weighting for i=7 because childbearing is assumed to cease at age 50. And $f^+(i)$ is then calculated as follows:

$$f^+(i)=(1-w(i-1))f(i)+w(i)f(i+1)$$

e.g. $f^+(2)=(1-w(1))f(2)+w(2)f(3)$

=(1-.076878)*(0.416893)+(0.102568)*(0.415077)

=0.427417

The P/F ratios are obtained by dividing column (3) by column (6) and all the results are shown in column (7) of Table 2.2 . The values of P(2)/F(2) or P(3)/F(3) are then used as an adjustment factor, k, for period fertility rates. If they are not consistent an average of the two is used. And these are not consistent also, an average of all the P(i)/F(i) ratios are used. These may be shown as follows:

k1=P(2)/F(2)=1.962534/2.044391=0.959959

k2=P(3)/F(3)=3.954939/4.172219=0.947922

ka=(P(2)/F(2)+P(3)F(3)/2=.959959+.94 7922= 1.43392

kmean=(P(1)/F(1)+P(2)/F(2)+..+P(7)/F(7))/7=0.932113

Table 2.3 shows how different values of total fertility rates are derived using different adjustment factors.

Table 2.4
ADJUSTED FERTILITY RATES,KENYA, 1984 .

Age group (1)	Index i (2)	Adjusted fertility rates $f^*(i)=Kf+(i)$ K=P2/F2 (3)	K=P3/F3 (4)	K=Ka (5)	K=MEAN (6)
15-19	1	0.188954	0.186585	0.187769	0.183522
20-24	2	0.410303	0.405158	0.40773	0.398507
25-29	3	0.395816	0.390853	0.393334	0.384437
30-34	4	0.339256	0.335002	0.337129	0.329503
35-39	5	0.265667	0.262336	0.264001	0.258029
40-44	6	0.127946	0.126341	0.127144	0.124267
45-49	7	0.048027	0.047425	0.047726	0.046646
Total		1.775969	1.7537	1.764833	1.724911
TFR		8.879845	8.7685	8.824165	8.624555

Total fertility rate is obtained as :

$$TFR=5\sum[f^*(i)]$$

It is therefore clear from Table 2.4 that Kmean gives the lowest values for total fertility rates.

2.3 The Gompertz Relational Model For Fertility.

2.3.1 The Theory About The Model.

Brass (1978) sought to reduce the number of parameters determining the shape of age specific fertility from the three by the Coale-Trussell model to two by postulating a relational scheme and any other schedule.

The Gompertz relational model was designed for the evaluation and adjustment of fertility estimates obtained from retrospective reports of birth histories or features of birth histories. In the most significant applications the observations are subject to considerable error. The aim was therefore to construct a model sufficiently rigid to reveal error deviations but flexible enough to follow the real, significant features of the observations that is to fit good data well but bad data badly.

The principle used in the description of the model was to begin with a mathematical function representing fertility rates by age with as few parameters as possible. The accuracy of the representation was then improved by empirical transformation of the age scale. The mathematical function was chosen so that the model could be expressed linearly in terms of the unknown parameters. This property greatly simplifies the comparison of models with observations which is required for explanatory analysis.

The Gompertz Function is defined by

$$Y = A^{B^X} \qquad (7)$$

where A and B are positive constants.

Then

$$\log Y = B^X \log A$$

which implies

$$\log \log Y = X \log B + \log \log A \qquad (8)$$

Thus a Gompertz function can be linearly transformed by a log of any base.

The Gompertz relational model for fertility proposed by Brass can be written as follows:-

$$F(x) = T \exp[-\exp\{-(a+b\ Ys(x))\}] \qquad (9)$$

This implies

$$-\ln[-\ln\{F(x)/T\}] = a+bYs(x) \qquad (10)$$

F(x) = cumulated fertility upto age x

T = the total fertility rate

and

$$Ys(x) = -\ln[-\ln Fs(x)]$$

Fs(x) is the standard cumulated fertility upto age x with Ts = 1.0

We can also write

$$P(i) = T \exp[-\exp\{-a+bYs(i)\}] \qquad (11)$$

which implies

$$-\ln[-\ln\{P(i)/T\}] = a+bYs(i) \qquad (12)$$

In this case

P(i) = the average parity of the ith age-group

and

$$Ys(i) = -\ln[-\ln Ps(i)] \qquad (13)$$

with Ps(i) being the standard average parity in the ith age-group with Ts = 1.0

If T can be found accurately from the data, then a and b can be estimated very easily by examining the relationship between the values of

$$-\ln[-\ln F(x)/T]; \quad -\ln[-\ln P(i)/T]$$

and the corresponding Ys(x) and Ys(i) values.

However, with most retrospective data from developing countries it is difficult to determine T accurately. Estimates from series of F(x) values are often quite different from those based on series of P(i) values, and both series are seldom reliable at older ages due to biases in the reporting of births last year and children ever born by older women.

The method proposed by Basia Zaba (1981) avoids the problem of estimating T directly, by postulating a relationship between the ratios of successive F(x) values and successive P(i) values and the parameters a and b needed to define a suitable model fertility schedule.

If;

$$Z(x) = -\ln[-\ln \frac{F(x)}{F(x+5)}] \qquad (14)$$

$$= -\ln[-\ln \frac{T \exp\{-\exp[-(a+bYs(x))]\}}{T \exp\{-\exp[-(a+bYs(x+5)]\}}]$$

$$= -\ln[\ln \frac{\exp\{\exp[-(a+bYs(x))]\}}{\exp\{\exp[-(a+bYs(x+5))]\}}]$$

$$= -\ln[\exp\{-(a+bYs(x))\}-\exp\{-(a+bYs(x+5))\}$$

$$= -\ln\{\exp(-a)\}\{\exp[-bYs(x)]-\exp p[-bYs(x+5)]\}]$$

$$= a - \ln[\exp\{-bYs(x)\}-\exp\{-bYs(x+5)\}]$$

$$= a - Qx(b) \qquad (15)$$

where

$$Qx(b) = \ln[\exp\{-bYs(x)\} - \exp\{-bYs(x+5)\}] \qquad (16)$$

By Taylor's expansion around b = 1.0

$$Qx(b)=Qx(1)+(b-1)Q'x(1)+\frac{(b-1)^2}{2!}Q''x(1)+\ldots \qquad (17)$$

The primes denote differentiation with respect to b.

Thus substituting (17) into (15) we get

$$Z(x) = a - Qx(1) - (b-1)Q^{1}x(1) - \frac{(b-1)^2}{2!}Q''x(1)+\ldots$$

$$= a - Qx(1) - bQ'x(1) + Q'x(1) - \frac{(b-1)^2}{2!}Q''x(1)+\ldots$$

Thus

$$Z(x) - Q'x(1) + Qx(1) = a - bQ'x(1) - \frac{(b-1)^2}{2!}Q''x(1)+\ldots \qquad (18a)$$

i.e.,

$$Z(x) - e(x) = a + bg(x) - \frac{(b-1)^2}{2!} Q''x(1) + \ldots \qquad (18b)$$

where,

$$e(x) = Q'x(1) - Qx(1) \qquad (19)$$

and

$$g(x) = - Q'x(1)$$

Differentiating Qx(b) with respect to b given in (16) we get

$$Q'x(b) = \frac{-Ys(x)\ \exp[-bYs(x)] + Ys(x+5)\ \exp[-bYs(x+5)]}{\exp[-bYs(x)] - \exp[-bYs(x+5)]}$$

$$= [\exp(-Qx(b)][-Ys(x)\ \exp\{-bYs(x)\} + Ys(x+5)\exp\{-bYs(x+5)\}] \qquad (20)$$

and

$$Q''x(b) = [\exp(-Qx(b)][Y^2 s(x)\exp\{-bYs(x)\} - Y^2 s(x+5)\exp\{-bYs(x+\%\}]$$

$$[-Q'x(b)*\exp\{-Qx(b)\}][-Ys(x)\exp\{-bYs(x)\} + Ys(x+5)\exp\{-bYs(x+5)\}]$$

$$= -[Q'x(b)]^2 + [\exp\{-Qx(1)\}][Y^2 s(x)\exp\{-bYs(x)\} - Y^2 s(x+5)\exp\{-bYs(x+5)\}] \qquad (21)$$

Thus,

$$Q'x(1) = [\exp(-Qx(1)][-Ys(x)\exp\{-Ys(x)\}+Ys(x+5)\exp\{-Ys(x+5)\}]$$

and

$$Q''x(1) = -[Q'x(1)]^2 + [\exp(-Qx(1)][Y^2 s(x)\exp(-Ys(x)-Y^2 s(x+5)\exp\{-Ys(x+5)\}$$

Zaba found out that for different values of x in the range

$15 < X < 35$, $Q''x(1)$ is almost a constant 'c' say.

Therefore,

$$Z(x) - e(x) = a+bg(x) - \frac{(b-1)^2}{2} c$$

$$= [a- \frac{(b-1)^2}{2} c] + bg(x) \qquad (23)$$

That is, the relationship between $Z(x) - e(x)$ and $g(x)$ for varying x is linear having the slope b and intercept

$$a-\{c(b-1)^2\}/2$$

This relationship can be extended directly to the pari the average parities:

$$Z(i) = -\ln[-\ln \frac{P(i)}{P(i+1)}] \qquad (24)$$

and

$$Qi(b) = \ln[\exp\{-bYs(i)\}-\exp\{-bYs(i+1)\}] \qquad (25)$$

These imply,

$$Z(i) -e(i) = a+bg(i) -\frac{(b-1)^2}{2} Q''(1) +... \qquad (26)$$

where,

$$e(i) = Qi'(1) - Qi(1) \qquad (27)$$

and

$$g(i) = -Qi''(1)$$

Once more $Qi''(1)$ turns out to be a constant independent of the age-group i and equal to c. So

$$Z(i) - e(i) = [a - \frac{(b-1)^2}{2} c] + bg(i) \qquad (28)$$

T is estimated last in this method from each reliable F(x) and P(i) value in turn.

For the F(x) series,

$$T(x) = \frac{F(x)}{\exp[-\exp\{-(a+bYs(x))\}]}$$

For the P(i) series,

$$T(i) = \frac{P(i)}{\exp[-\exp\{-(a+bYs(i))\}]}$$

As the 'P' values are generally thought to give a better indication of fertility level than the F' values, it is reasonable to take

$$T = \frac{1}{j-k} \sum_{i=k} T(i)$$

i.e., the mean of the first string of plausible T(i) values. The ratio of mean T(i) to mean T(x) corresponds to the traditional P/F ratio; and gives an indication of the level of omission or exaggeration of births in the last year

Table 2.5:The Standard Fertility Schedule with half year shifts

Age	ASFR	cumulativ Fertility	-ln[-ln Fs(x)]				) Ys(x)
X	fs(x)	Fs(x)	Ys(x)	X	fs(x)	Fs(x)	
10	-	.00000	-	30	.04155	.60861	.70000
11	.00000	.00000	-3.17091	31	.03952	.65016	.84272
12	.00000	.00000	-2.74255	32	.03754	.68968	.99014
13	.00002	.00002	-2.36854	33	.03553	.72722	1.14407
14	.00043	.00045	-2.04079	34	.03343	.76275	1.30627
15	.00268	.00313	-1.75210	35	.03133	.79618	1.47872
16	.00855	.01168	-1.49286	36	.02912	.82751	1.66426
17	.01875	.03043	-1.25061	37	.02691	.85663	1.86597
18	.02783	.05826	-1.04479	38	.02462	.88354	2.08894
19	.03602	.09428	-0.85927	39	.02203	.90816	2.33992
20	.04156	.13584	-0.69130	40	.01906	.93019	2.62602
21	.04603	.18187	-0.38524	41	.01555	.94925	3.32873
22	.04806	.22993	-0.53325	42	.01218	.96480	3.32873
23	.04904	.27897	-0.24423	43	.00893	.97698	3.75984
24	.04932	.32829	-0.10783	44	.00597	.98591	4.26479
25	.04902	.37731	-0.02564	45	.00367	.99188	4.80970
26	.04866	.42597	-0.15853	46	.00227	.99555	5.41311
27	.04774	.47371	-0.29147	47	.00133	.99787	6.12864
28	.04642	.52013	-0.42515	48	.00067	.99715	7.07022
29	.04504	.56517	-0.56101	49	.00018	.99982	+009
	.04344			50		1.0	

Source: Brass (1971), Budapest, Table A1 pp. 357.

The Fs(x) values incorporate a half-year shift, so that they correspond exactly to cumulated fertility rates based on reported births in the last 12 months.

Table 2.6:The Standard Values For Cumulated Fertilities.

Age x	Qx(1)	$Q'x(1)$	$Q''x(1)$	e(x)	g(x)
19.5	1.4260	2.4020	-0.9093	0.9760	-2.4020
24.5	0.1137	1.4501	-0.9567	1.3364	-1.4501
29.5	-0.6755	0.7430	-0.9634	1.4185	-0.7930
34.5	-1.2596	0.0382	-0.9532	1.2978	-0.0382
39.5	-1.8026	-0.8356	-0.9076	0.9670	0.8356
44.5	-2.6158	-2.1649	-0.7193	0.4509	2.1649
49.5	-4.5027	-4.4564	-0.1874	0.0463	4.4564

Source: Brass (1971), Budapest, Table B pp. 360.

For x = 24.5, 29.5 and 34.5

mean

$$Q''x(1) = [-0.9567 - 0.9634 - 0.9532]/3 = -0.9578$$

$$= -0.96$$

For i = 2,3 and 4

mean

$$Q''i(1) = [-0.9524 - 0.9639 - 0.9598]/3 = -0.9587$$

$$= -0.96$$

Table 2.7:The Standard Values For Mean Parities.

Age Group	i	Qi(1)	$Qi'(1)$	$Qi''(1)$	e(i)	g(i)
15-19	1	1.5815	2.6447	-0.9243	1.0632	-2.6447
20-24	2	0.4541	1.7438	-0.9524	1.2897	-1.7438
25-29	3	-0.4095	1.0157	-0.9639	1.4252	-1.0157
30-34	4	-1.0371	0.3355	-0.9598	1.3726	-0.3355
35-39	5	-1.5812	-0.4391	-0.9356	1.1421	0.4391
40-44	6	-2.2178	-1.5117	-0.8399	0.7061	1.5117
45-49	7	-3.4869	-3.2105	-0.5761	0.2764	3.2105

Source: Brass (1971), Budapest, Table C pp. 360.

2.3.2 Application of the Model to the KCPS data at the National Level

Table 2.8 below shows the procedure followed in the fi

fitting in of Gompertz Relational model to the data on the reported parities, P(i), shown in Table 2.3, column 3, page 7, to estimate total fertility rate in Kenya in 1984.

Table 2.8 ESTIMATION OF TOTAL FERTILITY RATE BY FITTING THE RELATIONAL GOMPERTZ MODEL TO P(i) VALUES, KENYA,1984.

Age(X)	P(i)	P(i)/P(i+	Z(i)	Z(i)-e(i)	Y
15-19	0.355154	0.180967	-0.53616	-1.82586	3.183934
20-24	1.962534	0.496223	0.355632	-1.06956	1.086352
25-29	3.954939	0.693797	1.006281	-0.36621	0.12279
30-34	5.700421	0.813388	1.577227	0.435127	0.191064
35-39	7.008241	0.896583	2.2149	1.5088	2.280852
40-44	7.816608	0.969341			
45-49	8.063829			-1.3177	6.864992

Age(X)	b	Y^(i)	P^(i)	P(i)/P^(i)
15-19	1.025357	-1.13499	0.04455	7.972031
20-24	a	-0.34874	0.242372	8.097197
25-29	-0.02894	0.333831	0.488617	8.094149
30-34		1.054759	0.705903	8.07536
35-39		1.973992	0.870313	8.052552
40-44		3.470603	0.96938	8.063512
45-49		6.180314	0.997932	8.080539
Mean estimate of Total Fertility				8.062191

The computational procedure for getting the Z(1), Z(1)-e(i), Y^(1),P^(1) and TFR=P(1)/P^(1), and these are shown as follows:

$Z(i) = -\ln[-\ln\{P(1)/P(2)\}]$

$= -\ln[-\ln(0.180967)] \qquad = -0.53616$

$Z(1)-e(1) = (-0.53616-1.06332) \qquad = -1.82586$

$P\hat{}(1) = e^{-e^{-Y\hat{}(1)}} = e^{-e^{(-0.06907)}} \qquad = 0.044549$

$TFR(1) = P(1)/P\hat{}(1) = (0.180967/0.044549) = \qquad 7.972123$

NOTE:

The values of e(i)are given in Table 2.7, page 18.

Table 2.9 shows the fitting of the same model to the period fertility F(i), for women in Kenya in 1984.

Table 2.9ESTIMATION OF TOTAL FERTILITY RATE BY FITTING RELATIONAL GOMPERTZ MODEL TO f(i) VALUES,KENYA, 1984.

Age(X)	F(X)	F(X)/F(X+	Z(X)	Z(X)-e(X)	Y
15-19	0.823927	0.283292	-0.23212	-1.56852	2.27451
20-24	2.908396	0.583571	0.618802	-0.79959	0.594095
25-29	4.983786	0.734821	1.177238	-0.12056	0.004605
30-34	6.782309	0.825324	1.650368	0.683368	0.571022
35-39	8.217749	0.918759	2.468268	2.017368	4.367399
40-44	8.944392	0.966935			
45-49	9.250243			0.212066	7.811631

Age(X)	b	Y^(X)	F^(X)	F(X)/F^(X)
15-19	0.981833	-0.86581	0.092835	8.875176
20-24	a	-0.14888	0.313318	9.282569
25-29	-0.10863	0.509335	0.54832	9.089192
30-34		1.255823	0.752133	9.017433
35-39		2.320032	0.906403	9.06633
40-44		4.308047	0.98663	9.065599
45-49		9.063261	0.999884	9.251316
Mean estimate of Total Fertility				9.092516

The computational procedure are the same as for obtaining Z(1), Z(1)-e(1), Y^(1), F^(1) and TFR=F(1)/F^(1).

But TFR(1)=F(1)/F^(1)=0.823927/0.092832=8.875382

The mean estimate of total fertility rate using the F(i) values is 9.251314.

NOTE: From these estimations at the National level using the Gompertz Relational Model and other subsequent results that will be given, it is evident that the use of F(i) gives higher values than when using P(i). For this reason, P(i)s are considered more appropriate and discussions will be centered on these together with those derived from the Coale-Trussell P/F ratio method.

2.4 QUALITY OF DATA

It has always been observed that reported mean parities decline, (or fail to increase as expected) with age, for women over 40, even when there may be evidence to show that fertility in the recent past has not increased. This has been attributed mainly to the underreporting of children ever born by older women, especially when dead children and those that have left home have been omitted.

To detect some of these errors, Zaba (1981) has deviced a way of detecting some of these errors by plotting a graph of $Y_i + Q'_i - Q_i$ against Q' to indicate which parts of the parity information are consistent with the model fertility schedule of the Gompertz type. The same is done for cumulated fertility.

