

**FERTILITY IN KENYA; PATTERNS AND
DETERMINANTS, 1989-2014**

**BY
ANTONY ABILLA**

**A RESEARCH PAPER SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
MASTERS OF ARTS IN ECONOMIC POLICY MANAGEMENT OF
THE UNIVERSITY OF NAIROBI**

JANUARY 2018

DECLARATION

This Research Paper is my own original work and has not been presented for a degree in any other university.

ANTONY ABILLA

X51/76361/2012

.....

Signature

.....

Date

This Research paper has been submitted for examination with my approval as university supervisors.

DR. ANTHONY WAMBUGU

.....

Signature

.....

Date

ACKNOWLEDGEMENT

For your kind heart and unwavering support through this entire process, be blessed always.

TABLE OF CONTENTS

DECLARATION	i
ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	vi
LIST OF FIGURES	vii
ACRONYMS	viii
ABSTRACT	ix
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background of the Study.....	1
1.1.2. Fertility in Kenya	1
1.1.3. Evolution of Population Policies in Kenya	3
1.2. Statement of the Problem	5
1.3 Research questions	5
1.4. Objectives of the Study	6
1.5 Justification of the study	6
CHAPTER TWO	7
LITERATURE REVIEW	7
2.1 Introduction.....	7
2.2 Theoretical Literature Review.....	7
2.3 Empirical Literature Review	8

2.3.1 Family Planning and Use of Contraceptives	8
2.3.2 Labour Force Participation and Income	10
2.3.3 Education	10
2.3.4 Child Mortality	12
2.3.5 Place of residence.....	13
2.4 Overview of the Literature	13
CHAPTER THREE	15
METHODOLOGY.....	15
3.1 Introduction	15
3.2 Study Design	15
3.3 The Theoretical Model.....	15
3.4. The Empirical Model	17
3.5. Empirical Specification of the Model	18
3.6. Definition and operationalization of variables	20
3.7. Data Sources	23
CHAPTER FOUR.....	24
RESEARCH FINDINGS AND DISCUSSION	24
4.1 Introduction.....	24
4.2 Descriptive Results.....	24
4.3 Econometric Results.....	26
4.3.1 Choice of Count Data Model	26

4.3.2. Estimated Model Coefficients	29
4.3.3. Relative Importance of women fertility determinants.....	38
4.4 DISCUSSION	39
4.4.1 The determinants of fertility at the individual woman level in Kenya.....	39
4.4.2 Relationship between number of children ever born and its correlates.....	42
CHAPTER FIVE.....	44
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	44
5.1 Summary of findings.....	44
5.2 Conclusion	44
5.3 Recommendations	45
5.4 Areas for future research.....	46
References	47

LIST OF TABLES

Table 1: Age-Specific Fertility Rates & Total Fertility Rates in Kenya 1978 to 2014	3
Table 2 : List of Variables, their description and measurements	19
Table 3: Socioeconomic and household characteristics of women between the ages of 15 to 49	25
Table 4: Sample means and variance for DHS datasets for the years 1989 to 2014.....	27
Table 5: Percentage of birth counts for the period 1989 to 2014.....	27
Table 6: Alpha results for zero inflated binomial Poisson regression.....	28
Table 7: Determinants of women fertility; Poisson-Logit Hurdle regression results (Coefficients and P-Values).....	31
Table 8: Odds Ratio (eform) for the determinants of fertility	33

LIST OF FIGURES

Figure 1: Kenya Population Projections 2008 to 2040	2
Figure 2: Trends in Total fertility rate, 1978-2014 in Kenya	2

ACRONYMS

AIC	Akaike's Information Criterion
CBS	Central Bureau of Statistics
DHS	Demographic Health Surveys
FP	Family Planning
ICPD	International Conference on Population and Development
KCS	Kenya Community Survey
KDHS	Kenya Demographic Health Survey
KNBS	Kenya National Bureau of Statistics
MLE	Maximum Likelihood Estimation
MLT	Maximum Likelihood Tobit
MOH	Ministry of Health
NCAPD	National Coordinating Agency for Population and Development
OLS	Ordinary Least Square
PoA	Programmes of Action
RH	Reproductive Health
STD	Sexually Transmitted Diseases
TFR	Total Fertility Rate
WDI	World Development Indicators

ABSTRACT

Despite significant fertility reduction in the 1980s and 1990s, fertility decline in Kenya has since slowed down. Between 1998 and 2014 fertility only declined by 17% moving from 4.7 children per woman in 1998 to 3.9 in 2014 compared to a reduction of 42% in the earlier years from 8.1 in 1978 to 4.7 in 1998. The study examined fertility in Kenya at the individual woman level, using cross-section data from the Kenya Demographic and Health surveys for the years 1989, 1993, 1998, 2003, 2008 and 2014. Applying a Poisson-logit hurdles model, the study determines that fertility in Kenya is on a declining trend and possibly at the onset of the demographic transition with the most important determinants showing inconsistent patterns in their influence across the years. The age of a woman, child mortality and woman's level of education are significant determinants of fertility and their influence remained consistently the same over the years. Wealth status, use of modern contraceptives, employment, place of residence and the number of females in the household showed inconsistent patterns across the years. Child mortality, the age of the woman, lower wealth quintile in relation to higher wealth quintile had a positive effect on fertility while, education level, residency in urban areas, use of modern contraceptives in relation to non-use, higher wealth quintiles in relation to lower wealth quintiles had negative effects on fertility. Policy scenarios will thus depend on a suitable environment that leads to the elimination of factors that are enhancing fertility while also promoting those factors that limit fertility if the primary focus is to reduce fertility rates and vice versa.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Kenya faces rapid population growth. The Kenya National Housing Census of 1999 enumerated 28.6 million people (KNBS, 2010), while the census in 2009 enumerated 38.6 million people (KNBS, 2010). This represents an average population increase of approximately 1 million people per year or an overall population increase of about 33% in less than 10 years. In the 30 years leading to 2009, the population had grown from 15.3 million people in 1979 to 38.6 million people, which represented an annual growth of about 3% that translates to an overall population growth factor of 2.5% over in this period. (KNBS, 2010).

The 2009 household census shows that Kenyan Population is largely youthful. Forty-two percent of the total population is below 15 years of age (KNBS,2010). This means there is an impetus for possible future population growth. The National Coordinating Agency for Population and Development (NCAPD) projects that at the current fertility rates, Kenya's population would increase by 100% from 38 million people in 2008 to 82 million people in 2040 (see figure 1) if fertility declines to 4 children per woman, while if the fertility rates reduce to the global replacement levels of 2.1 children per woman (Searchinger *et al.*, 2013), the total population would only increase by 70% to 65 million in the year 2040.

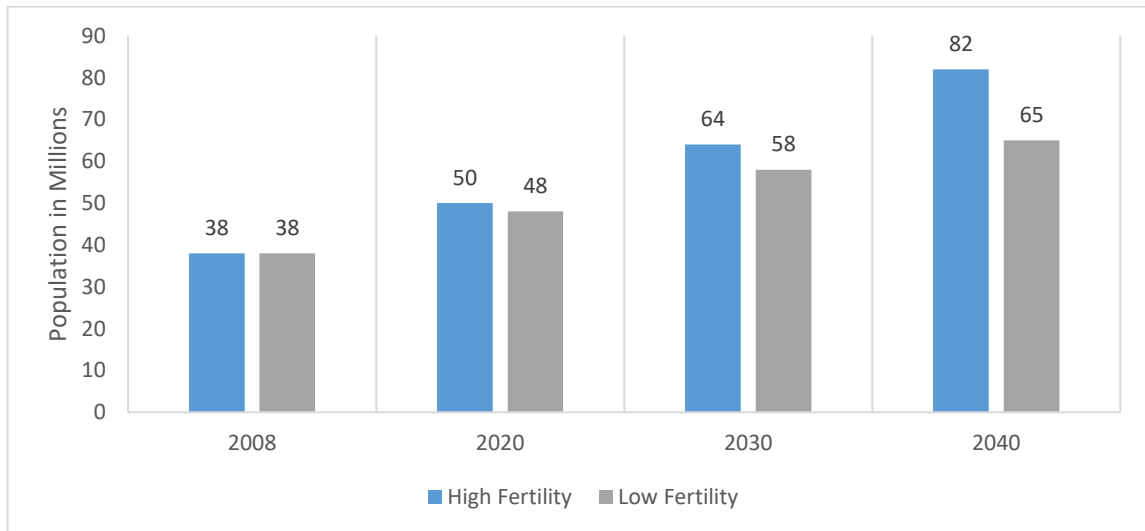
1.1.2. Fertility in Kenya

Kenyan women have a high fertility rate. The average births per woman in the mid-2000s was 4.5 and between the years of 1998 and 2008 fertility rates averaged at 4.7 (World Bank, 2016). However, fertility in Kenya declined from the 1960s before slowing down in the late 1990s. These variations in Total Fertility Rates (TFR) have occurred in the context of modest economic growth in Kenya between the 1960s and 2000s (Blacker *et al.*, 2005).

There has been a considerable decline in overall fertility trend in Kenya since 1977. (See figure 2) Fertility dropped drastically from 8.1 in 1978, 6.7 children per woman in 1989 to 4.7 in 1998. It increased slightly to 4.9 in 2003 up from 4.7 in 2008 before falling further to 4.6 in 2008. This is a decline of only 2% in the ten-year period between 1998 and 2008 compared

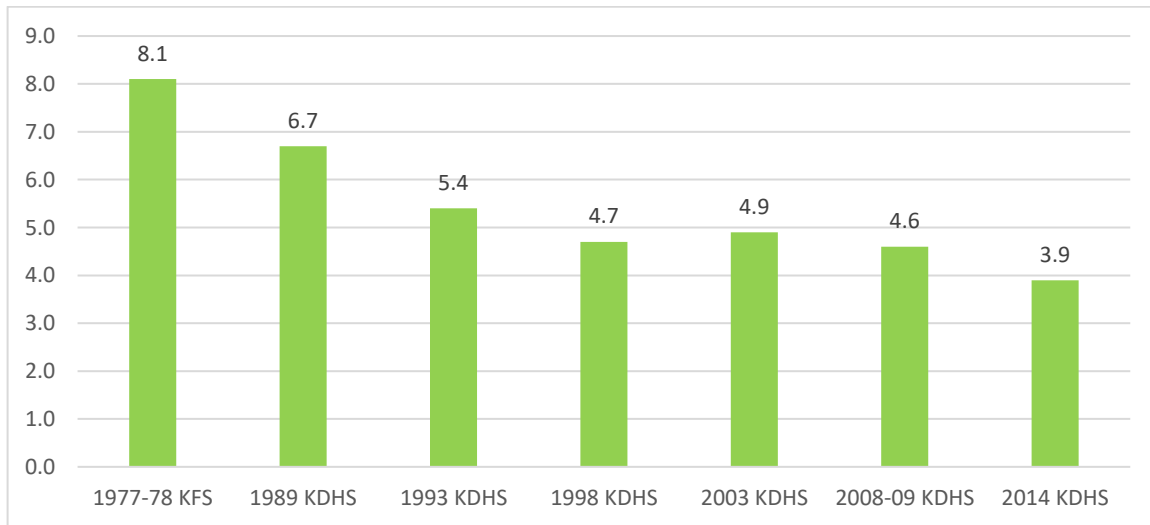
to a drop of 30% between 1989 and 1998 and a decline of 17% between 1978 and 1989. There has been a further reduction in TFR of 15% to 3.9 in 2014, a significant drop from the 2003 level of 4.9 children per woman marking a one-child decline in the past 10 years (KNBS and ICF Macro, 2014).

Figure 1: Kenya Population Projections 2008 to 2040.



Source: National Coordinating Agency for Population and Development, (2010). Projections take into account the effects of HIV and Aids.

Figure 2: Trends in Total fertility rate, 1978-2014 in Kenya



Source: Kenya Demographic Health Survey 2014 Final Report. Data from 2003 are nationally representative while data before 2003 exclude North Eastern region and several Northern districts in the Eastern and Rift Valley Regions.

From table 1 we observe that women, aged from 20-34 have the highest births compared with the women of the other age groups. The women aged 20-34 years show the highest number of births from the late 1970s to 2014. These women form the bulk of the population in the prime age of reproduction in this and the next generation and thus play a greater role in determining the overall population growth. However, examining the 2014 KDHS data we notice that the greatest fall in fertility is among the women at peak childbearing ages (20-34) when compared to the preceding years implying that government policy interventions may be having a reduction effect on fertility.