The gamma values when using mean parities are calculated as follows:

$$Y = -\ln(-\ln r) \text{ where } r = \frac{P(i)}{P(i+1)}$$

and P(i)s are mean parities as defined above.

The r values for KCPS sample as a whole are shown in column 3 of table 2.8 and the Y_is in column 4. The $Q'_i - Q_i$ and Q'_i are got from table B1 in appendix B. The $Y_i + Q'_i - Q_i$ values are shown in column 4 of table A1 of appendix B.

The gamma values when using cumulated fertility are calculated in the same way as for those for mean parities only that here $r = \frac{F(i)}{F(i+1)}$ and hence $Y_i = -\ln(-\ln r)$

The values of $Q'_i - Q_i$ and Q'_i are got from table B2 of the appendix B. For the whole KCPS sample $Y_i + Q'_i - Q_i$ has been shown in column 7 of table A1 of appendix A. The r values are shown in column 5 and Y values are shown in column 6. The graph representing $Y_i + Q'_i - Q_i$ against Q_i for the mean parities `P' and cumulated fertility `F' has been shown in appendix D for the whole sample and for some differentials at national level outlined in chapter 1.

The kind of patterns which might be observed after plotting the graph are described below. However only a few graphs are drawn to show the kind of errors that are most common.

The graphs in the appendix showing `P' and F' points shows that the common errors inherent in the data are the omission of children ever born by older women, age exaggeration and omission of current births by older women. For the whole sample, the major effect is on the omission of children ever born by older women and steep slopes of both points, suggesting a rising in fertility trends. When considering education alone it is found that reporting of parity for women with 1-4 years of education is the most inconsistent of all, but wowen with zero years of education report parity better than women with 9+

True Trend in Fertility	Type of Error Present in data	Effect on Plots of Y values
Constant	None	'F' point and 'P' points lie on the straight line.
Constant	Omission of children ever born by older women	'P' points curve upwards
Constant	Exaggeration of number of current births to older women	'F' points curve downwards at older ages
Constant	Age exaggeration	'P' and 'F' points both curve downwards at older ages
Falling	None	'P' line has gentler slope and lower intercept than 'F' line
Rising	None	'P' line has steeper slope and higher intercept than 'F' line

years of education. Women with 9+ years of education have been found to exaggerate their ages, especially the older women.

The errors among religious groups are most found among the protestant groups (other than catholics) and those with no religion. The protestants are most inconsistent in reporting current births which they tend to exaggerate. For the working status of women, those currently working are found to omit children ever born at older ages and even exaggerate their ages. The omissions for this sub-group are so large that the last 'P' point does not exist because $P_6 > P_7$. The women who had never worked also affect fertility reporting by omitting children ever born at older ages. The errors in the rest of the differentials are similar and can be seen by plotting graphs showing 'P' and 'F' points got by plotting $Y_i + Q'_i - Q_i$ against Q'_i from values given in appendix A.

2.5 LIMITATIONS OF THE GOMPERTZ RELATIONAL MODEL

One of the limitations of the Gompertz Relational model if the data is subject to alot of reporting errors as is evident from the results given in the next chapter, there is little that will be done to try to estimate trends. This has thus been left out.

The approximations also used in obtaining the estimating equations which do not work so well for the youngest (10-14) and oldest (45-49) age groups, especially if reported fertility distribution is radically different from the standard. Age groups 20-24 are considered the least affected by contaminating errors.

Therefore, the Gompertz Relational Model has the inherent ways of correcting some of the errors. And though the results by both methods will be given, those by Gompertz Relational Model should be considered more reliable.

2.6 Statistical Methodology.

A statistical multiple linear regression model has been used to analyse data at the macro and micro level. The standard multiple linear regression analysis helps to establish the relationship among several independent variables. In this study TFR and parity have been used as the dependent variables at the macro and micro levels respectively.

2.6.1 The Multiple Linear Regression Model

A standard multiple linear regression model is as given below:

$$Y = A + B_1 X_1 + B_2 X_2 + \ldots + B_k X_k + e_i$$

where

Y = the dependent variable and in this case it stands for the TFR and parity (TFR is for each district).

$X_1 \ldots X_k$ = the independent variables. And in this study they are 11 at macro and 13 at micro level.

$B_1 \ldots B_k$ = these are the regression coeficients.

e_i = error term (random error that is assumed to be normally distributed.

The number of cases is 29 at the macro level and 6581 at the micro level.

This model depends on several assumptions for it to be valid.

2.6.2 Assumptions And Use of the Present Model.

1. The dependent variable must not be dichotomous. But it can be in interval or ratio form.
2. The dependent variable must be a linear function of the explanatory (independent) variables.
3. There should be no reciprical from the dependent variable to the explanatory variables.
4. The dependent variable and the explanatory variables should be normally and randomly distributed.
5. The random error e_i is assumed to be uncorrelated with any of the independent variables. If the specific model violates this assumption it is bound to produce biased results on the estimates. The random errors are also assumed to have means of zero and constant variance; normally distributed and not correlated.

In linear regressions it is assumed that proportions predicted by a model lie between zero and one, but in practice there is no such guarantee and there may be extremes. In such case, a `logit' ( or `logit odds') scale and the associated logit linear regression models are more appropriate. However such non-linear models are not always available or may be very expensive for large data sets. For the present study linear models are used with some degree of confidence, because the overall mean of the response is close to one-half, and the means across the background variables rarely deviate outside the range 0.2 and 0.8 . With such scale the logit scale is nearly linear, and in practice the logit regressions will not differ greatly from the linear regressions. If there were a large number of means of less than 0.1 or more than 0.9, a more complex analysis may have been necessary. In this study a large number of variables was used and it was necessary to use computer facilities. The IBM package programme of the Statistical Package for Social Sciences (SPSS) by Nie et al (1975) has been used. This is the programme that produced the best linear relatioship for the independent variables.

In linear multiple regression analysis, values of the estimates of the regression weights and their standard errors are given. Hence the expected value of the dependent variable ($\hat{Y}$), can be obtained and the actual values gives us the multiple correlation coefficient, R. This is obtained through the relation:-

$$R^2 = 1 - \frac{\sum (Y_i - \hat{Y}_i)^2}{\sum (Y_i - \bar{Y})^2} = \frac{SSR}{SSY}$$

where R^2 is the coefficient of determination that shows the amount of variation in the dependent variable Y that is explained by the independent variable(s). The squareroot of this ratio is the pearson product moment correlation between

X and Y.

The standard error of estimate S_e, for a multiple linear regression model is defined as:-

$$S_e = \frac{\text{Unexplained variation}}{\text{Degrees of Freedom}} = \frac{SSE}{D.F.}$$

But in this case the number of the degrees of freedom equals the number of observations less the number of parameters to be estimated.

The multiple correlation coefficient (R) represents a single index measuring the strengths of the relationship between the dependent variable and the independent variables included in the model.

2.6.3 Testing of Statistical Significance

Tests assume that the underlying linear model is subject to the assumptions for the linear regression model given in the preceding subsection (2.6.2). It can however be stated with some confidence that none of these assumptions is satisfied completely. The issue however concerns the extent to which this negates the usefulnesss of statistical analysis, that is robustness of the tests. The above assumptions are plausible but the normality of the distribution of the error term is not necessarily critical for the size of the sample considered here.

Only one hypothesis test is employed in the present study. This is the F-test which is prefered to the t-test because the former can be generalised to include the latter as argued by Harnett (1975). The SPSS computer programme uses the F-test (Nie et al, 1975 : pp. 334-340). In the computation of the F, the following equation is utilized:

$$SST = SSR + SSE$$

where SST = total sum of squares,

SSR = squared sum of regressors, and it shows the sum of squares explained by the entire regression equation.

SSE = squared sum of errors (deviations).

then

$$F = \frac{SSR/k}{SSE/N-k-1} = \frac{R^2/k}{(1-R^2)/(N-k-1)}$$

where N = 29 (districts) at the macro level.

N = 6581, the whole KCPS sample at the micro level.

k = the number of regressors in the equation.

k, N-k-1 = degrees of freedom.

The F ratio is distributed approximately as the F distribution with degrees of freedom k and N-k-1.

In a multiple linear regression model, if the F value is equal to or exceeds the critical value of of F from the F distribution tables at a specified level of significance and at appropriate number of degrees of freedom, then the null $(H_0 = B_1 = B_2 = B_3 = \ldots = B_k = 0)$ is rejected and the alternative one adopted. If the F value falls short of the critical value of F ratio, the null hypothesis is not rejected i.e.

$$H_o = B_i = 0, \quad i = 1, 2, \ldots, k.$$

CHAPTER THREE

FERTILITY LEVELS AND DIFFERENTIALS AT NATIONAL LEVEL AND FERTILITY LEVELS AND TRENDS AT REGIONAL LEVEL.

3.0 Introduction

This chapter looks at the estimates of total fertility rate (TFR) for all the socio-economic and cultural variables defined in chapter one. All the differentials are at national level with data drawn from the KCPS, 1984. The differentials that are considered are: mother's educational level, religion, women's work status, polygamous status, contraceptive use, work status of husband, marital status and place of residence. The various categories of each differential have already been described in chapter one.

The fertility levels by the various differentials considered cannot be estimated at the provincial and district levels because of the small sample size of the KCPS. Therefore the differentials are only considered at the national level to give a general picture of fertility levels by various variables. The only variable considered for each district is the marital status of the women whose data has been drawn from the 1979 census and the results are given in chapter four.

Since this study relied most on the latest data available then, the change in fertility levels at the district and provincial levels have been considered between two periods: 1979 census results from Osiemo (1986) and results from the present study using the 1984 KCPS data. However, since the 1984 KCPS format is different from the 1979 census data, only areas covered by the former are compared. That is, the whole of North Eastern province, Samburu and Marsabit were left out while some districts are combined as done in the KCPS.

The demographic techniques that have been used are the Coale-Trussell P/F ratio method (henceforth referred to as CTM) and the Gompertz Relational model (henceforth referrered to as GRM). The computational procedures of the two methods are given in chapter two.

3.1 Fertility Differentials by Women's Education

The present results show that there is no great difference between those women with no education and those with 1-4 years of education. The TFR for women with no education 9.09 and 8.21 while those with 1-4 years is 9.2 and 7.79 as given by the CTM and the GRM respectively - see table 3.1 below. However, the two methods differ in pattern between the two educational categories. The CTM show that the fertility of those women with 1-4 years of education is slightly higher than the fertility of those with no education while with the GRM the pattern is the reverse. This may be due to the errors inherent in the KCPS data. In general it appears that the exposure of women up to four years of education is not enough to change their attitudes on fertility.

The TFR starts to decline after five years of education. The TFR for women with 5-8 years of education is

8.31 and 7.08 using the CTM and the GRM respectively. This is a percentage decline of 9.6 and 9.1 respectively from those with 1-4 years of education. Thereafter fertility declines more rapidily to 6.34 after 9 years of education (CTM) - a percentage decline of 23.8 %. However the decline with GRM is very small.

Table 3.1
Total Fertility Rates by the level of Education of Women.

Years of Education	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	: F(i)
None	9.096197	8.212953	9.841746
1-4 years	9.20149	7.793791	10.65133
5-8 years	8.314818	7.080577	9.630007
9+ years	6.335274	7.008787	7.966425

In general, though the fertility declines as the woman's education increases, the magnitudes of the differences are very small. This agrees with a study by the United Nations (United Nations, 1984: pp. 235) that the differences in fertility are greatest in countries that have had substantial fertility decline. The present results show that differences in fertility are greatest when women with no education are compared with those having 9+ years of education.

Table 3.12 show that women with no education decreased from 44.2% to 34.8% between 1977-78 and 1984 while those with 9+ years of education increased from 9.8% to 16.8% . It may thus be argued that more and more women are climbing to higher levels of education and Kenya may thus be cementing the pace for fertility decline in the near future.

Table 3.11
Per Cent Distribution of all Women by education Level, 1977-78 and 1984.

Education Level	1977-78 KFS All Women	1984 KCPS All Women
Unweighted No.	8,100	6,581
Total	100	100
None	44.2	34.8
1-4 years	18.4	16.1
5-8 years	27.4	32.1
9+ years	9.8	16.8
Not stated	0.2	0.2

Source: Central Bureau of Statistics, KCPS, First Report, 1984, Table 3.4.

3.2 Fertility Differentials by Religion.

The pattern of fertility when using the two methods of estimation differs between the catholics and the protestants. The CTM show that the fertility of the catholics is slightly higher than the fertility of the protestants. On the other hand the GRM show the opposite - see table 3.13. However, the differences between the catholics and the protestants are very small and both have TFRs above 8.0. A great difference in fertility appears only when the muslims are compared with the christians. The TFR for the muslims is 6.49 and 6.57 as given by the CTM and the GRM respectively. This is the lowest level of fertility for all the religious groups considered. Those with no religious affiliation fall between the christians and the muslims.

Table 3.12
Total Fertility Rates for all Women by Religion.

Religion	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	: F(i)
Catholics	8.954032	7.972924	9.052123
Protestants	8.699522	8.282569	9.291902
Muslims	6.492078	6.574507*	6.572476
No Religion	7.76379	7.854147	8.46987

* The TFR was calculated for the age groups 15-39 because mean parities, P(i)s, showed misreporting after age 40.

The low fertility for the muslims and the little difference between the catholics and the protestants was similarly found in Tanzania. In Kenya muslims are associated with less secular education and high levels of polygamy, the latter being associated with a high probability of childlessness (Henin, 1979). This may still be the case because table 3.13 show that in 1984 (KCPS), the muslims have the highest per cent childless (6.7%). The per cent childless for catholics and the protestants are almost similar (3.0 and 3.3

per cent respectively).

Table 3.13
Proportion Childless for all Women by Religion, KCPS, 1984.

Religion	Female Population	Per cent Childless
Catholics	2393	3.0
Protestants	3471	3.3
Muslims	244	6.7
No Religion	347	0

3.3 Fertility Differentials by Work Status of Women

Out of the total sample of 6581 women in the KCPS, 18.3% were working, 11.7% had worked in the past, while 70% had never worked. The differences in fertility using both methods show that women who had never worked had the highest fertility of 9.0 (CTM) and 8.1 (GRM). According to the CTM, women who were currently working had the lowest TFR of 7.59, followed by those who had worked in the past with 7.75, and finally that had never worked in the past having 8.1. The GRM however show women who had worked in the past as having the lowest fertility - see table 3.14 below.

The CTM gives an acceptable pattern of fertility because it is expected that women in employment should supress fertility because it introduces a high opportunity cost to the mother's time in childbearing. It would have been expected that women who had worked in the past to have lower fertility

Table 3.14
Total Fertility Rate by Work Status for all Women, 1984.

Work Status	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	: F(i)
Currently Working	7.585922	7.88493	7.637886
Worked in the past	7.747693	7.491149	10.01306
Never Worked	9.0023	8.100593	9.390289

than those currently working if the former would have worked up to the end of their childbearing period. But table 3.15 show that a majority of those who had worked in past had stopped working at early ages. It is therefore possible that these women would have been in casual employment which could not conflict alot with childbearing.

Table 3.15
Distribution of Women who had Worked in the Past by Age Group.

Age Group	Female Population	Percentage
15-19	102	12.9
20-24	186	23.5
25-29	160	20.2
30-34	148	18.7
35-39	86	10.9
40-44	56	7
45-49	54	6.8
Total	792	100

The high fertility for women who had never worked may be due to the fact that most of them reside in rural areas where fertility is high. Table 3.16 show that 72.6% of the women had never worked. This may be the reason for Kenya's persistent high fertility since most of these women are likely to be of low education.

Table 3.16
Per Cent Distribution of all Women aged 15-49 by Work Status and Place of Residence.

Work Status	Total	Nairobi/ Mombasa	Other Urban	Rural
Unweighted No.	6581	835	445	5301
Total	100	100	100	100
Currently Working	18.3	30.5	37.5	15.7
Worked in the Past	11.7	10.6	12.9	11.7
Never Worked	70	58.9	49.6	72.6

Source: Central Bureau of Statistics,KCPS, First Report, 1984, Table 3.11.

3.4 Fertility Differentials by Polygamy Status

There were 25% of the currently married women that were in polygamous unions. Their TFR is 8.35 while those in monogamous unions is 8.57 (CTM). The GRM gives 7.92 for those in polygamous unions and 8.19 for those in monogamous unions. Though the two methods are not consistent in their results, the difference between the two categories are small - see table 3.17.

A comparison with a previous study (Henin, 1979), show that gap between the groups is narrowing. This may be due to the fact the norms and virtues that used to govern polygamous unions are now being phased out. Table 3.18 also show that the proportion of women in such unions has decreased

Table 3.17
Total Fertility Rates by Polygamy Status for all Currently Married Women, 1984.

Polygamy Status	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	:	Gompertz Relational Model F(i)
Polygamous Union	8.351322	9.916014		8.133668
Monogamous Union	8.568295	8.188588		8.378444

between 1977-78 and 1984. And out of 25% of those in polygamous unions, only 11% have some secondary education and most reside in rural areas. Therefore even if the proportion of polygamy was to increase, no change will be expected with fertility because the gap between the two is now almost closing.

Table 3.18
Per Cent Distribution of Currently Married Women in a Polygamous Union by Age and Place of Residence.

	1977-78 KFS	1984, KCPS Total	1984, KCPS Nairobi/ Mombasa	1984, KCPS Other Urban	1984, KCPS Rural
Total	30	24.5	16.5	22.5	25.2
Age					
15-19	24	21.9	27.0	16.4	22.0
20-24	22	17.3	12.2	18.3	17.7
25-29	28	22.4	10.3	24.2	23.8
30-34	28	23.8	15.2	7.6	25.4
35-39	33	30.1	26.6	34.1	30.2
40-44	38	30.1	29.6	53.5	29.2
45-49	42	34.3	34.7	67.7	33.5

Source: Central Bureau Of Statistics, KCPS, First Report, 1984, Table 4.7.

3.5 Fertility Differentials by Contraceptive Use.

The data show that 29% of all the women and 33% of all the ever married women had used at least some contraceptive method. Though the KCPS First Report show that the rate of the ever users of contraception increased from 11% to 14%, their fertility is still high. The CTM gives the expected pattern of the differences in TFRs because the contraceptors have lower fertility than the non-contraceptors - see table 3.20.

Table 3.20
Total Fertility Rates by Contraceptive use of all women, 1984.

Contraceptive Use	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	: F(i)
Ever Use Any	8.427514	8.792008	9.579997
Ever Use None	8.67345	7.754796	9.039125

On average the fertility of the contraceptors is still high - thus corresponding with studies in other countries that contraception is only practiced to terminate childbearing rather than for birth spacing (Lecomte and Marcoux, 1976, pp. 182-187; Rizk, 1978, pp. 91-99).