Table 1: Age-Specific Fertility Rates & Total Fertility Rates in Kenya 1978 to 2014

Mother's Age at Birth	1977/78	1989	1993	1998	CENSUS	2003	2008-09	2014
	KFS	KDHS	KDHS	KDHS		KDHS	KDHS	KDHS
	1975-78	1984-88	1990-92	1995-97	1999	2000-02	2006-08	2011-13
15-19	168	152	110	111	142	114	103	96
20-24	342	314	257	248	254	243	238	206
25-29	357	303	241	218	236	231	216	183
30-34	293	255	197	188	185	196	175	148
35-39	239	183	154	109	127	123	118	100
40-44	145	99	70	51	56	55	50	38
45-49	59	35	50	16	7	15	12	9
TFR	8.1	6.7	5.4	4.7	5	4.9	4.6	3.9

Source: Kenya Demographic Health Survey (KDHS) Final Report, 2008.

1.1.3. Evolution of Population Policies in Kenya

Kenya has had numerous population policies instituted to guard against high population growth. The first was in 1967. It focused on family planning (FP) through the establishment of family planning clinics aimed at lowering births (Thuku *et al.*, 2013). The programme was voluntary and was respectful of the wishes, religious beliefs and customs of the individual parent's (Muia *et.al.*, 2003). Ajayi & Kekovole, (1998) argue that because of its narrow operational focus within the Ministry of Health (MOH), the policy failed to tackle the issue of high population growth.

The 1967 policy was revised to produce the Sessional Paper No.4, of 1984 on population policy (Muia *et.al.*, 2003). This incorporated both socio-economic and demographic goals diversified implementing ministerial offices and non-governmental, as well as religious organizations with clear intentions of reducing the population growth rate, fertility, infant mortality, and child mortality along with reducing the rural-urban and rural-rural migration. In the years that followed its application, a decline in population growth and fertility, increased knowledge on FP methods and elevated levels of contraceptive use, a decrease in sizes of ideal family, and increased immunization among children was observed (Thuku *et al.*, 2013). However, unmet need for FP, rural-urban disparities in fertility and mortality, high teenage fertility and high incidences of Sexually Transmitted Diseases (STDs) hindered its effectiveness (Republic of Kenya, 2012).

The 1994 National Population Policy was thus developed to address these failures and difficulties. This policy was modeled after the Programmes of Action (PoA) identified in Cairo during the 1994 International Conference on Population and Development (ICPD). Even though ICPD intensified focus on Reproductive Health (RH) policies and programmes, it failed to provide a comprehensive blueprint for implementation. With no clear guide, the Kenyan government shifted its population programmes and policies from a prominence of realizing her demographic targets for reduced population growth, to focussing on improving the RH of the population (Republic of Kenya, 2013). The Sessional Paper No. 1 of 2000 domesticated the ICPD/PoA of 1994, guiding implementation of these programmes up to 2010 (Republic of Kenya, 2013).

In the year 2012, the Sessional Paper No 3 of 2012 on Population Policy for National Development took over from the Sessional Paper No 1 of 2000. This paper presented a policy framework aimed achieving a high quality of life for the Kenyan population while integrating emerging demographic concerns and Kenya's Development framework as outlined in the Kenya Vision 2030 shifting focus from RH programs back to demographic targets (Republic of Kenya, 2012). To encourage further decline, it outlines a policy that seeks to encourage women to reduce their fertility by trying to change and influence the woman's desire to have children at the early stage of the reproduction process by improving education and increased awareness of FP methods (Republic of Kenya, 2012).

1.2. Statement of the Problem

Kenya targets to have a TFR of 2.1 by the year 2050 (Republic of Kenya, 2012). Despite significant fertility reduction in the 1980s and early 1990s, in the mid-2000s fertility decline in Kenya has slowed down. The common assumption in population projections is that once a population initiates a fertility decline, the process will remain until fertility falls to or below the replacement level (Searchinger *et al.*, 2013). However, in Kenya between 1998 and 2014 fertility only declined by 17% moving from a high of 4.7 children per woman in 1998 to 3.9 in 2014 compared to a reduction of 42% in the earlier decades moving from 8.1 in 1978 to 4.7 in 1998 (KNBS and ICF Macro, 2014). It is not clear why the rate of fertility reduction is slowing down in Kenya. With the slowdown, the targeted replacement level of 2.1 by the year 2050 may not be achieved.

Recent studies of fertility in Kenya have examined the factors that affect fertility at a point in time. These include, Askew, *et al.*, (2009); Anyara & Hinde, (2005), ; Blacker, *et al.*, (2005) ; Kabubo-Mariara, *et al.*, (2009) ; Ojaka, (2008) ; Ezeh, *et al.*, (2009) and Mutuku, (2013). These studies have relied on cross-section data at a particular point in time to examine fertility determinants. The question of changes in fertility determinants and hence fertility decline has not been addressed. This study seeks to fill this gap by empirically exploring the determinants of fertility in Kenya at the individual woman level, using cross-sections data for 1989, 1993, 1998, 2003, 2008 and 2014 periods.

1.3 Research questions

This study aims to find answers to the following research questions for the case of Kenya.

1. What factors determine fertility at the individual woman level in Kenya?
2. Have the factors that determine individual fertility in Kenya changed over the period 1989 to 2014?

1.4. Objectives of the Study

The main objective of the study is to empirically examine how the correlates of individual fertility have changed over the period from 1989 to 2014. The specific objectives of the study are

- a) To estimate a fertility equation of the total number of children ever born to a woman in Kenya using repeated cross-sectional data.
- b) To determine how the relationship between the number of children ever born and its correlates changed between 1989 and 2014.
- c) To draw policy implications from the findings.

1.5 Justification of the study

In a period of 30 years, Kenya's population has almost increased fourfold from 10.9 million inhabitants in 1969 to about 40 million inhabitants in 2014. The results of the study can help understand the trend in population growth. The results can also help policymakers in planning, monitoring, and evaluation of maternal and child health programs.

The study adds to the existing literature on fertility by presenting findings on fertility research conducted using six KDHS datasets covering a period of two and a half decades. In so doing, the study will provide information to the policymakers and the research community concerning the patterns, determinants and the dynamics of fertility over the said period. The findings of this study will additionally provide a suitable starting point for conducting further research on the efficacy of the varied population policy outcomes based on how the previous population policies have affected fertility in Kenya.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the literature on the determinants of fertility decisions. The first part examines the economic theories on fertility decisions. The second part reviews the empirical studies on the determinants of fertility decisions that have an economic orientation. The third and final part presents the overview of the literature.