3.6 Fertility Differentials by Place of Residence.

The results with the CTM gives the TFRs as 5.57 (metropolitan), 5.06 (other urban) and 9.0 (rural) areas in Kenya. The GRM gives 4.51, 5.62 and 8.15 for the metropolitan areas, other urban and rural areas respectively - see table 3.21. Though the results differ slightly with the methods, on average the fertility of the metropolitan areas is lower than the fertility of other urban areas. This agrees with another study that found out that countries like Ivory Coast, Sri Lanka, Kenya and Bangladesh show variations in fertility between major and other urban areas (Ashurst et al, 1984). However, the results show that the differences are small except when the rural areas are also considered. The lower fertility in the urban areas may be due to changes in attitudes brought about by higher levels of education, higher levels of women employment and the financial burden from children for services such as education, health and food which are quite expensive in urban areas.

Table 3.21
Total Fertility Rates by Place of Residence for all Women, 1984

Place of Residence	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	Gompertz Relational Model F(i)
Metropolitan Areas	5.570182	4.505474	6.409616
Other Urban Areas	5.057194	5.619071	6.837887
Rural Areas	8.995614	8.148674	9.411305

3.7 Fertility Differentials by Working Status of the Husband.

Table 3.22 show that about a third of the husbands of the currently married women are not working and the percent is highest in rural areas (34%). Most husbands that work are employed in other people's business (31%) in 1984.

Table 3.22
Per Cent Distribution of currently Married Women 15-49 by Work Status of Husband and Place of Residence, 1984.

Work Status of Husband	Total	Nairobi/ Mombasa	Other Urban	Rural
Total	100	100	100	100
Own Farm	19.3	2.0	8.4	21.3
Other Farm	10.7	6.2	10.5	11.1
Own Business	8.2	15.1	16.0	7.2
Other Business	30.6	70.9	50.0	26.3
Not Working	31.0	5.8	15.0	34.0
Not Stated	0.1	0.0	0.0	0.1

Source: Central Bureau of Statistics, KCPS, First Report, 1984, Table 3.14

This classification of the working status of the husband cannot be used as a proxy for the socio-economic status of the family because the income cannot be adduced. This could be the main reason for lack of any consistent pattern in TFRs - see Table 3.23. The CTM gives a TFR of 7.7 for those working in other farms as the lowest while the GRM the lowest for those working in their own businesses (5.54). However both methods give those not working as having the highest fertility - that is above 8.0.

Table 3.23
Total Fertility Rates by Work Status of Husband for all Currently Married Women, 1984.

Work Status	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	: F(i)
Own Farm	8.481992	7.596636	10.8377
Other Farm	7.715859	8.230337	11.12081
Own Business	8.715859	5.538697	11.39330
Other Business	8.030315	8.348398	10.23345
Not Working	9.158967	8.436988	12.01715

* The TFR was calculated for age groups 15-39 because mean parities, P(i)s, showed that there was misreporting after age 40.

3.8 Fertility Differentials by Marital Status

In the 1984 KCPs, one out of every four (25.5%) respondents are single; about two thirds are currently married while the rest are either divorced, separated or widowed. The fertility of the single women is the lowest at 4.97 (CTM) and 4.82 (GRM). They are followed by the separated women who have 6.5 and 6.53 using the CTM and the GRM respectively. The fertility of the separated and the widowed women are almost similar with the CTM. The highest fertility is by those that currently married who have a mean TFR of 8.49 and 8.19 using the CTM and GRM respectively.

In general, it can be seen that women in unstable unions (divorced, separated and widowed) have lower fertility than those in stable marriages. Fertility is low in unstable unions due to the time wasted without coition. However, the differences in fertility between those in unstable unions is very small especially when the CTM is used.

Table 3.24
Total Fertility Rates by Marital Status of all Women, 1984.

Marital Status	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	: F(i)
Single	4.965618	4.809335	4.856636
Married	8.487581	8.188069	11.12207
Divorced	7.432386	7.933118	8.945574
Separated	6.495865	6.526423 **	12.22214
Widowed	6.749682	9.164567	10.28176

** In calculating TFR age groups 30-34 were omitted because they were faulty as was shown by the mean parities.

3.9 Fertility Differentials by Ethnicity for all Women.

Ethnicity is a very important factor in fertility analysis because it may be related to the socio-economic status of the community. It is also a cultural factor that is likely to affect decisions about conception because in the African society children belong to the lineage rather than the parents only. And since tribal affiliation helps in establishing marriage patterns, sensitivity to change and job opportunities (especially land), an analysis of fertility differentials would be incomplete if it is not considered (Anker an Knowles, 1982). Table 3.25 below show the TFRs for the nine ethnic groups.

Table 3.25
Total Fertility Rates by Ethnicity for all Women, 1984.

Ethnic Group	Coale-Trussell P/F Ratio	Gompertz Relational Model P(i)	F(i)
Kikuyu	8.081006	7.806341	9.12659
Luo	8.736066	7.261923	9.913094
Luhya	9.390962	8.83187	8.9973
Kamba	9.370098	7.777814	9.666639
Kisii	9.357877	9.966059	8.066318
Meru-Embu	9.562079	8.167507	8.167636
Mijikenda	7.385107	6.467315	7.834881
Kalenjin	9.279335	8.703717	9.104557
Others	7.101726	-	8.283708

Table 3.25 show that when using the CTM, the Meru - Embu have got the highest fertility of 9.6. But with the GRM, Kisii have got the highest fertility of about 10.0. The CTM show that the Kisii, Luhya and the Kalenjin have TFRs that are very close to that of the Meru-Embu. The GRM give almost a similar pattern. The lowest fertility is found among the Mijikenda with a TFR of 7.39 (CTM) and 6.47 (GRM). This agrees with another study that found the Mijikenda to have lower fertility due to their long birth and breastfeeding periods (Mosley et al, 1982).

The Luhya and the Kisii show fertility levels that are very high. This is expected since the two ethnic groups reside in the Lake Basin that has been known for high fertility (Mwobobia, 1982). Table 3.26 and 3.27 also show that the two ethnic groups have almost the same proportions of women that are currently married in polygamous unions and those never marrying between age 15 to 19 respectively. Table 3.26 show that 78.6% of the Luhya and 76.1% of the Kisii had never married by age 15-19. Table 3.27 show that 27.7% of the Luhya and 25.5% of the Kisii were currently in polygamous unions. The Kamba who have slightly lesser proportions in such unions (15.2%) but almost similar proportions of those never married by age 15-19 have a TFR of 9.37 (CTM) and 7.78 (GRM). And on average the fertility of the Kamba is less than that of the Kisii and Luhya. Therefore, cultural factors alone may not fully explain the fertility differentials, but the ecology of the place matters. The ecology determines the availability of food and the prevalence of diseases. The kamba live in a semi arid-area where food is scarce.

The Kikuyu and the Luo have TFRs that are almost similar but are slightly lower than those of the Luhya and the Kisii though the Luos come from the Lake Basin as the other two groups. The lower fertility for the Luo in relation to the Kisii and the Luhya may be due to the high proportion of women in polygamous unions (40.4%), the highest of all but almost similar to the Mijikenda (39.2%).

Table 3.26
Per Cent Distribution of Women 15-19 and 20-24 who have never Married by Ethnicity.

	Age	
Ethnic Group	15-19	20-24
Total	73.8	23.5
Kikuyu	91.9	36.7
Luo	41.9	14.4
Luhya	78.6	25.5
Kamba	77.2	17.7
Kisii	76.1	31.4
Meru-Embu	87.1	37.7
Mijikenda	58.3	11.3
Kalenjin	57.9	15.5
Others	56.7	9.9

Source: Central Bureau Of Statistics, KCPS, First Report, Table 4.6.

Table 3.27
Per Cent of Currently Married Women in a Polygamous Union by Ethnic Group, 1984.

Ethnic Group	Total
Total	24.5
Kikuyu	10.3
Luo	40.4
Luhya	27.7
Kamba	15.2
Kisii	25.5
Meru-Embu	13.9
Mijikenda	39.2
Kalenjin	23.4
Others	33.9

Source: Central Bureau Of Statistics, KCPS, First Report, Table

Though the Luo and the Kikuyu show TFRs that are not very different, the proportions of those in polygamous unions and the age at marriage are rather different. Whereas only 10.3% of the Kikuyu women are in polygamous unions, about 40.4% of the Luo women are in such unions. And whereas 91.9% of the Kikuyu never marry by age 15-19, only 41.9% of the Luo are in such category. Therefore, it is possible that monogamy plays a great role among the Kikuyu to keep fertility high although they marry late, while early marriage among the Luo which would have kept fertility much higher is depressed by the prevalence of polygamy.

The relatively high fertility among the Kalenjin would be explained by their early age at marriage (42.1% get married by age 15-19). The Kalenjin also share some socio-economic and ecological aspects as the people at the Lake Basin especially those favouring agricultural productivity.

In general, it can be said that a part from the Mijikenda at the Coast, the differences in TFRs are very small. The differences are well explained not by socio-economic factors alone, but also ecological fators, the latter which are responsible for the kind of diet, economic and health conditions of the people.

3.10.0 FERTILITY LEVELS AND TRENDS AT PROVINCIAL AND DISTRICT LEVELS 1979 AND 1984.

3.10.1 Fertility Levels and Trends in Nairobi.

Nairobi is the capital city of Kenya. Both methods of estimation show that TFR in 1984 was 5.97. Osiemo (1986) found the TFR for Nairobi to be 4.86 (CTM) and 6.67 (GRM). On average the TFR in 1979 was 5.77. Therefore fertility in Nairobi increased only marginally or infact remained constant. This may be due to the high level of education and female employment. In 1984, female literacy level in Nairobi was 87.8%, and had also the largest population that was currently working in Kenya (32.9%).

3.10.2 Fertility Levels and Trends in Central Province

Table 3.28 below show that there has been a general decrease in fertility levels in Central province at provincial and district level. The only exception is Kirinyaga district which show an upward trend with both methods. Kiambu district show a marginal increase with the GRM. Nyeri district show the largest decline in fertility to levels below 7.0 in TFRs, the lowest in the whole of Central province.

Nyeri district which show the lowest TFR has the highest level of female literacy of about 88.2%, the highest in Kenya, and Kirinyaga with relatively high fertility has 71.7%, the least in Central province (KCPS Report, 1986). The high levels of female literacy in Central province may explain the fertility decline in Central province.

Table 3.28
Total Fertility Rates in Central Province, 1979 and 1984.

	Coale-Trussell P/F Ratio Method		Gompertz Relational Model (with P(i)s)	
	1979	1984	1979	1984
Central Province	8.47	7.86	7.5	7.22
Kiambu	8.16	7.15	7.55	7.9
Kirinyaga	8.7	9.08	7.38	9.06
Muranga	8.5	7.78	7.52	7.44
Nyandarua	9.47	8.92	8.17	6.9
Nyeri	8.16	6.88	7.14	6.23

3.10.3 Fertility Levels and Trends in Coast Province.

Coast province, characterised by its islamic influence has a large muslim population. Table 3.29 show that for the province as a whole, fertility rose only marginally (by less than 0.2 TFR) between 1979 and 1984 with both methods. Highest increases in TFRs are recorded for Taita-Taveta district and despite its highest TFRs, it is one of the districts with the lowest early childhood mortality (Kibet, 1981).

On the other hand Kwale show the highest decreases in TFR from 7.33 to 5.73 (CTM), and 6.18 to 5.37 (GRM) between 1979 and 1984 respectively. Mombasa has the lowest levels of fertility. It may be argued that the generally low levels of fertility may be due to underreporting of births since early childhood mortality range from 120 per 1000 in Taita Taveta to over 200 per 1000 in Kilifi and Lamu (Kibet, 1981). In 1984, female literacy levels were low except for Mombasa with 75 per 1000. The province has also relatively high proportions of polygamy and childlessness (Henin, 1979). It is therefore possible that fertility may increase as these conditions are removed.

Table 3.29
Total Fertility Rates in Coast Province, 1979 and 1984.

	Coale-Trussell P/F Ratio Method		Gompertz Relational Model (with P(i)s)	
	1979	1984	1979	1984
Coast Province	7.1	7.23	6.02	6.22
Kilifi *	7.6	7.39	6.44	7.02
Kwale	7.33	5.73	6.18	5.37
Mombasa	5.66	6.25	4.77	4.45
Taita-Taveta	8.06	9.49	7.33	8.45

* The TFRs for Kilifi, Lamu and Tana River are added to average so that it can be comparable with the 1984 KCP

3.10.4 Fertility Levels, Trends and in Eastern Province

The CTM show that TFRs in 1979 were above 8.0. In 1984, fertility has risen to very high levels. Table 3.30 show that the TFR in 1984 is 10.52 in Meru; 9.97 in Kitui; and 8.62 both Machakos and Embu. For the province as a whole, fertility increased from 8.29 to 9.01. According to this method it may be said that fertility is very high in Eastern province and has been rising between 1979 and 1984.

The GRM show similar increases in TFRs, the highest increase being in Kitui from 6.36 to 8.27, followed by Embu which increased from 7.38 to 8.07 between 1979 and 1984 respectively. The province as a whole records an increase of 1.04 in TFRs between the same period of time. Though the 1979 values are medium in magnitude, the 1984 rates shows that fertility is high in Eastern province. Therefore, though literacy levels were found to be high in this province especially Embu (76%) and Machakos (77.7%) (KCPS, 1984), this has had no much impact on the fertility of the area.

Table 3.30
Total Fertility Rates in Eastern Province, 1979 and 1984.

	Coale-Trussell P/F Ratio Method		Gompertz Relational Model (with P(i)s)	
	1979	1984	1979	1984
Eastern Province	8.29	9.01	6.82	7.86
Embu	8.93	8.62	7.38	8.07
Kitui	8.1	9.97	6.36	8.27
Machakos	8.58	8.62	7.21	7.54
Meru	8.13	10.52	6.72	7.94

3.10.5 Fertility Levels and Trends in Nyanza and Western Provinces.

Table 3.31 show that as expected, the fertility rates are concentrated in the range of 8.0 and above. The CTM show that in both 1979 and 1984, Kisii district has the highest TFR of 10.0 and 10.19 respectively. Kisii is followed by Kakamega which had 9.07 in 1979 and 10.43 in 1984. The districts with the lowest TFRs are Siaya and Kisumu, then Busia. Four districts (Kisumu, Siaya, Bungoma and Busia) showed a downward trend between 1979 and 1984. The three remaining districts showed an upward trend in fertility with Nyanza province increasing from 8.69 to 9.66 between 1979 and 1984. Kisii district, which has the highest TFR is a high potential agricultural area while Siaya with the lowest TFR is among the low agricultural productivity areas. Therefore, agricultural productivity could well explain some of the fertility differentials in the Lake Region. However, this cannot explain the high fertility in South Nyanza because the latter is poor agriculturally. The high fertility in South Nyanza may be due to high mortality rate (Kibet, 1981).

Table 3.31
Total Fertility Rates in Nyanza and Western Provinces, 1979 and 1984.

	Coale-Trussell P/F Ratio Method		Gompertz Relational Model (with P(i)s)	
	1979	1984	1979	1984
Nyanza Province	8.69	8.93	7.79	8.47
Kisii	10.03	10.19	9.09	9.04
Kisumu	8.1	7.4	7.76	8.22
Siaya	7.83	7.46	7.13	9.97
South Nyanza	8.5	9.75	7.9	9.64
Western Province	8.96	9.66	8.6	9.22
Bungoma	9.42	8.88	9.1	10.65
Busia	8.07	7.69	7.62	7
Kakamega	9.07	10.43	8.73	9.23

The GRM also show that a part from Kisii which show al almost no change and Busia which show a decline in fertility, all districts show an upward trend in fertility. However, this method show that Bungoma has the highest fertility and then Kisii. In 1979, Siaya had the lowest level of fertility (7.13) and in 1984, Busia had the lowest level of fertility (7.0).

3.10.6 Fertility Levels and Trends in Rift Valley.

Table 3.32 show that when using the CTM, the fertility levels are quite high both in 1979 and 1984. In 1979, only Baringo has a TFR of less than 8.0. Trans-Nzoia and Kericho had the highest TFRs of 9.32 and 9.11 respectively. The same method show that between 1979 and 1984, fertility increased for the majority of the districts except for Narok - Kajiado and Trans-Nzoia which show a decline. The drastic declines in fertility shown by Narok (8.1 to 5.63) may be due to the combining of the two districts into one. Table 3.32 also show that whereas only two districts had fertility above 9.0 in 1979, in 1984 six districts had TFRs of above 9.0, and only three have TFRs below 9.0. In 1984 also, Nandi and Uasin-Gishu had TFRs of above 10.5 - see table 3.32 below.

The GRM gives equally high values for 1979 but relatively low values for 1984 except for Kericho (10.54), Baringo (10.82) and Uasin-Gishu (10.98). The rest of the districts show TFRs of less than 7.0, which are: West Pokot (6.9), and Narok-Kajiado (6.25). The rest are above 7.0 in TFRs.

Table 3.32
Total Fertility Rates for Rift Valley Province, 1979 and 1984.

	Coale-Trussell P/F Ratio Method		Gompertz Relational Model (with P(i)s)	
	1979	1984	1979	1984
Rift Valley	8.48	9.02	7.36	7.86
Kericho	9.11	9.52	8.23	10.54
Nakuru	8.85	8.91	7.86	6.4
Nandi	8.57	10.74	7.36	6.79
Narok-Kajiado	8.01	5.63	6.25	6.16
Baringo*	7.09	9.24	8.68	10.82
Trans-Nzoia	9.32	7.65	8.58	5.68
Uasin-Gishu	8.66	10.99	7.24	10.98
West Pokot**	8	9.73	6.9	6.47

* Baringo and Laikipia are combined as done in the KCPS.

** West Pokot has also been combined with Elgeyo Marakwet as in the KCPS.

It can therefore be seen that the fertility levels are rising. Though the GRM show some decline between 1979 and 1984, this is neutralised by some districts with very high TFRs as in Kericho, Baringo and Uasin Gishu. The high fertility in Rift Valley may be attributed to the high childhood mortality that range from 80 per 1000 in Laikipia to 190 per 1000 in West Pokot (Kibet, 1981). The low levels of female literacy may be another. The KCPS second report shows that about 40% of the women in Rift Valley are illiterate but are reducing fast for each district. Given that the province is now experiencing increased socio-economic development and ethnic heterogeinity, fertility may start to decline in the near future.

3.10.7 Classification of Fertility Levels for 1984 into Low, Medium, High and Very High.

Low	TFR<6	High	7<TFR<8
Medium	6<TFR<7	Very High	8<TFR

COALE_TRUSSELL METHOD RESULTS

LOW	
Nairobi	5.97
Kwale	5.73
Narok-Kajiado	5.63

MEDIUM	
Nyeri	6.88
Mombasa	6.25

HIGH	
Kiambu	7.15
Muranga	7.78
Kilifi	7.39
Kisumu	7.4
Siaya	7.46
Trans-Nzoia	7.65
Busia	7.69

VERY HIGH	
Kirinyaga	9.08
Nyandarua	8.92
Taita-Taveta	9.49
Embu	8.62
Kitui	9.97
Machakos	8.62
Meru	10.52
Kisii	10.19
S.Nyanza	9.75
Kericho	9.52
Nakuru	8.91
Nandi	10.74
Baringo	9.24
Uasin Gishu	10.99
West Pokot	9.73
Bungoma	8.88
Kakamega	10.43

GOMPERTZ RELATIONAL MODEL RESULTS.

LOW	
Nairobi	5.97
Kwale	5.36
Mombasa	4.45
Trans-Nzoia	5.68

MEDIUM	
Nyandarua	6.9
Nyeri	6.23
Nakuru	6.4
Nandi	6.79
Narok-Kajiado	6.16
West Pokot	6.47

HIGH		VERY HIGH	
Kiambu	7.9	Kirinyaga	9.06
Muranga	7.44	Taita Taveta	8.45
Kilifi	7.02	Embu	8.07
Machakos	7.54	Kitui	8.27
Meru	7.94	Kisii	9.04
Busia	7	Kisumu	8.22
		Siaya	9.97
		S. Nyanza	9.64
		Kericho	10.54
		Baringo	10.62
		Uasin Gishu	10.98
		Bungoma	10.65
		Kakamega	9.23

It has to be noted that the figures for TFRs presented here differ from those given in the First Report of the KCPS. This is mainly due to the methodologies used. The results summarised above for the GRM show that Nairobi, Mombasa, Kwale and Trans-Nzoia have fertility rates classified as 'low'. Nyandarua, Nyeri, Nakuru, Nandi, Narok-Kajiado and West Pokot all fall in the 'medium' category. Two of these are from Central Province while the rest are from Rift Valley Province. Any substancial fertility reduction in Kenya should at first aim at achieving these levels for most of the districts. Only six districts are in the 'high' category. Most of the districts are in the 'very high' category, showing the high general fertility rate for Kenya as a whole. The same applies to those results by the CTM.

3.11 SUMMARY

The fertility levels by the various regions in Kenya shows that total fertility rates in Kenya are still high and the differences between regions persist. The differences range from as low as below six (Mombasa, Kwale, and Nairobi) to high as above ten (Meru, Kisii, Nandi, Uasin Gishu, Kericho and Bungoma). The results suggest that fertility is lower in urban areas than in rural areas because the estimates of TFR for Nairobi and Mombasa (the two major urban centres and the two that are 100% urban districts) are considerably lower than for the sorrounding rural areas (central province and coast province respectively).

Districts in Central province show some fertility decline except for Kirinyaga between 1979 and 1984 (CTM). In general, the CTM show that 16 out 29 districts that are analysed show increases in fertility with most ofthem being in Rift Valley, Nyanza and Eastern provinces. The GRM show that 13 districts show increases in fertility and the rest show declines.

The analysis of differentials at national level show there are differences in fertility levels between and within the socio-economic diffrentials considered. The fertility of women with zero years of education is not very different from the fertility of women with 1-4 years of education (all have the TFRs of above 8.0). Although fertility is observed to start declining after 5-8 yaers of education, a major decline starts only after 9 years of education and over when the TFRs reach 7.0 and below. For religion, not much difference is observed between the catholics and the protestants, but there is a big difference between the two groups and the muslims. The Muslims have a TFR of about 6.5 while the Others have about 8.0 and above. Those with no religion fall in between the two groups.

The working status of women show that women who had never worked have the highest fertility and those currently working have the lowest. Both women in polygamous unions and in monogamous unions show TFRs of 8.1 and above and no big gap between the two. The same applies to the users and non users of contraceptives where the gap is equally small. Place of residence shows that rural areas have the highest fertility but there is no major difference between the major and other urban areas in fertility.

The differential of marital status show that the single women have the lowest fertility of below 5.0 while the married women have the highest of 8.0 and above. The divorced, separated and widowed show TFRs of between 6.5 and 7.9. The working status of the husband not clearly defined as to show clear differences in fertility. As for ethnicity, it is observed that the Mijikenda have the lowest TFR. There are no much diffrences between the other ethnic groups.

CHAPTER FOUR

MARITAL FERTILITY DIFFERENTIALS BY DISTRICTS IN KENYA.

4.0 Introduction

It has been noted in chapter one that data for various differentials at district level from the KCPS was not available because of the small sample size of the KCPS. Therefore data from the 1979 census by marital status has been incorporated to see how the various districts in Kenya vary in TFRs. In this chapter all the 41 districts are analysed. The estimation of TFRs are done using the Coale-Trussell P/F ratio method (CTM) and the Gompertz Relational model (GRM). The computational procedures of the two methods are shown in chapter two.

4.1 Marital Fertility Levels for Nairobi.

The CTM show that the widowed women have the highest TFR of 6.59, followed by the married women with 6.05 and finally the divorced/separated women with 5.0. However the GRM show that the married women have the highest TFR of 5.72, followed by the widowed (5.51) and the divorced/separated with 4.66. In general, there is no much difference between the fertility of the married women and the widowed but a big a difference exists between these two groups and the divorced/separated women - see table 4.1 below.

Table 4.1
Total Fertility Rates by Marital Status for Nairobi, 1979.

Marital Status	Coale-Trussell P/F Ratio	Gompertz R. Model with P(i)s
Married	6.05	5.72
Widowed	6.59	5.51
Divorced/separated	5	4.66

4.2 Fertility Levels by Marital Status for districts in Central Province.

Table 4.2 show that the married women have got the highest fertility in Central province. In all the districts, the CTM show that married women have a TFR of above 8.0. Even Nyeri district which has been known for low levels of fertility has a TFR of 8.0 for the married women. Nyandarua district has got the highest TFR of 9.1 which is nearly close to the TFR for the district as a whole (see table 3.28).

The GRM also show the married women with the highest TFRs of all the marital categories. The highest TFR for the married women is still in Nyandarua district with 8.6, followed by Kiambu district which has got 8.03 while the lowest is in Nyeri with 7.54. Kirinyaga and Muranga districts have 7.78 and 7.86 in TFRs respectively - see table 4.2 below.

As for the widowed women, the CTM show that Kiambu district has the highest of 10.15, followed by Muranga with 9.43, then Kirinyaga district with 7.46 and Nyandarua with 7.23 as the lowest.

Table 4.2
Total Fertility Rates by Marital Status by Districts in Central Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Kiambu	8.07	8.03	10.15	6.65	6.11	5.93
Kirinyaga	8.37	7.78	7.46	7.28	5.5	5.7
Muranga	8.25	7.86	9.43	6	4.9	6.65
Nyandarua	9.1	8.6	7.23	7.07	6.43	-
Nyeri	8	7.54	7.84	6.6	5.62	5.39

Table 4.2 show that the fertility of the widowed differs greatly for the two methods for Kiambu district (10.15 with CTM and 6.65 with GRM). The widowed women in Muranga have got the lowest TFR of 6.0 in the whole of Central province as given by the the CTM.

Of all the three categories of marital status, the divorced/separated women have the lowest fertility while the married women have the highest fertility.

4.3 Fertility Levels by Marital Status for districts in Coast province.

The fertility of the married women in Coast province is relatively lower than the fertility of the married women in Central province. Table 4.3 show that Mombasa has the lowest fertility of 5.65 for the married women using the GRM. Kilifi, Kwale and Lamu have TFRs of 6.19, 6.75 and 6.93 respectively.

Only two districts have TFRs of above 7.0. These are Tana River (7.47) and Taita-Taveta (7.81).

The general pattern from table 4.3 is that the fertility of the widowed women is lower than the fertility of the married women. The CTM show that Mombasa has the lowest TFR of 4.94 and Tana River has the highest TFR of 7.64. The GRM show almost a similar pattern for the widowed with Mombasa mantaining consistently the lowest TFR of 4.07 and only Tana River and Taita-Taveta have TFRs of just above 6.0. The fertility of the divorced/separated is the lowest in Coast province. Most of the estimates are below 6.0 and Mombasa has TFR as low as 4.22 (CTM) - see table 4.3.

Table 4.3
Total Fertility Rates by Marital Status by Districts in Coast Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Kilifi	7.4	6.19	6.55	5.12	4.8	4.01
Kwale	7.46	6.75	6.81	5.56	5.14	4.12
Mombasa	6.09	5.65	4.94	4.07	4.22	5.66
Lamu	7.37	6.93	5.2	5.51	-	-
T. River	7.88	7.47	7.64	6.08	6.81	6.43
Ta-Taveta	8.19	7.81	6.76	6.35	5.56	5.23

4.4 Fertility Levels by Marital Status for districts in Eastern province.

The CTM show that except for Isiolo and Marsabit districts, there is very little difference between the fertility of the married women and the fertility of the widowed women. Except for the two districts, mentioned, all others have got TFRs that range from 8.06 to 8.59 for both married and the widowed. Isiolo has a TFR of 6.75 for the married and 5.44 for the widowed while Marsabit has 6.25 for the married and 5.6 for the widowed. Table 4.4 show that these two districts have consistently lower levels of fertility for the three categories considered and for both methods of estimation. Osiemo, (1986) found that these two districts had the the lowest TFR of 6.5 while the others had above 8.0. This may explain the consistently low levels in the two districts compared with the others.

Table 4.4
Total Fertility Rates by Marital Status by Districts in Eastern Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Embu	8.52	7.74	8.47	6.47	6.13	5.68
Kitui	8.06	6.79	8.1	8.56	5.93	4.55
Machakos	8.28	7.5	8.59	6.56	6.58	5.03
Meru	8.15	7.03	8.42	5.63	5.89	-
Isiolo	6.75	6.56	5.44	5.21	4.91	4.62
Marsabit	6.25	5.8	5.6	5.12	5.08	4.6

Though the GRM show that the estimates for the married and the widowed are lower than those by the CTM, there is some difference between the married and the widowed. The fertility for the married women in Embu is 7.74 while it is 6.47 for the widowed. Meru has 7.03 for the married and 5.63 for the widowed. The same pattern applies to all other districts except for Kitui whose TFR for the married is 6.79 while that for the widowed women is 8.56. The GRM further show that the highest level of fertility for the married women is in Embu district with 7.74 and lowest in Marsabit with 5.8.

In general, the fertility of the divorced/separated is the lowest and that of the married is the highest - just as many of the districts analysed - with the exception of Kitui which show the widowed to have the highest TFR.

4.5 Fertility Levels by Marital Status for Districts in Nyanza Province.

Nyanza districts are among those with the highest fertility rates in Kenya (see Table 3.31). The fertility rates by marital status are also generally high. For the married women, the CTM show that all the districts except Siaya have TFRs that are above 8.0. The highest is in Kisii district with a TFR of 9.92. In both 1979 and 1984, the TFR for the district as a whole stood at just above 10.0 (see table 3.31). Siaya, which in 1979 had a TFR of 7.83 and 7.46 in

1984 has a TFR of 7.76 for the married women. The results for the married women in Nyanza show that there is a close correspondence between the TFRs for the districts and the TFRs for the married women in the respective districts.

The GRM gives almost similar levels for the married women as those given by the CTM. The highest in TFR is Kisii with 9.23 and the lowest is still Siaya with 7.23. South Nyanza has a TFR of 8.02 and Kisumu has a TFR of 7.86.

The CTM further show that there is little difference between the fertility of the widowed women and that of the married women. In fact South Nyanza has the same TFR of 8.38 for both categories. Kisii which still has the highest TFR of 9.44 and Siaya with 7.38 has still the lowest. It is only the GRM that show a large difference between the married and the widowed women. The TFR in Kisii reduces from 9.44 to 8.42; Siaya reduces from 7.86 to 7.33 and South Nyanza reduces from 8.02 to 7.21 as shown in table 4.5 below.

Table 4.5
Total Fertility Rates by Marital Status by Districts in Nyanza Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Kisii	9.92	9.23	9.44	8.42	7.59	7.83
Kisumu	8.12	7.86	8.32	7.22	5.61	5.24
Siaya	7.76	7.23	7.38	6.77	5.68	5.28
S.Nyanza	8.38	8.02	8.38	7.21	6.47	5.4

As with results from other districts, the divorced/-separated women have the lowest TFRs in Nyanza. Both methods of estimation show almost similar results except for South Nyanza which has 6.47 and 5.4 using the CTM and the GRM respectively. Even for the widowed, Kisii district still show the highest in TFR which is still above 7.5.

The analysis within each district with the CTM show that Kisii and Siaya have the married women as having the highest fertility followed by widowed, then the divorced/separated. South Nyanza district show no difference between the fertility of the married women and the fertility of the widowed women, while the widowed have the highest fertility in Kisumu district and the lowest is with the divorced/separated women.

The GRM show that apart from Kisii with highest fertility for the widowed women and lowest for the divorced/separated women, the rest show highest TFRs for the married and lowest for the divorced/separated women.

4.6 Fertility Levels by Marital Status for Districts in Rift Valley Province.

Table 4.6 below show that the fertility of married women in Rift Valley province is generally high. Most districts have TFRs of over 8.0 using CTM. Only Elgeyo-Marakwet, Turkana and Samburu have 7.42, 6.64 and 6.86 respectively. The highest TFR for the married women using the CTM is shared by Trans-Nzoia (9.16) and Kericho (9.04). The fertility of the married has been found to be closely related with the TFR for the district as a whole. From the results of Osiemo (1986) of TFRs at district level, it can be seen that those districts with TFRs above 9.0 corresponds with TFRs of married women in those districts. It can therefore be said that TFR in Rift-Valley province is very much determined by women that are married.

Table 4.6
Total Fertility Rates by Marital Status by Districts in Rift Valley Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Kericho	9.04	8.84	6.86	7.42	6.02	5.8
Nakuru	8.85	8.19	8.28	6.7	6.51	6.4
Nandi	8.65	7.81	8.69	5.84	5.49	4.71
Narok	8.11	6.77	9.07	5.47	7.21	5.74
Baringo	8.55	7.46	-	-	6.27	5.83
T-Nzoia	9.16	8.82	9.38	6.57	6.04	6.73
U-Gishu	8.56	7.63	7.01	6.54	6.59	5.3
W.Pokot	8.16	7.37	8.19	6.39	6.85	6
Laikipia	5.56	7.23	6.63	6.31	6.31	5.58
Kajiado	8.23	6.42	8	5.18	6.41	4.39
Marakwet	7.42	6.9	7.61	-	5.81	5.95
Turkana	6.64	5.79	8.6	5.36	4.4	4.39
Samburu	6.36	6.36	9.76	5.56	5.76	5.95

Though the GRM show lower TFRs for married women, Kericho and Trans-Nzoia still maintain the lead with 8.44 and 8.82 respectively. Samburu and Turkana still have the lowest too. Most other districts have TFRs of over 6.0 but less than 8.0.

Not much difference is noticeable when using the CTM between married and the widowed women in Rift Valley province. However one peculiar result is that Turkana and Samburu that have lowest fertility rates for the married women have among the highest TFRs for the widowed with 8.6 and 9.76 respectively. A part from Kericho, Laikipia which show marked reductions from the married to the widowed, the rest of the districts show relatively similar results.

Fertility between the married shows a big reduction only when the GRM is used. With the model, all the districts except Kericho have TFRs of less than 7.00, and Nandi, Narok, Kajiado, Turkana and Samburu have TFRs less than 6.0.

The CTM only shows marked reductions in TFRs with the divorced/separted women, because, a part from Narok district with 7.21, the rest are below 6.9 (W. Pokot) and the lowest is 4.4 (Turkana). Results with GRM for the separated show that the highest is Trans-Nzoia (6.73) followed by Nakuru(6.4), then West Pokot (6.00) and the lowest is Turkana (4.39).

The differences within each district between the married, widowed and divorced/separated women show that seven out of thirteen districts in Rift Valley have fertility of the widowed women as the highest and that of divorced/separated as the lowest. These are Nandi, Narok, Trans-Nzoia, W. Pokot, Elgeyo-Marakwet, Turkana and Samburu districts. The rest of the districts (six) have the fertility of the married women as the highest. The GRM however shows the married to have the highest rates. It also show that all the districts except Narok, Trans-Nzoia, Kajiado and Samburu have the divorced/separated women as the ones with lowest TFRs. The four districts have the widowed as having the lowest fertility rates.

4.7 Fertility Levels by Marital Status for Districts in Western Province.

Table 3.11 below show that Bungoma District has got the highest TFR of 9.9 and the lowest is by Busia (7.96) - with the CTM. The same method show that the widowed women have got even higher fertility except for Kakamega. Bungoma has a TFR of 10.88 and Busia has a TFR of 8.04. Kakamega's TFR reduces from 8.9 for the married women to 6.99 for the widowed women.

The GRM shows also that Bungoma has the highest TFR for both married and widowed women with 9.33 and 8.54 respectively. This is no surprise because it is the district with the highest overall TFR both in 1979 and 1984 (see Table 3.31). Busia district has the lowest TFRs for both married and widowed with this method. Busia district has also the lowest TFR in

Western province as discussed earlier (Chapt.3). Therefore, there seems to be some relationship between the fertility of the married and widowed women and the overall TFR for the district in Western province.

Table 4.7

Total Fertility Rates by Marital Status by Districts in Western Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Bungoma	9.9	9.33	10.88	8.54	5.7	6.43
Busia	7.96	8.04	8.04	7.15	4.59	3.72
Kakamega	8.9	6.99	6.99	8.12	5.57	5.9

Both methods of estimation show that the divorced/separated women have the lowest TFRs compared to other categories. All estimation vary between 3.72 and 6.43. All the same, Bungoma show still the highest TFRs.

As for the variations within each district among the three categories, the GRM show that the divorced/separated have the lowest. The CTM however show that apart from Kakamega, the fertility of the widowed women is the highest and that of the divorced/separated is the lowest.

4.8 Fertility Levels by Marital Status for Districts in North Eastern Province.

The CTM show that Garissa district has the highest fertility for both married women and the widowed. It has a TFR of 7.53 for the married and 5.34 for the widowed. Mandera has 4.45 for the married and 3.98 for the widowed while Wajir has 4.51 for the married and 5.19 for the widowed. It is therefore clear from Table 4.8 below that Mandera is the district with the lowest for both married and widowed women. And in general, the fertility of the married is higher than that of the widowed women.

The GRM gives rather higher values than the ones given by the CTM, especially for Mandera and Wajir. All the same the married women in Garissa district have still the highest TFR (7.5) and lowest is Mandera (6.87). It is still the district with the highest for both the widowed and the divorced/separated women.

And within the districts themselves, the GRM show that the fertility of the married women is the highest in all the three districts and the divorced women have the lowest. However, with the CTM, it is only Garissa which follows the same pattern. The divorced/separated women in Wajir have the highest while it is the widowed women in Wajir with the highest level of fertility.

Table 4.8
Total Fertility Rates by Marital Status by Districts in North Eastern Province, 1979.