2.2 Theoretical Literature Review

Becker (1960) outlined the central economic theory of fertility. In this theory, fertility choice depended on the value that parents assigned to their offspring under the quality-quantity framework. It postulated that parents agree about fertility goals on the basis of comparative costs of children, the parent's income, and their preferences for children against consumption as well as the quality and quantity of the children born. Parents who have more children commit less of their time and resources to each of their child and vice versa. This framework advances an inverse relationship between the number of children and the total investment in human capital for those children.

Parents wishing to have children and provide for their welfare will invest in their children's education. However, since the parents in question are faced with limited material and non-material resources, they have to make a choice in that those that want a high level of human capital for their children must limit the number of children (Becker, 1960). If the parents in due course decide to give priority to the number (quantity), the level of schooling and human capital (quality) they can provide will be reduced. Conversely, if the parents decide to prioritize the high level of human capital and schooling (quality) they can provide, they will be forced to reduce the number of children. Hence, the negative relationship between quantity and the quality of the children (Becker and Lewis, 1973).

The Easterlin framework (Easterlin, 1975), supplements Becker (1960) and Becker and Lewis (1973). In this framework, fertility decisions by parents acting as utility maximizing agents, in the same style as explained by Becker, needed more emphasis on the role of social norms in influencing their preferences. It reiterated that children were to be treated as commodities

like any other whose supply or demand depended on the preference of the active agents, which in this case were the parents and associated the desire for children to the demand for goods and services. It further suggested that the number of children who survived would depend on their survival probability; the rise of infant survival projections would decrease the likely number of children born thus the prospective output of children (the demand) would vary directly with the natural fertility (the supply) in absence of fertility control. Therefore, in this framework income, children costs and parent preferences relative to the demand for other goods and services are all immediate elements of the demand for children (Easterlin, 1975; 1978).

In summary, the work of Becker (1960), Becker and Lewis (1973) and Easterlin (1975; 1978) marked the birth of the microeconomic modeling of fertility. For Becker, the emphasis was on the parent's preferences for children set against competing forms of consumption. For Easterlin, the emphasis was on the importance of the shadow prices for the children, which was not limited to the price of market inputs but included the opportunity cost for the parents in terms of forgone earnings. In both cases, however, the economic fertility models considered the children as durable goods from which the parents derived fulfillment and thus consequently based on the constraint of resources and time they maximized their utility. These models of fertility transformed all fertility decisions into a utility maximization problem whose outcome depended on the preference of the participating agents, parents, subject to an outlined non-linear cost structure, with the preferences facing exogenous influence (Becker, 1960; Becker & Lewis, 1973 and (Easterlin 1975;1978).

2.3 Empirical Literature Review

The section is divided into parts with a focus on the major determinants of fertility decisions as argued by the majority of the studies in the field, namely education, child mortality, labour participation and income, and place of residence among other demographic variables.

2.3.1 Family Planning and Use of Contraceptives

Family planning programmes aid in the reduction of fertility by increasing the availability of contraceptives. Hammerslough, (1992) using data from rural Kenya in 1989 finds that increased contraceptive services accelerated Kenya's fertility reduction and concludes that the availability of family planning is necessary but not efficient in fertility reduction. Jain and

Ross (2012) used DHS data from 40 developing countries to examine the associations between socioeconomic conditions, family planning program strength, and fertility. The results show that fertility is generally lower in countries with stronger family planning programs and good socioeconomic standing. Goldberg *et al.*, (1989) examined the contraceptive use and fertility decline in Chogoria Kenya and the results show higher contraceptive prevalence in Chogoria than the national average and fertility was 2.5 births lower than the national fertility rate. Emereuwaounu & Emereuwaounu, (1984) finds that in Nairobi, the expression and support for modern contraceptive values are voiced mainly by wives with a larger number of children and such is a consequence of higher fertility and not the cause of it.

Nguyen-Dinh,(1997) find that community knowledge of contraception had a negative effect on fertility among the women in Vietnam. Zurayk, (1979) using the Bongaarts Index establishes that contraception use has a stronger influence on fertility reduction in the upper and lower social class women in Rural South Lebanon. Phillips *et al.*, (1988) and Debpuur *et al.*, (2002) in their respective studies in Bangladesh and Northern Ghana find that the existence of good family planning reduces fertility in these countries. Benefo & Pillai, (2005) using categorical data on 1988 Demographic and Health Survey, 1988-1989 Living standards survey and the 1988 Population Census finds that access to family planning services has a positive effect on reduction in family size preference, knowledge and desire to use contraception among men and women in rural Ghana.

Casterline and El-Zeini, (2014) using survey data from 45 countries in Africa, Asia and Latin America and the Carribean from the mid-1970s to 2014 find that fertility declined when unmet fertility planning needs were reduced. Diamond-Smith *et al.*, (2014), find that for women in France, increasing the effectiveness of user-dependent family planning methods currently being used was more effective in reducing unintended pregnancy than altering the method of contraceptive. Jejeebhoy *et al.*, (2014) finds that in six Indian states: Andhra Pradesh, Bihar, Jharkhand, Maharashtra, Rajasthan, and Tamil Nadu, increased premarital awareness of contraceptive options among the married women aged 15–24 facilitated the adoption of appropriate contraception after marriage to delay first pregnancy.

2.3.2 Labour Force Participation and Income

Greater female labour force participation will negatively impact fertility. The impact of income on fertility, on the other hand, is inconclusive. Fang, *et al.* (2012) analyzed the 2006 China Health and Nutrition Survey data to assess how female employment affects fertility in China. They find that female employment negatively affects fertility. Engagement in employment activities decreases the desired number of children by 0.35 and the actual number of children by 0.50.

Schultz (2005) analyzed the Kenya Household Welfare Surveys of 1994 and 1997 and found that consumption from incomes from land ownership, agricultural and non-agricultural rents are positively related to fertility in Kenya. But a 10% increase in household consumption per adult from other sources reduced fertility by 0.20 child in 1994 and 0.18 child in 1997 implying that increasing other sources of income such as such as labor earnings decrease fertility. Nguyen-Dinh, (1997) finds that in Vietnam, a stable source of income has a negative effect on fertility and that women working in non-agricultural sectors have fewer children compared to those in nonagricultural sectors while unemployed women had the highest fertility.