	Married		Widowed		divorced/separated	
District	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s	Coale-Trussell	Gompertz P(i)s
Garissa	7.53	7.5	5.34	6.79	4.6	5.84
Mandera	4.45	6.87	3.98	5.73	4.89	4.91
Wajir	4.51	7	5.19	4.91	-	5.93

4.9 SUMMARY

The discussion in this chapter has centred on the data on marital status drawn from the 1979 census. The results have shown that the married women have the highest TFRs. They are followed by the widowed women whose fertility is not very much different from that for the married. The divorced/separated women have the lowest levels of fertility and the difference from the rest is quite big. The closeness of the levels of fertility between the married and the widowed women would be due to the fact in most communities, the widowed women still in childbearing age possibly continue bearing through traditional arrangements or it may these women get widowed at the late ages of their childbearing period. In divorce, women are the ones who usually remain with the children. This may make them not have any other children because of the economic burden that the children impose on them in terms of labour supply and the depletion of past resources.

CHAPTER FIVE

A MULTIVARIATE ANALYSIS OF FERTILITY DIFFERENTIALS IN KENYA.

5.0 Introduction.

In the previous three chapters, demographic estimations have been made on total fertility rates(TFR) for the various districts in Kenya covered by the KCPS sample. This has also been done by different socio-economic variables at the national level. Estimations have also been done for all districts by the the different categories of marital status by data drawn from the 1979 census. The results have shown that there are wide differences in TFR between the districts in Kenya and also by marital status of the women. However the KCPS sample is too small to allow estimation of TFRs by all the variables being considered by each district covered by the survey. Therefore, the only way of looking at the differential of TFR between districts is by using a multivariate linear regression analysis. Such a study is good because it can be comparable to other earlier studies as by Mwobobia (1982) and Anker and Knowles (1982). A similar regression at the household level has been done to counter-check the macro results. This is because most of the variables used also greatly concern the individual persons. The methodology of the multiple regression analysis has already been given in chapter two.

5.1 Defination of Variables at the Macro level.

In this section , eleven variables have been tested. The variables that are considered are the education of the mother, place of reidence, working status of the woman, working status of the husband, polygamy status, contraceptive use, marital status, and age at marriage of the woman.

The names of how the variables have been used in this macro analysis are as follows:

TFR	total fertility rate for each district as the dependent variable. TFR used are those from the Coale-Trussell P/F ratio method.
HEDUC	proportion of women with 9+ years of education.
RURB	proportion of women residing in urban areas.
WRK1	proportion of women currently working.
WRK3	proportion of women who have never worked.
WRKHB	proportion of women with husbands employed in salaried jobs.
WRKHN	proportion of women with husbands not working.
POLYG	proportion of currently married women that are in polygamous unions.
EVUSE	proportion of women who have ever used at least one contraceptive method.
OTHERS	proportion of women married in the past (widowed and divorced).

MAGE proportion of married women that married by the age of 17 years (i.e up to 17 years).

NB:The proportions for each district are given in the appendix. The means of the variables considered here are shown below together with their standard deviations and number of cases.

Table 5.0

Means, Standard Deviations and cases of the Variables.

VARIABLE	MEAN	STANDARD DEV.	CASES
TFR	8.5028	1.5558	29
SEDUC	30.2276	8.8833	29
HEDUC	15.4414	9.5255	29
RURB	13.6483	25.001	29
WRK1	17.5414	8.6448	29
WRK3	70.7896	12.9465	29
WRKHB	30.3379	15.0901	29
WRKHN	31.6793	15.5612	29
POLYG	24.7276	13.7255	29
EVUSE	28.5448	14.1898	29
OTHERS	7.5897	3.9547	29
MAGE	48.7793	12.3947	29

5.2 Multiple Linear Regression Results and Discussion.

In any form of regression analysis with correlated variables, the effect of a variable on a response in general depends on which other variables are included in the regression equation. Thus, the issue of which variables to control. To present all the variables in one regression can be misleading.

The approach adopted here is to introduce each independent variable in a hierachical fashion, to allow a more comprehensive analysis of the effect of independent variables on the dependent variable (TFR). This recognises that no single effect of each has an interpretation specific to the set of variables in the regression equation at each step. In a stepwise regression subprogramme, the inclusion of the variables has been determined by the computer programme. Each additional variable was being entered into the equation at a separate stage on the merits of the amount of the unexplained variation in TFR it accounted for. Therefore the variable that explained most of the unexplained variation in the independent variable by those already in the equation was the next one to be entered into the equation. However in the results presented, only a few equations or steps are shown.

Four equations are used to analyse the results from the stepwise regression. Equation one includes women who have never worked (WRK3) and women residing in urban areas (RURB). Equation two includes equation one and currently working women (WRK1), women with 5-8 years of education (SEDUC), and women marrying by age 17 (MAGE). Equation three includes equation two and the ever users of contraceptives (EVUSE), women married in the past and women living in polygamous unions (POLYG). Equation four includes all the variables in the regression model. The results are shown in table 5.1 below.

Table 5.1
The Unstandardized Regression Coefficients (B) of the Independent variables with TFR at the Macro Level.

VARIABLE	1	2	3	4
WRK3	0.065*	0.123*	0.123*	0.16*
RURB	-0.021*	-0.025*	-0.024*	-0.021
WRKI		0.09***	0.085***	0.128**
SEDUC		0.048**	0.045**	0.062**
MAGE		0.028	0.083*	0.08**
EVUSE			0.037***	0.057**
OTHERS			-0.094**	-0.094***
POLYG			-0.03	-0.017
HEDUC				-0.042
WRKHN				0.021
WRKHB				0.026
CONSTANT	4.17	-4.326	-6.345	-11.856
R^2	0.51	0.633	0.705	0.734
F	13.518	7.939	5.967	4.268

* significant at .01 level.

** significant at .05 level

*** significant at .10 level.

It has already been noted that the variable that explained most of the variation in the dependent variable that was not already explained by those already in the equation was the next one to be entered into the equation. Taking women married to employed husbands (WRKHB) for instance, its low rank in the equation is due to the fact that a greater portion of TFR explained by it had already been accounted for by other variables in the equation. These are probably HEDUC and WRK1 on which the impact of employment on TFR depend. It is most likely that most currently working women (WRK1) marry men that are working.

The variable that explained most of the variation in TFR between districts in Kenya is WRK3 and it explained 40.4 per cent (F=18.31505, s.l. = .01). The first equation in table 5.1 show that RURB was the next one to be entered and the amount of explained variation increased to 51.0 per cent (F= 5.601, s.l. =.01). RURB has thus a negative (depressing effect) on TFR at this stage. Currently working women (WRK1) were the third to be entered and the amount of explained variation (R^2) increased to 57.4 per cent (F=3.3772, s.l. =.05).

The second equation in table 5.1 includes five variables. The first three variables: WRK3, RURB and WRK1 have B values of 0.124 (F=13.268, s.l.=.01); -.025 (F=6.729, s.l.=.01) and 0.09 (F=2.634, s.l.=.10) respectively. The forth variable, SEDUC, is significant at level .05 and the last one MAGE is not significant at all.

The third equation in table 5.1 includes all the variables except HEDUC, WRKHN and WRKHB. In this equation, POLYG is the last variable with a B value of -0.03 and is not significant at any level under consideration. WRK1 which is significant at .01 in equation two is now only significant at .10 level. Therefore the inclusion of other variables reduces the effect of WRK1 because they are the ones who are most likely to use contraceptives (EVUSE), given that employment in Kenya depends on educational attainment, and they are most likely to be either separated or divorced from their husbands (OTHERS). MAGE which is not significant in equation two is significant at .01 level in equation three. This is probably due to the fact that those women marrying by the age of 17 years are not much affected by urban residence (where most marry late) or working status since a majority of them would not be working by age 17.

The last equation in table 5.1 (equation four) shows the inclusion of all the variables and can be written as follows:

$$TFR = -11.856 + 0.16\,\underset{(7.193)}{WRK3^{*}} - 0.021\,\underset{(1.513)}{RURB} + .128\,\underset{(2.983)}{WRK1^{**}}$$

$$+ .062\,\underset{(3.267)}{SEDUC^{**}} + .08\,\underset{(4.377)}{MAGE^{**}} + .057\,\underset{(3.512)}{EVUSE^{**}} - .094\,\underset{(2.176)}{OTHERS^{***}}$$

$$- .017\,\underset{(0.681)}{POLYG} - .042\,\underset{(.894)}{HEDUC} + .021\,\underset{(1.036)}{WRKHN} + .026\,\underset{(.681)}{WRKHB}$$

$$+ 1.03\ (\text{St. error}).$$

F values are shown in Parenteses.

*, **, *** are defined as before.

After all variables are entered into the equation, it can be seen that only four variables (RURB, OTHERS, POLYG and HEDUC) are negatively related with TFR. The rest of the variables are positively related with TFR. The first variable with the negative effect on TFR is RURB but which is not significant. It has to be noted that this variable had a significant negative effect on TFR in the first three equations at .01 level. Therefore the inclusion of HEDUC, WRKHN and WRKHB reduces the effect of RURB. This is because most women in urban areas are those with at least secondary education or husbands that are employed (WRKHB). Therefore the effect of RURB on TFR would be through education and work status. In a separate regression with TFR that included only work status of the women and husbands, and education shows that RURB is negatively significant at .05 level with the unstandardized regression coefficient of -0.03 (F = 3.582). Therefore the negative impact of RURB cannot be disregarded as significantly influencing fertility in Kenya regions.

The OTHERS (widowed, separated and divorced) is the second variable that negatively influences fertility (TFR) with an unstandardized regression coefficient (B) of -0.094 (F = 2.176, s.l. = 0.10). This is probably because women who are widowed or divorced are left with an economic burden the children impose on the mother in terms of labour supply to earn income. This result also show that the norms that used to be observed in the African society such as of remarriage or widows being taken within the clan are being phased out slowly. The depressing effect from separate women would be due to less time spent on coition.

The other two variables that have negative correlation coefficients are POLYG and HEDUC. POLYG has a B value of -0.017 but is not significant at any of the three levels being considered. When HEDUC is held as a dependent variable and regressed with POLYG and EVUSE - EVUSE has a B value of 0.227 (F =5.952, s.l. = .01) and POLYG has a B value of -0.198 (F=2.846, s.l.=.10). It therefore shows that POLYG alone cannot have a significant negative effect such as 9+ years of education which may enable women to get employment. It has also to be borne in mind that polygamy as a practice is being phased out in the African society (Kenya included) as the cost of living rises and christianity (which abhores polygamy) spreads more and more. Therefore POLYG cannot at this time be used as a way of reducing fertility in Kenya.

HEDUC has also negative association with TFR with a B value of -0.042 but which is not significant at any of the three levels. HEDUC was entered ninth into the regression equation, thus showing its low rank in explaining TFR variation between districts. Therefore, though HEDUC depresses fertility, it has to be accompanied by the use of contraceptives so as to regulate fertility, and employment to increase the opportunity cost of rearing more children. In Kenya, only three districts have more than 25 per cent of women who have ever used any contraceptive method. These are Nairobi, Mombasa and Kirinyaga. Most of the districts have less than 20 per cent of such women.

In equation four, EVUSE and WRK1 are positively relate to TFR. EVUSE has a B value of 0.057 (F=3.512, s.l.=.05) and WRK1 has a B value of 0.128 (F=2.983, s.l.=.05). The positive B value of EVUSE show that in Kenya, women use contraceptives only to terminate childbearing when they have already had enough children. This can be confirmed by the results when EVUSE and POLYG are regressed alone with those marrying by age of 17 (MAGE). In this the B value for POLYG is .63 (F=48.642, s.l.=.01) and the B value for EVUSE is -0.313 (F=12.842, s.l. =01) - see table 5.2 below. This show that if women start using contraceptives immediately they marry, contraceptives can have a strong depressing effect on fertility. The results with POLYG also implies that if enters a polygamous union early in age, then POLYG can have a increasing effect on fertility. Results from the two variables (EVUSE and POLYG) regressed with HEDUC and WRK1 show that EVUSE still has a positive impact on fertility. This show that though the women attaining HEDUC are eventually employed, little is made of the contraceptive devices. This could be due to the lack of sex education in schools and colleges in the country.

Table 5.2
Unstandardized Regression Coefficients (B) for Regressios among some Independent Variables.

Variable as Dependent	Independent variable	B	F
MAGE			
	POLYG	0.63*	48.642
	EVUSE	-0.313*	12.842
HEDUC			
	EVUSE	0.227*	5.952
	POLYG	-0.198*	2.846
WRK1			
	EVUSE	0.298*	8.358
	POLYG	0.296*	7.736

Currently working women (WRK1) show a positive B value with TFR in equation four of 0.128 (F=2.983, s.l.=.05). In theory, working women would be expected to depress fertility because working time competes with childbearing and the latter is likely to have a higher opportunity cost so as to make women have fewer children. Therefore, the present results show that women either have not understood the concept of work or the conditions of work (such as maternity leaves) do not affect the woman's income.

The other factors that are positively related to fertility and are significant are: WRK3 with a B value of 0.16 (F=2.93, s.l.=.05), SEDUC with a B value of 0.062 (F=3.267, s.l.=.05) and MAGE with a B value of 0.08 (F=4.377, s.l.=.05). As for WRK3, childbearing never in any way competes with their sources of income. Given that this category excludes women only in formal employment, then a good number could be working on the farm. It therefore implies that farm work is not as lucrative as to compete with time spent in childbearing. Such women would also be giving higher number of children as a security in old age and as a source of labour for their farms.

Women's education up to 5 - 8 years (SEDUC) has still a positive effect on TFR in Kenya despite the fact that a good percentage of women are now attaining that level. This could be due to their lack of contraceptive knowledge and they are likely to be inclined to traditional virtues of large families, having dropped out of school early. Not many are likely to be in formal employment. As for the positive relationship of MAGE with TFR, it is as expected since early marriage exposes women to a long childbearing period. A combination of MAGE and EVUSE is the only one that enables TFR to be lowered. Table 5.2 show that POLYG is postively and strongly related with MAGE because women who are taken as second or third wives are normally young.

The regression equation (equation four) show that the two categories of working status of the husband (WRKHN and WRKHB) are the least variables that explains variation in TFR between districts in Kenya. The two are positively related with TFR with B values of 0.021 and 0.021 but which are not significant. It thus show that these variables have already been accounted for by the working status of the women and other socio-economic variables in the model. It may that working status of the husband influence fertility but not directly.

5.3 ANALYSIS AT THE MICRO-LEVEL.

The analysis at the micro-level has been done only to counter-check the results already given on some of the variables. These results are also useful because they can be comparable with those studies done by Kocher (1979a and 1979b), Farooq (1979), Snyder (1974) and Anker and Knowles (1982).

5.4 Definition of Variables at Micro level:

PARI: the total number of live births including current pregnancy as the dependent variable because TFR could not be calculated from each woman.

AGE: age of women in years as a continous variables.

NEDUC: binary variable indicating if woman has ever had any schooling (1 if no education, 0 if otherwise).

PEDUC: binary variable indicating if woman has completed some schooling but is probably not functionally literate (1 if completed 1-4 years in school, 0 if otherwise).

SEDUC: binary variable indicating if woman has completed 5-8 years of education (1 if completed 5-8 years of education, 0 if otherwise).

HEDUC: binary variable indicating if woman has completed 9 years and over of schooling (1 if completed 9 + years, 0 if otherwise).

RURB: binary variable indicating if woman lives in an urban area (1 if urban, 0 if rural).

RURR: binary variable indicating woman's rural residence (1 if rural, 0 if otherwise).

WRK1: binary variable indicating if woman is currently working (1 if currently working, 0 if otherwise).

WRK2: variable indicating if woman worked in the past (1 if worked in the past, 0 if otherwise).

WRK3: variable indicating if woman has never worked (1 if never worked, 0 if otherwise).

WRKHF: variable indicating if husband owns farm or works on farm (1 if owns or works on farm, 0 if otherwise).

WRKHB: variable indicating if husband either owns business or formally employed (1 if owns business or formally employed, 0 if otherwise).

WRKHN: binary variable indicating if husband does not work at all (1 if not working, 0 if otherwise).

EVUSE: binary variable indicating if woman has ever used any method of contraception (1 if ever used any, 0 if otherwise).

EVNON: binary variable indicating if woman has never used any method of contraception (1 if never used, 0 otherwise).

<u>POLYG</u>: binary variable indicating if woman has a co-wife (1 if has a co-wife, 0 if otherwise).

<u>MONOG</u>: binary variable indicating if woman has no co-wife (1 if woman has no co-wife, 0 if otherwise).

<u>SINGL</u>: variable indicating if woman has never married (1 if single, 0 if otherwise).

MARRD: variable indicating if woman is currently married (1 if currently married, 0 if otherwise).

OTHERS: variable indicating if only married in the past (divorced, widowed and separated) (1 if married in the past, 0 if otherwise).

Note The underlined variables have been ommitted from the regression equation to serve as reference categories. This is to avoid multicolinearity.

The means of the all variables considered here and their standard deriations are shown in table 5.3 below. N =6581

5.5 Multiple Linear Regression Results and Discussion at the Micro (individual) Level.

The approach adopted here is the same as that adopted at the macro level - stepwise regression. As before, only four regression steps are presented from four equations. The equations include the following variables:

1. AGE and MARRD.
2. AGE, MARRD, HEDUC, RURB and OTHERS.

Table 5.3
Means and Standard Deviations of the Variables used at the Micro Level.

VARIABLES	MEAN	STANDARD DEVIATION	CASES
NEDUC	0.36	0.48	6581
PEDUC	0.1641	0.3704	6581
SEDUC	0.3095	0.4623	6581
HEDUC	0.1641	0.3704	6581
RURB	0.1422	0.3492	6581
RURR	0.8578	0.3492	6581
WRK1	0.1896	0.392	6581
WRK2	0.1202	0.3252	6581
WRK3	0.6902	0.4625	6581
WRKHF	0.2094	0.4069	6581
WRKHB	0.2742	0.4461	6581
WRKHN	0.2162	0.4117	6581
POLYG	0.1715	0.3769	6581
MONOG	0.529	0.4992	6581
EVUSE	0.2977	0.4573	6581
EVNON	0.7023	0.4573	6581
AGE	28.788	9.1059	6581
SINGL	0.2388	0.4264	6581
MARRD	0.6915	0.4619	6581
OTHERS	0.0697	0.2547	6581
PARI	4.0874	3.8889	6581

3. AGE, MARRD, HEDUC, RURB, OTHERS, SEDUC, EVUSE and WRKHB.
4. AGE, MARRD, HEDUC, RURB, OTHERS, SEDUC, EVUSE, WRKHB, WRK2, WRK1, WRKHN, PEDUC and POLYG.

The results of the four equations are presented in table 5.4 below.

Age of the mother is the variable that explained most of the variation in parity between the individual women. It explained about 46.9 per cent of the total variation in parity with a B value of .293 (F=5821.773, s.l.=.01). The results presented in table 5.4 show that AGE and MARRD were the two variables that explained most of the variation in parity (49 per cent) of all the variables considered.

Table 5.4
The Unstandardized Regression Coefficients (B) with Parity.

VARIABLE	1	2	3	4
AGE	0.266*	0.248*	0.237*	0.237*
MARRD	1.325*	1.502*	1.493*	1.615*
HEDUC		-0.742*	-1.057*	-1.094*
RURB		-0.718*	-0.634*	-0.59*
OTHERS		0.98*	0.872*	0.929*
SEDUC			-0.47*	-0.525*
EVUSE			0.457*	0.516*
WRKHB			-0.274*	-0.359*
WRK2				-0.355*
WRK1				-0.266*
WRKHN				-0.188*
PEDUC				-0.145**
POLYG				-0.097
CONSTANT	-4.306	-3.76	-3.31	-3.2
R^2	0.49	0.505	0.51	0.512
F	3165.598	1343.709	856.466	530.468

* .01 level of significance.

** .05 level of significance.

In equation one, AGE has a B value of .266 and MARRD has a B value of 1.325 and all are positively significant at .01 level. Equation two show that the inclusion of three more variables into the equation increases the explained variation only marginally to 50.5 per cent though all are still significant at .01 level. These variables are HEDUC, RURB and OTHERS. As would be expected, the two variables: HEDUC and RURB are negatively related with parity while the other three: AGE, MARRD and OTHERS are all positively related with parity.

Equation threee includes three more variables: SEDUC, EVUSE and WRKHB, to those already in equation two. The total amount of explained variation again increases only to 51 per cent but all are significant at .01 level. In this equation, four variables are negatively related with parity. These are HEDUC (B=-1.057), RURB (B=-.634), SEDUC (B=-.47) and WRKHB (B=-.274). The rest of the variables positively influence parity (fertility).

Equation four includes all the variables that are tested in the model and the total amount after the last step has been reached is about 51.2 per cent. Equation four can be presented mathematically as follows:

$$\text{PARI} = -3.2 + \underset{(2562.42)}{\overset{*}{.237}\ \text{AGE}} + \underset{(181.113)}{\overset{*}{1.615}\ \text{MARRD}} - \underset{(81.298)}{\overset{*}{1.094}\ \text{HEDUC}} - \underset{(32.75}{.59\ \text{RURB}}$$

$$+ \underset{(33.588)}{929\ \overset{*}{\text{OTHERS}}} - \underset{(30.481)}{.525\ \overset{*}{\text{SEDUC}}} + \underset{(43.831)}{.516\ \overset{*}{\text{EVUSE}}} - \underset{(12.593)}{.359\ \overset{*}{\text{WRKHB}}}$$

```
           *               *               *                **
-.355 WRK2 - .266 WRK1 - .188 WRKHN - .145 PEDUC
 (11.203)    (8.722)         (3.332)     (2.047)

-.097 POLYG + 2.719 (St. error).
   (1.052)
```

F values are shown in parenteses.

* and ** are .01 and .05 levels of significance respectively.

The regression equation above shows that most of the variables are significant at .01 level except PEDUC which is significant only at .05 level and POLYG which is not significant at all. The equation also show that only four variables are positively related with parity. These are AGE, MARRD, OTHERS, and EVUSE. The results of EVUSE are the same as was found at the macro level which further confirms that women in Kenya only use contraceptives to terminate childbea-ring rather than spacing of births. The OTHERS results are different from the ones at the macro level which was negative. The positive relationship of MARRD with parity is as would be expected since women who are constantly in marital unions waste little time without coition, which may continue until the end of childbearing.

It has already been noted that most of the variables showed negative relationship with parity of the woman. HEDUC with a B value of 1.094 (F=81.298, s.l.=.01) and RURB has a B value of .59 (F=32.783, s.l.=.01) have the same effect as was found with the results at the macro level - a part from HEDUC which is not significant at the macro level. This confirms further that increasing education and urbanization in the country can have a strong reducing effect on fertility in Kenya. However to achieve greater heights in urbanization in Kenya is likely to take time. The women who had either worked only in the past (WRK2) and those currently working (WRK1) also exhibit negative correlations with parity which are significant at .01 level. Though the results at the macro level showed that WRK1 is positively related with TFR, the present results show that women who worked in the past or currently working - childbearing is likely to have a higher opportunity cost that cannot be afforded. Therefore, to an individual woman working, it is lucrative enough to work than rear children. However, the results for the working status of husband show that all the categories are negatively related with parity. This is unlikely and may be that either the effect is masked by working status of the wife or defective data.

The variables: PEDUC and SEDUC are also found to negatively influence parity though the results at the macro level have shown otherwise. This is unlikely since these levels of education are considered insufficient to change a woman's attitude towards fertility. This may mean that the results at the macro level are more reliable than the ones at the micro level. Finally, POLYG was the least in explaining variation in parity between individual women and is not significant.

5.6 SUMMARY

The multiple linear regression analysis has been done at both macro and micro level. At the macro level, TFR has been used as the dependent variable and regressed against eleven socio-economic and cultural variables for the 29 districts that were covered by the KCPS. Four variables show negative relationships with TFR. These are: RURB, OTHERS, POLYG and HEDUC. RURB has been found to be significant at .01 level when HEDUC, WRKHB and WRKHN are not included. The variable, POLYG has got the highest depressing effect on fertility but it is not significant. The variable, OTHERS, is only significant at .10 level. HEDUC has a negative but insignificant effect on fertility showing that higher education alone is not enough to reduce fertility in Kenya. It needs to be accompanied with the use of contraceptives and widespread employment for women to reduce fertility. The results at the macro level also show that women either do not understand the concept of work or use contraceptives only to terminate childbearing and not for spacing births. MAGE and WRK3 also have an increasing effect on TFR. However, the working status of the huband has significant effect on TFR.

The micro level results also show that RURB and HEDUC negatively related with fertility and are significant. POLYG is also negatively related with parity (fertility) though not significantly. All other variables negatively influence parity except AGE, MARRD, EVUSE and OTHERS. EVUSE has the same effect as at the macro level. However, women in unstable unions (OTHERS) have a positive effect while at the macro level the effect is negative.

CHAPTER SIX

SUMMARY AND CONCLUSIONS

6.0 QUALITY OF DATA

The major source of data in this study has been the KCPS data of 1984. The Gompertz relational Model has shown that the data is contaminated with a lot of reporting errors especially in children ever born, age and current births. Therefore, the estimates of total fertility rates have to be given some allowance for such errors. The errors are found not to be concetrated on any one particular sub-group in the population, but are found to be inherent in almost all socio-economic variables considered, though to varying extents.

6.1 SUMMARY OF RESULTS AND CONLUSIONS

The main objective of this study was to estimate the fertility differentials in Kenya at both macro and micro-level using both demographic and statistical techniques. Two demographic techniques were used to estimate total fertility rates. These were the Coale-Trussell P/F ratio (CTM) and the Gompertz Relational model (GRM). This was done at the national level, by various socio-economic and demographic variables at the national level and by the various provinces and districts that were covered by the sample survey. Total fertility rates by marital status based on the 1979 census data were also estimated to supplement the data at the district level. The statistical technique that was employed was the multiple linear regression using the 1984 KCPS data at the macro level and at the micro (household) level.

6.1.1 DEMOGRAPHIC ESTIMATIONS

The two methods of estimation used were found not to give similar patterns of fertility rates by the various fertility differentials and across the country as a whole. For instance, whereas the CTM gave the TFR for the whole of Kenya at 8.62, the GRM gave it at 8.06 (using mean parities). The value of 8.06 from the GRM was found to be closer to 8.1, derived from 1977 National Demographic Survey whose data was considered more reliable. The TFR derived from the CTM would mean that there has been some substantial increase in TFR in the recent past. A plausible conclusion would be that though the GRM results were considered more reliable, on average it it can be said that there has been a slight increase in fertility in the recent past.

The results derived from the GRM when using the cumulated fertility, F(i)s, were found in most cases to be higher than those derived from the mean parities, P(i)s, probably due to the errors outlined above. Therefore, those derived when using the mean parities were relied on most in discussions.

The estimation of TFRs by the various fertility differentials for the whole sample showed that differences within each of them were very striking. Within some of the differentials such as polygamy and contraceptive use, the gaps were found to be narrowing. In education, women with zero years and those with 1-4 years of education were found not to have any major difference in TFRs. This means that women's education up to four years is not enough to change the perceptions of women towards a large family size because it hardly changes their lifestyles. Fertility was found to decline slightly only after 5 years of education. Significant declines in fertility were found to occur after 9 years of education. This could be due to the fact that these women are likely to get paid employment in the formal sector, have higher incomes and opportunity costs and accesss to family planning services - factors that are associated with the suppression of fertility.

The TFRs by the various religious categories showed that there was little difference between the catholics and the protestants and both had mean TFRs of 8.0 and above. The lowest fertility was shown by the muslims who had a TFR of about 6.5. The women designated as having no religion fell in between. Low fertility for the muslims was found to be due to the high proportion of childlessness among them.

Women who had never worked were found to have the highest fertility of all the three categories of work status that were considered. Though the two methods of estimation never gave similar patterns between those that were currently working and those that had worked in the past, on average, the former were found to have the lowest TFR.

Those women in polygamous unions were found to have a TFR that was not very different from those in monogamous unions. This could be attributed mainly to the erosion of the virtues that used to govern the polygamous unions thus lowering fertility. The users of contraceptives were found to have higher fertility than the non users of contraceptives when using the GRM - a difference of more than one. This may be due to the reason that contraceptives would have been used only for terminating childbearing rather than the spacing of births.

Fertility rates by place of residence showed that those women residing in metropolitan areas (Nairobi/Mombasa), on average had the lowest TFR and those in rural areas had the highest TFR. There was however little difference between the fertility of those residing in metropolitan areas and those in other urban areas. The high fertility in the rural areas could be due to the fact that children are seen as a source of labour and as security at old age because enough social amenities have not affected the rural people.

As for the working status of the husband, it was realised that the classifications were not clear enough as to give differences in TFRs. Apart from those that were not working that showed the highest TFR, the rest showed that there were no striking differences in TFRs. Striking differences in TFRs were found to be with women classified by marital status. The married women were found to have the highest TFR and the single women had the lowest TFR of below 5.0. The divorced, separated and the widowed had fertility that was low but was in between the married and the single women. This was also confirmed by the results from the 1979 census data by marital status for all the districts in Kenya.

Fertility rates by ethnic groups were not greatly different except for the Mijikenda who had the lowest for both methods of estimation. The CTM showed that the rest of the groups considered had TFRs of between 8.0 and 9.4. However, the Kisii on average had the highest TFR. It was therefore not suprising that Kisii as a district was also found to have one of highest TFRs in Kenya.

The distribution of fertility across the country showed that differences between regions still persist. The differences range from as low as below six (Mombasa, Kwale and Nairobi) to as high as above ten (Meru, Kisii, Nandi, Uasin Gishu, Kericho and Bungoma). It was found that most of those districts with the TFRs of above 10.0 are in the rainy and most agriculturally productive central and western part of Kenya. The low fertility in Nairobi and Mombasa would be due to high level of urbanization that are compounded by the high levels of education and high cost of living. The low levels of fertility in the Coast province could be attributed to the high proportion of childless women (majority being muslims) and probably misreporting births.

6.1.2 STATISTICAL ANALYSIS RESULTS.

A multiple linear regresion model was applied at both the macro and micro level. The results at the macro level showed that most of the variation in TFR between the different districts in Kenya was explained by WRK3 (unemployed women) but it was positively and significantly related with TFR. The urban place of residence (RURB) had a depressing effect on TFR. This variable is however significant when the other interrelated variables such as HEDUC and WRKHB are not included. This is because most women who reside in urban areas are likely to have at laest 9 years of education or their husbands are likely to be employed. The effect of RURB thus works through higher education and employment. But for RURB and HEDUC to have a strong effect on fertility, it has to be accompannied by the knowledge and use of contraceptives.

Unstable unions (OTHERS) were also found to be negatively related with TFR. These are the women who are either divorced, widowed or separated and thus spend a lot of time outside marital unions. Divorced or widowed women are also with an economic burden since they they look after the children and at the same time work to earn income. Therefore, the economic burden is in terms of the time spent to look after the children instead of selling their labour in the market.This is likely to make them have fewer children than those constantly in marital unions. This is also an indication that the practice of another man taking over a widow or remarriages are slowly dying out in the African society.

Women with 9 years of education and over (HEDUC) and those in polygamous unions (POLYG) also influence fertility in a negative direction, but they are not significant. Polygamy can become significant when it is accopanied by the use of contraceptives. HEDUC is also not significant because such women hardly know how to regulate their fertility, given the lack of sex education in Kenya's education system.

The positive relation between WRK1 and TFR showed that Kenyan women either don't understand the concept of work or the working conditions not as bad as to hinder childbearing. For instance, there is no maximum number of maternity leaves that a working is entitled to during her working period. The positive effect of EVUSE with TFR showed that women use contraceptives only to terminate childbearing.

SEDUC had a positive correlation with TFR because such women are unlikely to get employed and may not make effective use of contraceptives. The fact that both categories of the working status of the husband (WRKHB and WRKHN) had a similar effect on TFR showed that the working status of the husband may not such a strong factor in explaining variation in TFR and it may not be as important as women's education in policy making.

The results at the micro level showed that AGE accounted for most of the variation in parity between women. HEDUC and RURB had a depressing effect on parity. The MARRD, OTHERS and EVUSE had positive relationships with parity and were all found significant at .01 level. Apart from POLYG which had a negative and an insignificant effect on parity, the rest of the the rest of the variables had negative and significant effects with parity. The most unexpected results were those showing that even PEDUC and SEDUC also negatively influence fertility. The working status of the woman and husband had the same effect on parity. These results at the micro level leads to the conlusion that the macro level results are more reliable than the former (micro level).

6.2 RECOMMENDATIONS FOR FURTHER RESEARCH

(1) The use of the Gompertz Relational model showed that the values of the TFRs when using mean parities are in most cases much lower than when using the cumulated fertility. It would have been expected that the values for cumulated fertility be lower than the ones for mean parities. Therefore a further investigation into the goodness of the 1984 KCPS data for fertility analysis is necessary.

(2) The use of both the Coale-Trussell P/F ratio and the Gompertz Relational model showed different patterns in TFRs even with same cases with several categories. The problem was found to exist even when using the

1979 census data on marital status. Therefore another research into the robustness of the methods when estimating the same thing is needed.

(3) The independent variables included in the multiple linear regression model at the macro level explained 73.4 per cent of the total variation in TFR in Kenya. Another study to establish the factors that account for the remaining unexplained variation of about 26.4 per cent is necessary. However, the interrelations of such factors with the present ones are inevitable. A similar study at the micro level where only 51.2 per cent of total variation in parity is explained is also necessary.

(4) The negative relationship between TFR and working women was masked by other variables included in the regression model. Another study using the KCPS data the relationship between TFR and working status of women is thus necessary.

(5) The use of contraceptives was found to positively influence fertility, when the opposite would be expected. A separate study is thus needed to establish the reasons for this.

(6) The results on marital status showed that widowed women had higher fertility than the divorced/separated. It would have been expected that their fertility be

relatively similar to that of the divorced/separated but not to the married as the results showed. Another study to establish the fertility behaviour of both the widowed and the divorced/separated is necessary.

6.3 RECOMMENDATIONS FOR POLICY MAKERS

(1) Any study on fertility in a country like Kenya with high fertility aims at finding ways and means of reducing such high levels of fertility in the country. In this study efforts were made to examine the quality of the KCPS data which formed the major part of this study.. However, it was found out that the data was contaminated with a lot of reporting errors. Given that this was the latest of major demographic surveys undertaken by the government, caution should be taken in future surveys or censuses to avoid such errors.

(2) Of all the factors included in the study, 9+ years of education, age of the woman, currently married women and urban residence were found to be the major factors suppressing the otherwise stronger link between each of the other independent variables and fertility. The other variables such as women with husbands that were employed, polygamous unions and women with husbands that were not working were found to be weakly related fertility. In particular women with 5-8 years of

education were found to postively influence fertility at the macro level. The current 8-4-4 system is to ensure that the majority of the people get at least eight years of education. Therefore most of these will have to made to continue to secondary level, otherwise the system will lead to an increase in fertility.

(3) Urban residence and 9+ years of education were found to be stastistically significant when they are accompanied by the use of contraceptives. Therefore, sex education should be introduced into the schools' and colleges' curricula so as to help reduce fertility.

(4) Though urban residence showed a depressing effect on fertility, increasing the level of urbanization in the near future is not feasible. The only solution in the short run will have to improve the rural infrastructure and increase the economic investments in the rural areas to create jobs.

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APPENDIX A: ERROR ANALYSIS BY FITTING THE GOMPERTZ RELATIONAL MODEL TO THE KCPS DATA.

Table A1
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for the whole sample.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.180967	-0.53616	1.59936	0.283927	-0.23212	-1.2081
2/3	0.496223	0.355632	-0.93407	0.583571	0.618802	-0.7176
3/4	0.693797	1.006281	-0.41893	0.734821	1.177238	-0.24119
4/5	0.813388	1.577227	0.20469	0.825324	1.650368	0.35262
5/6	0.896583	2.2149	1.0728	0.918759	2.468268	1.50129
6/7	0.969341	3.4693	2.76316	0.966935	3.392515	2.94166

Table A2
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women with zero years of education.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.365144	-0.00743	-1.07063	0.418308	0.137497	-0.83848
2/3	0.553119	0.523943	-0.76573	0.625612	0.7571	-0.5793
3/4	0.722592	1.124207	-0.30100	0.78483	1.417629	-0.0008
4/5	0.855153	1.854866	0.482326	0.852032	1.831762	0.53401
5/6	0.910818	2.370727	1.228627	0.935673	2.710717	1.743737
6/7	0.975716	3.70759	3.00145	0.967448	3.408415	2.957555

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Table A3
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women with 1-4 years of education.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.257971	-0.30373	-1.36693	0.379001	0.030233	-0.94574
2/3	0.575151	0.592177	-0.69752	0.643844	0.820304	-0.51609
3/4	0.717991	1.104737	-0.32047	0.739959	1.200115	-0.21831
4/5	0.843757	1.772660	0.400063	0.834896	1.712313	0.414563
5/6	0.949096	2.951824	1.809724	0.895798	2.206914	1.239934
6/7	0.8367	1.724345	1.01821	0.973058	3.600444	3.149584

Table A4
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women with 5-8 years of education.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.165747	-0.58627	-1.64947	0.418308	0.137497	-0.83848
2/3	0.499013	0.363668	-0.92603	0.625612	0.7571	-0.5793
3/4	0.662623	0.887829	-0.53738	0.78483	1.417629	-0.0008
4/5	0.879668	2.054082	0.681528	0.852032	1.831762	0.534012
5/6	0.930557	2.63148	1.48938	0.935673	2.710717	1.743737
6/7	1.031055	-	-	0.967448	3.408415	2.957555

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Table A5
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women with 9+ years of education.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.128533	-0.7186	-1.7818	0.161389	-0.60099	-1.57697
2/3	0.410246	0.115414	-1.17428	0.507021	0.386837	-0.94956
3/4	0.678396	0.94669	-0.47852	0.764747	1.315985	-0.10244
4/5	0.720405	1.114919	-0.26033	0.804208	1.523731	0.225981
5/6	0.833488	1.703003	0.560903	0.999999	13.8155	12.84852
6/7	0.657894	0.870573	0.164433	1	-	-

Table A6
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for catholic women.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.175438	-0.55415	-1.61735	0.2657	-0.2817	-1.25768
2/3	0.500887	0.369075	-0.92062	0.569191	0.573519	-0.76288
3/4	0.672482	0.924377	-0.50083	0.749697	1.244498	-0.17393
4/5	0.760865	1.297192	-0.07535	0.826445	1.657467	0.35972
5/6	0.954882	3.07479	1.93338	0.901511	2.266418	1.29944
6/7	0.92818	2.596559	1.84042	0.963313	3.2867	2.83584

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Table A7
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for protestant women.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.166698	-0.58309	-1.64629	0.278849	-0.24457	-1.22055
2/3	0.505128	0.381344	0.90836	0.597638	0.664037	-0.69996
3/4	0.68015	0.953366	0.47184	0.708408	1.064982	-0.35345
4/5	0.819241	1.612562	0.24002	0.815778	1.591537	0.29378
5/6	0.881124	2.067064	0.92496	0.923812	2.535197	1.56822
6/7	0.984953	4.189055	3.48287	0.974083	3.63975	3.18889

Table A8
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women with no religion.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.337666	-0.82222	-1.88542	0.414763	0.12778	-0.8482
2/3	0.56703	0.566791	-0.72290	0.599757	0.670935	-0.6655
3/4	0.790296	1.446695	0.02145	0.808648	0.549327	-0.8691
4/5	0.806636	1.537663	0.165123	0.882559	2.080013	0.7823
5/6	0.836178	1.720853	0.57853	0.965179	3.339889	2.3729
6/7	1.196179	-	-	0.962035	3.2518	2.8009

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Table A9
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for currently working women.