Chani *et al.*, (2011), empirically examined the long run relationship between fertility and female labour force participation among other variables in Pakistan between 1980 to 2009. They find that female labour force participation has both long run and short run negative but insignificant relationship with fertility. Murthi *et al.*, (1995) found that in India, female labour force involvement has a negative and significant effect on the total fertility rate. Lata and Mitra (2001) find that employment is positively related to the number of pregnancies in South Africa. Mooeni *et al.*, (2014) using data linked from numerous Iranian datasets covering the period between 1986,1996,2006 and 2011, find that with better economic conditions, the parent's preferences shifts towards fewer but more qualified children.

2.3.3 Education

Education is usually connected with every aspect of fertility outcomes. This is because it affects both the parental productivity in childbearing, contraceptive use as well as the overall separable preferences for children (Ushie, *et al.*, 2011). For the women, education signifies the women's independence and ability in the society, in that a highly educated woman can opt

to have fewer children for the reason that there is a higher opportunity cost in term of wages that she may have to forego (Aksan, 2014). In examining the role of education to determine fertility behaviour various studies have come up with similar findings. Sather *et al.*, (2003), in rural Pakistan, examines the roles of girls schooling opportunities as a motivation for fertility change. Using primary data of women in rural Punjab and North West frontier, they find that girl schooling impacts contraceptive use predominantly by helping a woman operationalize their wishes rather than by prompting changes in their fertility decisions and thus affect fertility more prominently.

Emereuwaounu & Emereuwaounu, (1984) applying a multivariate analysis on data from women in Nairobi, finds that wives education does not show any statistical independence in explaining fertility but has a negative correlation of -0.171 between education and fertility among these women and that wives with post-primary education had the smallest number of children compared to all other women. Nguyen-Dinh, (1997) finds that higher maternal education has a larger negative impact on fertility among women in Vietnam. Ahmed (2010) uses data from 600 household residents in Urban and rural Gezira in Sudan, finds that a year's increase of the woman's schooling reduced fertility levels by 2.4% more than the average. In attempting to answer what would happen to fertility if all women became literate overnight and nothing else changed in Andhra Pradesh and Utter Pradesh, Parikh and Gupta (2001) using the National Family and Household survey from 1992-1995 they show if all uneducated women were to be educated with no changes in any other thing, the number of living children of an ever-married woman in Andhra Pradesh would go down by 0.15 and in Utter Pradesh by 0.08.

Murthi, et al. (1995), examines district-level data based on 296 districts in India, obtained from the 1981 census, find that female literacy negatively and significantly affects the total fertility rate. Lata and Maitra (2001), find that education is positive and significant in influencing both the number of births only if the threshold of education being greater than primary school is met while Mboup and Saha (1998) show that fertility declines are evident among women with higher education in Ghana, Kenya, and Namibia. Senona (2008), in South Africa using 1998 DHS data, focusing only on women with income between the ages of 15-49, finds that education level has a negative effect on fertility and implies that women would

rather further their education than raise the number of their children. Ketkar,(1979) in Siera Leone establishes that education has a negative direct effect on fertility of the woman and improvement in women's education is expected to reduce fertility. Imai and Takahiro (2014), using various estimation techniques on National Family Health Survey data for the periods between 1992-2006 in India, find that the mother's literacy shows negative effects on fertility.

2.3.4 Child Mortality

Child mortality is important in determining overall fertility. Murthi, *et al.* (1995), while performing district level analysis on Fertility and Gender Bias in India links child mortality to the determination of overall fertility. The study finds that a decline in infant mortality usually accompanies fertility decline and irrespective of their background, parents will compensate for higher infant mortality with more births to increase their children's survival rate. Nguyen-Dinh, (1997) establishes that for the women in Vietnam, even though the effect of child mortality is positive, the quantitative effect is very small. Doubling of the child mortality variable from the mean of 0.01 causes the number of children ever born to increase only 0.053 in the ordered-logit, 0.0058 in the Poisson and 0.067 in the OLS model in the estimation.

Emereuwaounu & Emereuwaounu, (1984) finds that Infant mortality has a powerful independent effect on fertility performance concluding that in the suburbs of Nairobi, wives who suffer from high infant and child mortality have high fertility in an attempt to compensate for the loss. Aksan, (2014) concludes that the higher rates of fertility in Africa are a result of the continued uncertainty with regards to the child's survival given the prevailing high rates of child mortality with those surviving expected to face poor health conditions. Using data from several African countries, they find that community child mortality contributes at least 1.54% more births while replacement fertility contributes to 0.0038% additional births indicating that observed mortality risk tends to be an important driver of high fertility.

Ali, (1985) found out that high infant mortality affects fertility positively in developing countries. Ahmed (2010), in Sudan, finds that child mortality positively and significantly affects fertility and an increase in child mortality will increase fertility by 1.2 and consequently placing the average replacement rate at 2.2. Ketkar,(1979) finds that uncertainty introduced by high child mortality rates increases the number of children ever born in Siera Leone with an estimated elasticity of fertility with respect to child mortality at +0.20.

2.3.5 Place of residence

Findley (1980), using 1973, National Demographic Survey examines how the interaction of place factors among other variables in Tanzania influences fertility and finds that fertility decisions in rural areas are largely influenced by urban-based considerations. Nguyen-Dinh, (1997) finds that residency in rural areas positively influences the number of children for the women in Vietnam while Senona 2008 also finds that in South Africa place of residence inversely affect fertility choices of the individual women. Zhang, (1990) finds that place of residence background among the women in China had a significant effect in the determination of their fertility and that women living in rural areas had higher fertility than their urban counterparts.

2.4 Overview of the Literature

Studies of fertility decisions have been used for different purposes in sociodemographic research as an exploratory practice designed to identify the principal determinants of reproductive behavior. They have also served as an approach to describe and interpret the process of fertility decline and identify the sectors leading the change and as a means of projecting future fertility trends.

In Kenya, these studies have been guided by theories of modernization and the demographic transition. The works of Askew, *et al.*, (2009) ; Anyara & Hinde, (2005), ; Blacker, *et al.*, (2005) ; Kabubo-Mariara, *et al.*, (2009) ; Ojaka, (2008) ; Ezeh, *et al.*, (2009); Mutuku, (2013) have examined fertility from this point of view examining how the proximate factors affect fertility and their consequences to the recent observed fertility trends and their corresponding determinants by examining the existence of differences in reproductive behavior according to certain demographic and socioeconomic characteristics. These studies have used the technique proposed by Bongaarts or any one of its variants, emphasizing the importance of contraception, child mortality, availability of child health care and nutrition services, as key factors important in the determination of total fertility rate variances by socioeconomic characteristics.

Empirical works from Africa and across the globe present arguments that socio-economic variables of female education, female labour force participation and urbanization, place of residence play an important role in determining fertility rates. However, by contrast, income

is a relatively weak predictor of fertility decline, and in most cases shows an unpredictable outcome for fertility in both income variable for the woman and the household. Child mortality and decision to take up forms of family planning also play an important role in that child mortality necessitates a need to have a replacement child while family planning participation limits the number of children thus influencing fertility.

A common trait of these studies, especially studies that apply African DHS data, is the unfitting treatment of socioeconomic variables that translates into a hierarchical or purely descriptive attempts at establishing the relative importance of the variables or to evaluate their independent effects. In this regard, a more dynamic analysis for these variables is required to explain individual fertility behaviors consequently providing a more satisfactory and integrated explanatory framework.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter presents the theoretical model that will be used for the analysis of fertility decisions and will present the model specification, and estimation techniques, the definition of variables and the data sources.

3.2 Study Design

This study is designed as a repeated cross-sectional retrospective study using the KDHS surveys for all the years that the survey data is available. This allows for the examination of previous women exposures to the determinants of fertility in relation to the fertility outcomes as currently established in Kenya. Previous studies gave focus on a single DHS datasets examination at one point in time.

3.3 The Theoretical Model.

Becker, (1960) considered children as durable goods from which parents derive consumption services. Parents maximize utility subject to budget and time constraints. Thus price and income effects on the quantity of children can be examined.

Becker proposed a quality-quantity framework in which a household maximizes utility over the quantity of children **n**, the expenditure on each child called the quality of children **q**, and the quantities of other commodities denoted by **z**.

$$U = u(n, q, z_1, \dots, z_m) \dots\dots\dots (1)$$

There are no good substitutes for children, all the various commodities can be aggregated into a single commodity vector **z**. Thus the utility function in (1) can be rewritten as

$$U = u(n, q, z) \dots\dots\dots (2)$$

Within each household, children are not purchased but result from self-production each household using market goods and services and the own time of the mothers (Becker, 1960). It is important to note that the opportunity cost of the mothers own time, and the household production function differ from one household to the next with similar variations being

experienced in the cost of producing and rearing children. We denote the cost of producing and rearing children to P_n and the cost of other commodities (children substitutes) Z to P_z . The total cost thus should be less than the total income I the family has access to or is available. The family budget constraint can be denoted by

$$P_n n + P_z z = I \dots\dots\dots (3)$$

Under normal marginal utility conditions equation (2) and (3) holding q constant (implying zero quality costs), must satisfy the following condition

$$\frac{\frac{\partial u}{\partial n}}{\frac{\partial u}{\partial z}} = \frac{MU_n}{MU_z} = \frac{P_n}{P_z} \dots\dots\dots (4)$$

If condition (4) holds then the demand for children depends on the relative cost and price of children as well as the full income. This infers that an increase in relative price of children P_n relative to P_z reduces the demand for children and increases the demand for other commodities. But the demand for children is not only affected by the price of children but also by real income.

Assume that in any family all the children have the same quality and that each family produces the best quality of children with its own time and market goods, let P_c be the constant cost of a unit of quality, q the total quality of each child, and thus $P_c(q)(n)$ the total amount spent on children. Then the budget constraint, equation (3) can be modified and represented as follows

$$(P_c q)n + P_z z = I + P_c n q = M$$

$$P_n n + P_q q + P_z z = M \dots\dots\dots (5)$$

The budget constraint is composed of $P_n n$ the cost of children, $P_q q$ the cost of total amount spent on the children in terms of quality and $P_z z$ as the cost of competing commodities.

The problem is to maximize the utility function (2) subject to budget constraint (5). That is

$$\text{Max } u = u(n, q, z)$$

$$\text{subject to : } P_n n + P_q q + P_z z = M$$

The Lagrangian function for the problem is;

$$L = u(n, q, z) + \lambda[M - P_n n - P_q q - P_z z] \dots\dots\dots (6)$$

The first order conditions are as follows,

$$\frac{\partial L}{\partial n} = -\lambda P_n \dots\dots\dots (i)$$

$$\frac{\partial L}{\partial q} = -\lambda P_q \dots\dots\dots (ii)$$

$$\frac{\partial L}{\partial z} = -\lambda P_z \dots\dots\dots (iii)$$

$$\frac{\partial L}{\partial \lambda} = M - P_n n - P_q q - P_z z \dots\dots\dots (iv)$$

Setting the first order condition equal to zero and solving for **n**, **q**, and **z**, the following are the obtained reduced-form equations

$$n = n(P_n, P_q, P_z, M) \dots\dots\dots (v)$$

$$q = q(P_n, P_q, P_z, M) \dots\dots\dots (vi)$$

$$z = z(P_n, P_q, P_z, M) \dots\dots\dots (vii)$$

The demand equation of interest is thus represented by **n = n(P_n, P_q, P_z, M)** which is the demand equation for number of children.

3.4. The Empirical Model

The empirical model fashioned after the children demand function (v) outlines a demand equation for the number for children **n** represented as

$$n_i = X\beta + \varepsilon \dots\dots\dots (viii)$$

where **n_i** is the number of children ever born to a woman **i** during her reproductive cycle, while **X** is a vector of explanatory variables of **P_n**, **P_q**, **P_z** and household income level **M**, **β** is a vector of coefficients and **ε** is the error term.

The response variable (**n**) is discrete and not continuous and a linear model is not appropriate as **ε** is not normally distributed (Zhang, 1990). This study adopted the Poisson model that

assumes that the errors follow a Poisson distribution and that the mean and variance of the errors are equal (Gujarati, 2004).

Thus, the probability that the number of births n is equal to the observed n_i can be represented as

$$\Pr(n_i = n) = (\rho^n e^{-\rho})/n!$$

$$E(n) = var(n) = \rho$$

Where, n_i is the positive integer and ρ is the expectation of the random variables n_i and that ρ is equal to both the expected value of n and also the variance (Winkleman & Zimmermann, 1994).