	Mean Parities			Cumulated Fertility		
(1) AGE GROUPS	(2) r P(i)/P(i+1)	(3) Y=-ln(-ln r) or Z(i)	(4) Y+Q' - Q	(5) r F(i)/F(i+1)	(6) Y=-ln(-ln r) Z(i)	(7) Y+Q' - Q
1/2	0.196143	-0.4879	-1.5199	0.282761	-0.23361	-1.2096
2/3	0.561017	0.548177	-0.7415	0.636658	0.79513	-0.5413
3/4	0.68929	0.988613	-0.4366	0.744792	1.221968	0.1965
4/5	0.759993	1.293005	-0.0795	0.793989	1.466703	0.16895
5/6	0.861567	1.903793	0.7617	0.960174	3.203004	2.236
6/7	1.061129	-	-	0.989275	4.529791	4.0789

Table A10
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women worked in the past.

	Mean Parities			Cumulated Fertility		
(1) AGE GROUPS	(2) r P(i)/P(i+1)	(3) Y=-ln(-ln r) or Z(i)	(4) Y+Q' - Q	(5) r F(i)/F(i+1)	(6) Y=-ln(-ln r) Z(i)	(7) Y+Q' - Q
1/2	0.268684	-0.27322	-1.33644	0.453842	0.235717	-0.74026
2/3	0.610855	0.70746	-0.58224	0.653441	0.854377	-0.50962
3/4	0.706782	1.058337	-0.36687	0.758771	1.287158	-0.13127
4/5	0.852624	1.836114	0.46357	0.859779	1.889947	0.5922
5/6	0.861589	1.903966	0.76187	0.927381	2.585073	1.61809
6/7	0.80289	1.516232	0.81009	0.938179	2.751775	2.30092

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Table A11
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women never worked in the past.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.169225	-0.57465	-1.63785	0.259939	-0.2981	-1.27408
2/3	0.507745	0.38894	-0.90076	0.557758	0.538145	-0.79826
3/4	0.626181	0.75904	-0.66617	0.73058	1.158632	-0.25979
4/5	0.828635	1.671448	0.29891	0.83019	1.681473	0.38372
5/6	0.924358	2.542678	1.40058	0.911895	2.383472	1.41649
6/7	0.964864	3.330698	2.62456	0.967995	3.425643	2.97478

Table A12
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women in polygamous unions.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.399648	0.086462	-0.97674	0.49864	0.362591	-0.61321
2/3	0.59976	0.670946	-0.61875	0.703547	1.045202	-0.2912
3/4	0.741341	1.20633	-0.36191	0.781758	1.401573	-0.01686
4/5	0.82661	1.658517	0.28563	0.847987	1.802481	0.50473
5/6	0.902152	2.273295	1.131195	0.935212	2.703341	1.73636
6/7	0.978704	3.838492	3.13235	0.955453	3.088512	2.63765

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Table A13
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women in monogamous unions.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.435244	0.18405	-0.87915	0.460668	0.254794	-0.71804
2/3	0.555866	0.532343	-0.75736	0.67742	0.917866	-0.41855
3/4	0.703192	1.043768	-0.38144	0.788544	1.437307	0.01888
4/5	0.820562	1.620672	0.24813	0.852077	1.832095	0.53435
5/6	0.90404	2.293812	1.15171	0.924327	2.542256	1.57528
6/7	1.001672	-	-	0.972477	3.578811	3.12795

Table A14
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for ever users of contraceptives.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.321212	-0.1272	-1.1904	0.449704	0.076984	-0.89899
2/3	0.55018	0.514985	-0.77472	0.644203	0.821571	-0.51483
3/4	0.669312	0.912535	-0.51268	0.762708	1.306079	-0.11235
4/5	0.795729	1.476238	0.103698	0.830552	1.683813	0.38606
5/6	0.857517	1.872666	0.73057	0.944703	2.866745	1.89977
6/7	1.00844	-	-	0.972314	3.572823	3.12196

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Table A15
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for non users of contraceptives.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.161613	-0.60023	-1.66344	0.265121	-0.28334	-1.25932
2/3	0.476587	0.299615	-0.99009	0.568388	0.571016	0.76533
3/4	0.711699	1.078509	-0.3467	0.728924	1.151427	0.09584
4/5	0.816074	1.593323	0.22078	0.828383	1.66983	0.37208
5/6	0.912476	2.390402	1.2483	0.907512	2.332547	1.36556
6/7	0.94108	2.801365	2.09523	0.963137	3.28183	2.83097

Table A16
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women who reside in metropolitan areas.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i+1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i+1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.190081	-0.507	-1.5702	0.264187	-0.286	-1.26198
2/3	0.508896	0.392286	-0.89741	0.548376	0.509503	-0.8269
3/4	0.64786	0.933312	-0.49190	0.792463	1.458395	0.03997
4/5	0.955263	3.084163	1.71162	0.924421	2.543553	1.2458
5/6	0.969696	3.481156	2.33906	0.923245	2.527477	1.5605
6/7	0.909574	2.356208	1.65007	1		

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Table A17
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women who reside in other urban areas.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y -ln(-ln or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.21503	-0.42981	-1.49301	0.294441	-0.20104	-1.17702
2/3	0.689035	0.98762	-0.30208	0.634357	0.787143	-0.54926
3/4	0.631129	0.775996	-0.64921	0.811432	1.56564	0.14721
4/5	0.888844	2.138487	0.76595	0.916346	2.437704	1.13995
5/6	0.752656	1.258268	0.116168	0.961884	3.247775	2.28077
6/7	1.793372	-	-	1		

Table A18
Calculation of Gamma values and Points for plotting on the graph using mean parities and cumulated fertility for women who reside in rural areas.

	Mean Parities			Cumulated Fertility		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AGE GROUPS	r P(i)/P(i +1)	Y=-ln(-ln r) or Z(i)	Y+Q' - Q	r F(i)/F(i +1)	Y=-ln(-ln r) Z(i)	Y+Q' - Q
1/2	0.177629	-0.54699	-1.61019	0.283106	-0.23264	-1.20862
2/3	0.484551	0.322228	-0.96747	0.582114	0.614174	-0.72223
3/4	0.708184	1.064063	-0.36115	0.72658	1.141291	-0.27714
4/5	0.805903	1.533443	0.1609	0.817084	1.599421	0.30167
5/6	0.916437	2.438841	1.29647	0.917814	2.456206	1.48923
6/7	0.97027	3.85394	3.1478	0.966547	3.380649	2.92979

APPENDIX B

Table B1
Mean Parities - terms of Taylor expansion of $Q_i(b)$.

i/i+1	$Q_i(1)$	$Q'_i(1)$	$Q'_i(1)-Q_i(1)$
1/2	-1.58151	-2.64471	-1.0632
2/3	-0.45409	-1.74379	-1.2897
3/4	0.40951	-1.0157	-1.42521
4/5	1.03705	-0.33549	-1.37254
5/6	1.5812	0.4391	-1.1421
6/7	2.21783	1.51169	-0.70614
7/8	3.48685	3.21053	-0.27632

Source: Zaba (1981), Table 5.

Table B2
Fertility Cumulants - terms of Taylor expansion of $Q_i(b)$
(with half year shift).

i/i+5	$Q_i(1)$	$Q'_i(1)$	$Q'_i(1)-Q_i(1)$
14.5/19.5	-1.426	-2.40198	-0.97598
19.5/24.5	-0.11373	-1.45013	-1.3364
24.5/29.5	0.67545	-0.74298	-1.41843
29.5/34.5	1.25957	-0.03818	-1.29775
34.5/39.5	1.8026	0.83562	-0.96698
39.5/44.5	2.61577	2.16491	-0.45086
44.5/49.5	4.50266	4.45641	-0.04625

Source: Zaba (1981), Table 3B.

APPENDIX C.

The Percentage of the Different Variables used for the Regression at the Macro Level.

District

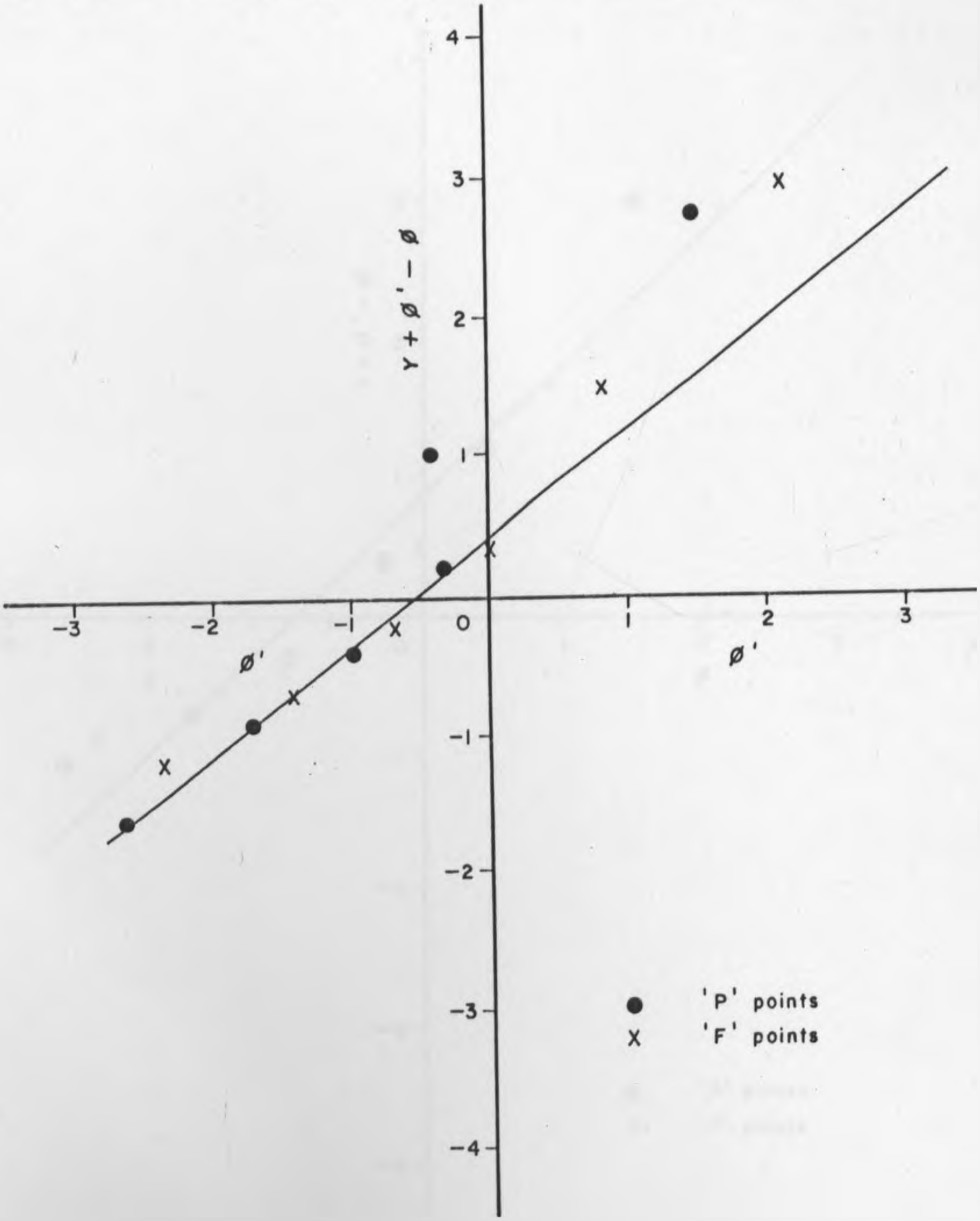
Variable	TFR	SEDUC	HEDUC	RURB	WRK1	WRK3
Nairobi	5.97	33.8	42.5	100	32.9	56.9
Kilifi	7.39	17.1	6	10.4	12.9	78.2
Kwale	5.73	14.7	7.1	6.1	18.6	68.7
Mombasa	6.25	29.1	31.2	100	25.2	63.6
T-Taveta	9.49	35.9	10	12.2	11.2	81.4
Embu	8.62	29.6	20.9	6	8	81.4
Kitui	9.97	28.9	13.3	1.2	20.1	69.4
Machakos	8.62	39.2	22.7	2.5	25.8	60.1
Meru	10.52	28.4	13.1	0	7.7	87.7
Kiambu	7.15	42.9	17.5	12	20.4	61.9
Kirinyaga	9.08	30.3	28.5	5.7	9.5	80.4
Muranga	7.78	45.9	21	5.1	14.4	74.1
Nyandarua	8.92	42.6	14.1	0	8.4	70.3
Nyeri	6.88	43.4	27.7	10.6	14.2	68.3
Kericho	9.52	29	4.4	0.9	24.9	72.3
Nakuru	8.91	37.2	18.9	22.2	22	58.8
Nandi	10.74	27.9	5.8	0	22.3	75.3
Naro-Kaj.	5.63	21.5	15.2	0	38.8	29
Baringo	9.24	4.4	2.9	0	7.2	84
T-Nzoia	7.65	26.6	13.2	10.9	13.1	79.2
U. Gishu	10.99	25.7	7.2	7.5	8.2	87.2
W. Pokot	9.73	24.5	0	0	12.1	84.5
Kisii	10.19	31.7	19.3	5.3	7.5	86.7
Kisumu	7.4	33.2	20	30.7	36.5	51
Siaya	7.46	32.3	6.8	8.3	16	61.3
S. Nyanza	9.75	28.4	7.3	1.9	22.8	59.7
Bungoma	8.88	35	18.4	19.3	14.9	78.3
Busia	7.69	25.5	12	11.8	17.9	67
Kakamega	10.43	32.1	20.8	5.2	15.2	76.2

Cont. of APPENDIX C.

District / Variable	WRKHB	WRKHN	POLYG	EVUSE	OTHERS	MAGE
Nairobi	73.6	4	16.1	35.5	5.3	42.4
Kilifi	25.2	29	38.3	11.2	10.8	57.3
Kwale	33.3	19.9	32.1	13.3	10.1	57.3
Mombasa	65.1	10.1	18.2	32.9	4.6	34.7
T-Taveta	41.3	18.4	18.7	21.7	10	58.7
Embu	26.9	53.1	16.8	39.6	7.4	32.1
Kitui	41	27.5	25.7	33.2	5.2	44.3
Machakos	44.1	9.2	9	47.4	12.1	40.2
Meru	24.8	5.3	13.5	37.8	4.7	41.9
Kiambu	44.5	16.7	6.1	39.7	9.4	24.1
Kirinyaga	28.2	21.5	9.9	46.4	4.2	37.8
Muranga	27.2	35.9	4.9	39.3	6.9	33.7
Nyandarua	26.5	51	13.9	40.1	8.8	34.8
Nyeri	43.8	28.6	8.1	47.5	7.1	22.8
Kericho	14.9	24	18.3	30.2	19.5	53.7
Nakuru	37.5	32.8	16.4	37	9.4	44.6
Nandi	9.6	30.6	34.1	16.9	4.3	60.6
Naro-Kaj.	29.2	20.3	60.1	65.8	16.5	63.5
Baringo	17.4	57	24.9	27.2	2	50
T-Nzoia	19.9	42.8	31.7	9.9	6.9	56.7
U. Gishu	22.6	45.3	28.6	13.3	7.8	51.6
W. Pokot	15.8	55.3	18.7	11.7	0	51.7
Kisii	39.3	39.9	26.8	16.4	10.3	61.7
Kisumu	28.5	31.8	37.6	30.5	7.9	58.5
Siaya	25.8	41.9	47.2	20.9	6	64
S. Nyanza	15.6	55.4	40.6	16.9	6.3	70.5
Bungoma	4.7	51.2	37.5	15.6	4.8	57.3
Busia	19.3	29.8	45	16.9	6.1	54.6
Kakamega	34.2	30.4	18.3	13	5.7	53.5

APPENDIX D : FITTING OF THE GOMPERTZ MODEL.