If we the demand function as a count model and let n_i represent the total of children ever born for the i^{th} woman during her reproductive era and if X_i is the vector of covariates and β is a vector of coefficients then the Poisson model for this study is represented as

$$\Pr(n_i | X_i) = \exp(X_i' \beta) = \exp(\beta_0 + \beta_1 P_n + \mu_i P_q + \delta_i P_z + \omega_i M) \dots \dots \dots (ix)$$

Where P_n is the vector of the cost of children, P_q is the vector of the cost of total amount spent on children in terms of quality and P_z is the cost of competing commodities for the children and $\beta_i, \mu_i, \delta_i,$ and ω_i represent the coefficients. Provided that n_i are independent observations and X_i are the corresponding predictor variables composed of P_n, P_q, P_z and M , then $\beta_i, \mu_i, \delta_i,$ and ω_i can thus be estimated.

3.5. Empirical Specification of the Model

The model estimated for the study of the determinants of fertility is specified as,

$$n_i = \beta_0 + \beta_1 Hz + \beta_2 \log(AM) + \beta_3 EC + \beta_4 LPe + \beta_5 LP + \beta_6 LPun + \beta_7 EWp + \beta_8 EWS + \beta_9 EWt + \beta_{10} CM + \beta_{11} WQ1 + \beta_{12} WQ2 + \beta_{13} WQ3 + \beta_{14} WQ4 + \beta_{15} Ru + \varepsilon_i$$

The description of the respective variables is shown in table 2 below. Reference dummies for education, employment and wealth have been omitted in the model specification in line with the estimation results.

Table 2 : List of Variables, their description and measurements

Dependent Variable	Description	Measurement
Ni	Total Children ever born	Sum of children born alive
Independent Variables		
Hz	Number of female members in the household where the woman resides	Total number of women and girls above 15 years of age
AM	Age of woman at first birth	Age of woman in completed years
Use of family planning		
EC	Dummy for Woman using family planning.	Equal to 1 if a woman is using modern family Planning, 0 otherwise
Employment status		
LPc	Dummy for Woman's participation in casual employment	Equal to 1 if a woman is casually employed, 0 otherwise
LPe	Dummy for Woman's participation in formal employment	Equal to 1 if a woman is in formal employment, 0 otherwise
LP	Dummy for Woman's participation in other forms of employment	Equal to 1 if a woman is in other forms of employment, 0 otherwise
LPun	Dummy for Woman who is unemployed	Equal to 1 if a woman is unemployed, 0 otherwise
Education Attainment		
EWn	Dummy for Woman with no Education	Equal to 1 if a woman has not been educated, 0 otherwise
EWp	Dummy for Woman with Primary Education	Equal to 1 if a woman has received primary education, 0 otherwise
EWs	Dummy for Woman with Secondary Education	Equal to 1 if a woman has received secondary education, 0 otherwise
EWt	Dummy for Woman with post-Secondary Education	Equal to 1 if a woman has received post-secondary education, 0 otherwise
Child mortality		
CM	Number of Children who died before age 5 but were born alive	Sum of children who died before age five borne to the same woman
Wealth status		
WQ1	Dummy for Women in first wealth quintile	Equal to 1 if a woman is in the first wealth quintile, 0 otherwise
WQ2	Dummy for Women in second wealth quintile	Equal to 1 if a woman is in the second wealth quintile, 0 otherwise
WQ3	Dummy for Women in third wealth quintile	Equal to 1 if a woman is in the third wealth quintile, 0 otherwise
WQ4	Dummy for Women in fourth wealth quintile	Equal to 1 if a woman is in the fourth wealth quintile, 0 otherwise
WQ5	Dummy for Women in fifth wealth quintile	Equal to 1 if a woman is in the fifth wealth quintile, 0 otherwise
Place of residence		
Ru	Dummy for women residing in Urban areas	Equal to 1 if a woman resides in Urban areas, 0 otherwise

3.6. Definition and operationalization of variables

Total children ever born

The individual woman is the unit of analysis; the dependent variable is the total number of children ever born by the woman excluding stillbirths. This is the same as was used by Ketkar, (1979), Senona, (2008) and Ushie *et al.*, (2011). The study focused on all women of reproductive age between the years of 15 – 45 across six cross-sectional periods of 1989, 1993, 1998, 2003, 2008 and 2014 Kenya DHS data.

Number of Females in the Household

The household family structure is important in determining fertility within the household. In the extended family prevails in most households. The greater the size of the extended family, the greater will be the fertility because women in the extended family set up tend to have more children than women who are in the nuclear family setup, due to the reduced wife's burden and household cost of rearing children Ketkar,(1979). Since rearing children is mostly delegated to the women in most households, due to culture and tradition, the number of female members in the household is used as an exogenous variable to measure the relative cost of rearing children per household. Therefore, the greater the number of women in the household, the greater will be the fertility. For this study, this was measured by the total number of females aged above 15 years within the same household where the woman resides, in the similar manner used by Ketkar,(1979).

Child Mortality

Child mortality is important in determining the fertility within a household, households experiencing higher child mortality rates have a tendency to have larger family sizes and produce a higher number of children to act as a replacement for those that have died through the direct replacement effect. To measure the effect of this variable, since it introduces a higher degree of uncertainty within the family formation process, the woman's own experience of child mortality was measured as an exogenous variable. For this study, child mortality constituted the total number of children who died before they attained the age of five excluding stillbirths, a similar approach applied by (Ahmed, (2010); Aksan (2012); Murthi, *et al.*

(1995)). Child mortality would consequently have a positive effect on the overall fertility of the woman.

Age of woman

The age of the woman at first birth is essential since it shows the age where the woman first got involved with childbearing. Younger women with children in their early years tend to have a greater capacity to have more children since they are at the onset of their fertility while mature women are almost nearing their completed fertility Ushie *et al.*, (2011). The age of the woman is expected to have a positive effect in relation to an overall number of children borne to the woman. In this study, this was measured in absolute numbers of completed age years at the time of first birth. Younger women are expected to have more additional births and as such the effect of this variable need to be positive in relation to total fertility. For this study, the age group of the women was used to account for the non-linear relationship inherent between a woman's age and the age at first birth (Chani *et al.*, (2011); Ushie *et al.*, (2011)).