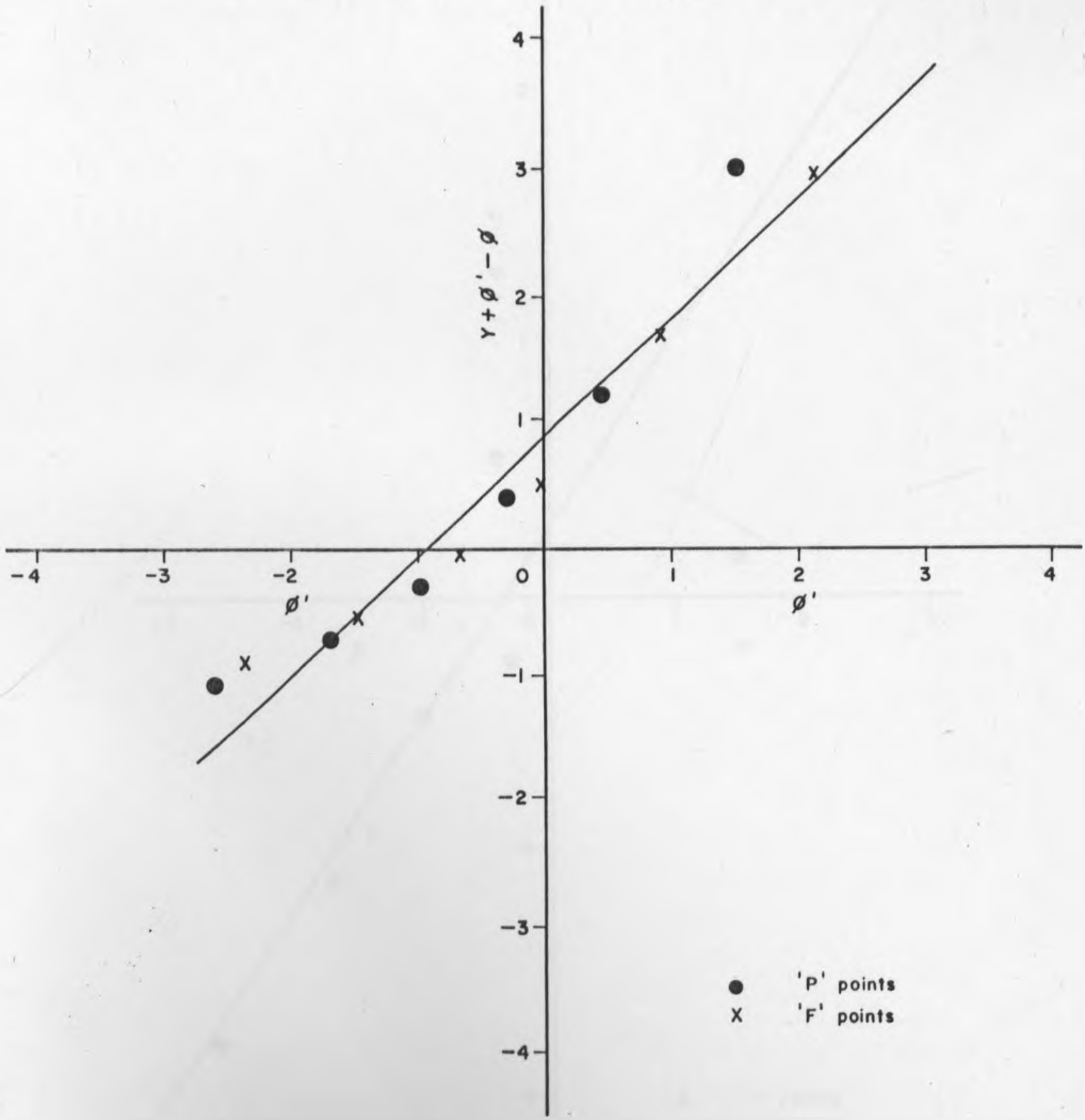
Fig. I KCPS WHOLE SAMPLE



Parity reporting affected by omission of children ever born by older women

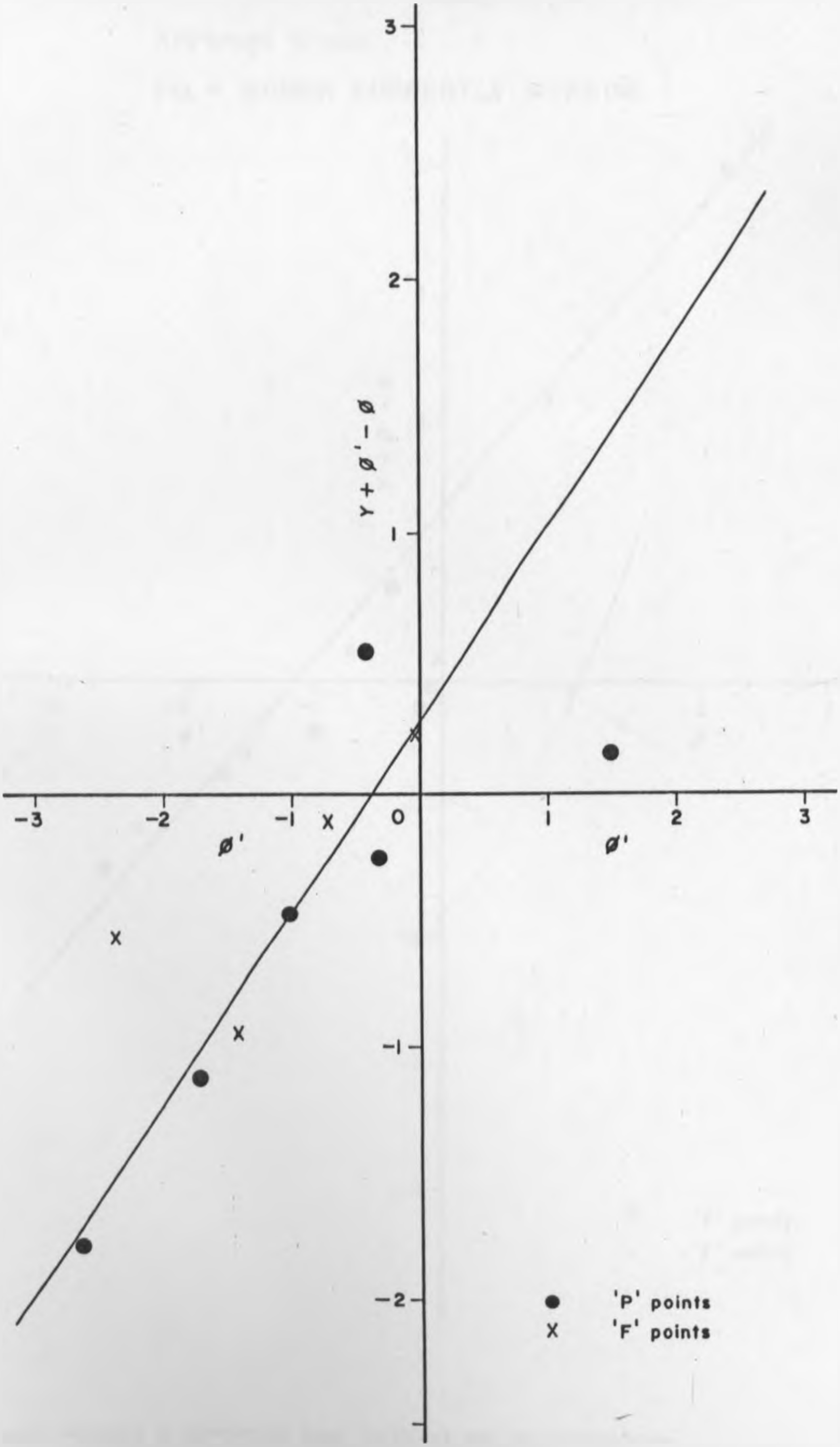
APPENDIX D cont.

Fig. 2 WOMEN WITH ZERO YEARS OF EDUCATION



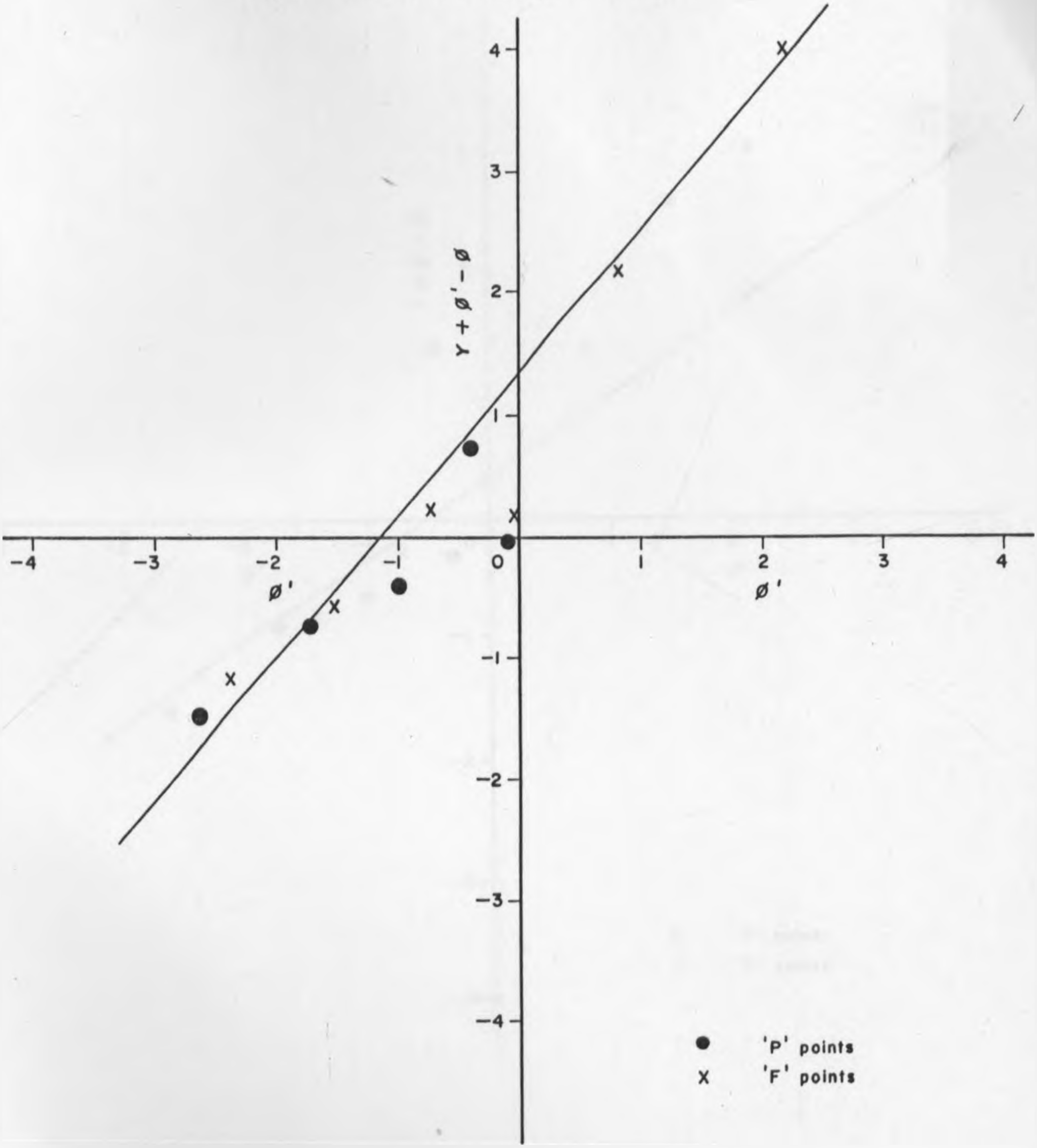
Parity reporting is affected by omission of children ever born by older women

Fig. 3 WOMEN WITH 9+ YEARS OF EDUCATION



APPENDIX D cont.

Fig. 4 WOMEN CURRENTLY WORKING

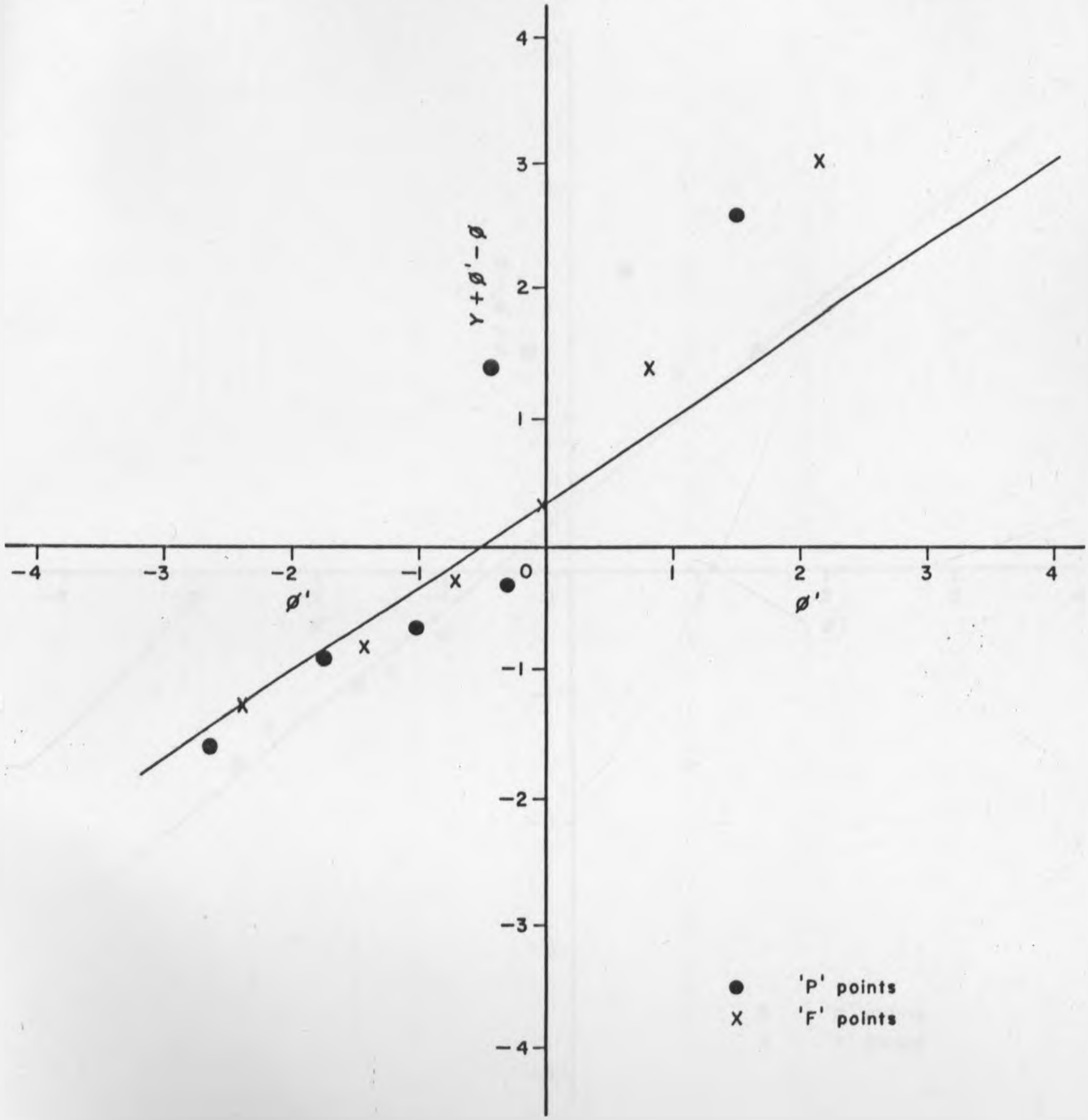


Parity reporting is affected by both omissions and age exaggeration

Note : that the last 'P' point does not exist because omissions are so large in the last age group that $P_6 > P_7$

APPENDIX D cont.

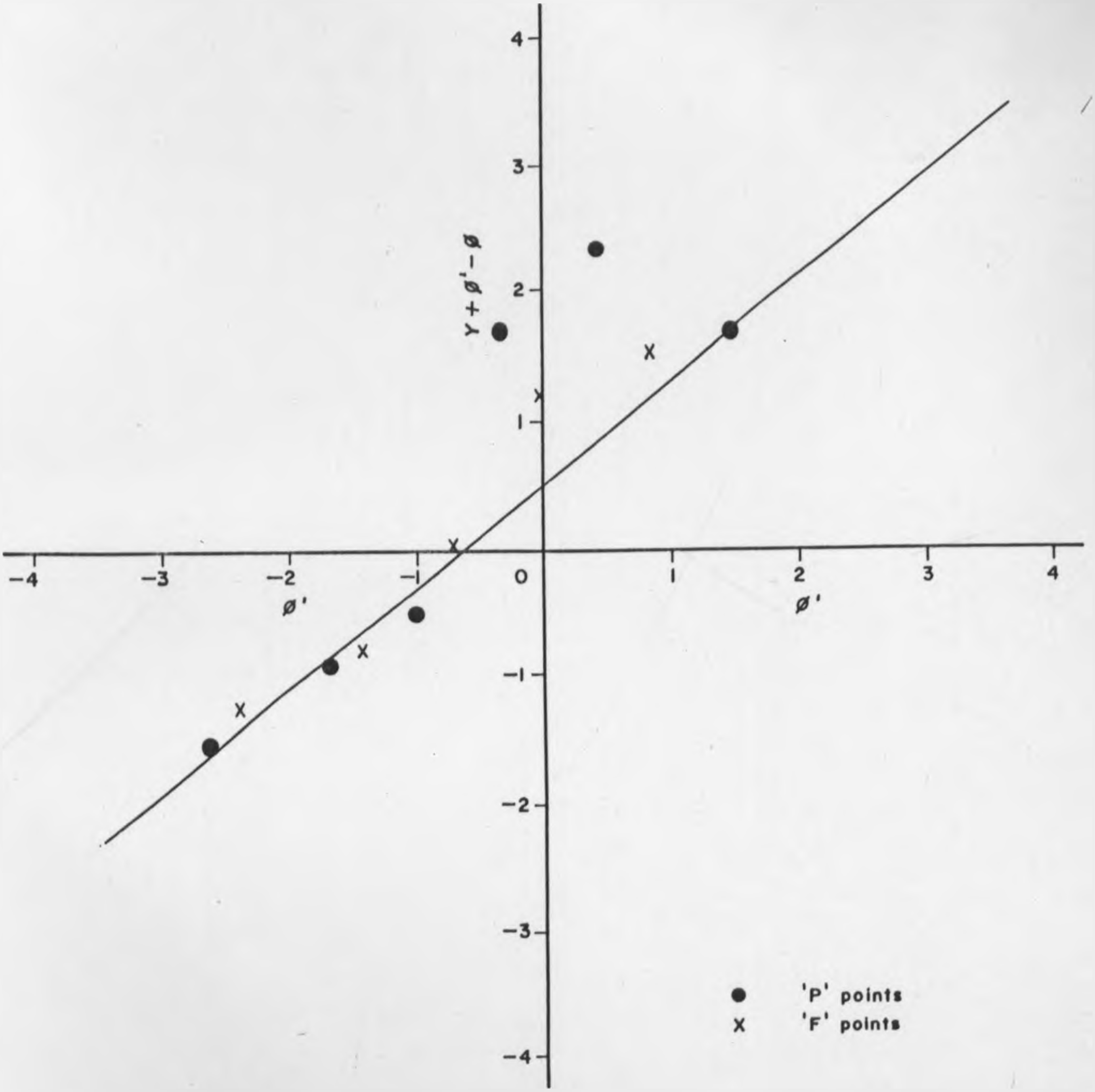
Fig. 5 WOMEN : NEVER WORKED



Parity reporting is affected by omission of children ever born by older women

APPENDIX D cont.

Fig. 6 WOMEN IN METROPOLITAN AREAS



Parity reporting is affected by omission of children ever born by older women.

Note: that the last 'F' point does not exist because omission of current births in the last age group are so large that $F_6 > F_7$