Education Attainment

The education level of the woman is an exogenous variable in the fertility equation. In this sense, education is an external source that modifies and alters perceptions that change fertility behavior and thus plays a greater role in determining the number of children born. Measured as the duration spent in school in absolute numbers, this variable should produce a negative coefficient in the fertility equation for longer durations spent in school. In this study, schooling attainment was measured as the highest schooling level completed as was the case for Sather *et al.*, (2003) and Aksan, (2014).

Use of contraceptive

The use of contraceptive for the woman is important since it shows the ability of a woman to be in charge of her childbearing capacity. Women who use contraceptive are less likely to get pregnant and thus will tend to have fewer births than women who do not use contraceptives (National Research Council, 1990). For this study, the type and method of contraceptive were not assessed and any form of contraceptive use was taken as is. Consequently, this variable was measured based on the response, the woman provided to the question of whether she uses modern contraceptives or not (Okech, *et al.*, 2011). The effect of this indicator should be

negative in that fertility control measures should result in reduced births for the women who are using contraceptives.

Employment Status

The employment status of the woman is related to the amount of labour that the woman is able to supply in the market. This is compensated in return with the take-home wages that the woman achieves for participation in the labour market. For the woman, the higher the compensation wage, the higher the incentive to engage in the labour market and commit longer hours at the expense of childbearing (Aksan, 2014). Engagement in the labour market is anticipated to affect fertility negatively. For this study, employment status categorized on the types of employment that the woman is engaged in, either casual, formal or other forms of employment were treated as active measures for employment status (Okech, *et al.*, 2011).

Place of residence

The dummy for the region where the household is located indicates the opportunities available for the members of the household in terms of education, health services, and nutrition as well as employment opportunities all of which can play part in determining fertility as well as the level of income. For instance, occupations in urban areas tend to pay relatively more when compared to those in rural areas (Ahmed, (2010); Okech, *et al.*, (2011). The expected sign of the coefficient of this for this variable cannot be easily determined a priori.

Wealth status

The wealth status is an exogenous variable that will account for the level of assets in the household. This variable is a function of various information from the household characteristics that relate to the household's overall wealth standing and each household categorized depending on their level of wellbeing (Okech, *et al.*, 2011). It acts as a representation of the household assets level.

For this study, the wealth status is measured using the wealth index. This is a composite measure of the households living standard computed and generated through principal component analysis of data on household's ownership of selected assets, such as televisions and bicycles, materials used for housing construction and types of water access and sanitation

facilities (KNBS and ICF Macro, 2014). As a result, all individual households are separated and placed on a continuous scale of relative wealth known as the wealth Index which is divided into five quintiles.

3.7. Data Sources

The study analyzed DHS datasets for Kenya covering the period 1989 to 2014. Within this period, a detailed process of data collection covering both the socio-economic and demographic profiles of all women aged between 15 and 45 years of age in their core reproductive ages were carried out using DHS data sets.

DHS is a national survey in which respondents are drawn using a multi-stage cluster sampling technique and sampling weights are always used. The survey always involved an individual woman survey questionnaire (among others) including variables on individual bio-demographic factors, household characteristics, and women in the selected households of the reproductive age (15-49 years) was asked to participate in the study. The datasets used in this study contained information on women who had had children or who reported to have never had children. The study was intended to apply all the six DHS datasets; however, the 1989 data set was excluded from the regression analysis since it had a number of variables not consistent with later DHS' surveys and a number of variables considered useful in this study were not properly recoded in the 1989 survey.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study and their interpretation. The analysis dwells on the determinants of fertility for the period between 1989 to 2014. The first section presents the descriptive statistics. The second section presents econometric results detailing the choice of the count model and the estimated model coefficients. A final section discusses the results.

4.2 Descriptive Results

Table 2 presents the descriptive statistics of the socio-economic and household characteristics of women between the ages 15 to 49 years from the various KDHS data sets. The total number of children ever born to a woman consistently decreased from 1989 to 2014. The average number of children born to a woman in 1989 was 4.9, which then declined to 3.17, 2.89, 2.75, 2.68 and 2.48 respectively for the years 1993, 1998, 2003, 2008 and 2014. The number of females where the woman lives did not show variations averaging at 1.66 women per household for the entire period of the study.

The average age at first birth increased marginally from 1989 to 2014 rising from a low of 18.12 in 1989 to 19.58 in 2014. This shows that in the span of two and a half decades the age at first birth for the women has risen by 1.46 years.

The penetration of modern family planning contraceptives showed improvement. The penetration of contraceptives steadily rose from 16.33% in 1989 the first DHS survey to reach 39.13% in 2014. This is indicative of progress by the agencies mandated to promote family planning services mainly through the reduction of the use of other forms of contraceptives among the women which reduced from 83.67% in 1998 to 60.87% in 2014.

The way the data for the first and second DHS, (1989 and 1993) was recoded did not provide useful information that could enable classification of employment into formal and informal, formal and casual employment as was desired for this study making it impossible to have a trend analysis for this period.

Table 3: Socioeconomic and household characteristics of women between the ages of 15 to 49

Characteristics	1989	1993	1998	2003	2008	2014	
Total Children ever born (mean)	4.90	3.17	2.89	2.75	2.68	2.48	
Total number of women above 15yrs per household (mean)	-	1.77	1.67	1.69	1.63	1.55	
Age of woman (mean)	28.95	27.62	27.95	28.06	28.49	28.88	
Age of woman at 1st birth (mean)	18.12	18.57	18.81	19.07	19.18	19.58	
Age in 5- year groups (%) 15-19	5.66	23.26	23.49	22.65	20.85	18.73	
	20-24	23.41	21.72	19.64	20.64	20.31	18.45
	25-29	28.77	16.19	17.4	16.87	17.22	19.63
	30-34	18.49	14.43	12.51	13.25	14.31	14.51
	35-39	14.86	10.18	12.57	10.62	10.39	12.14
	40-44	6.81	8.459	8.08	9.61	9.09	9.28
	45-49	2.00	5.753	6.31	6.36	7.83	7.26
Family Planning (%) Modern	16.33	20.69	23.60	22.72	27.96	39.13	
Employment (%) Casual	-	N/A	7.11	7.89	10.48	12.62	
	Formal	-	N/A	17.90	16.15	17.47	24.51
	Informal		75.78	74.98	75.96	72.05	62.86
	Formal/Casual	-	24.22				
Education (%) No education	26.74	17.93	11.53	12.67	8.91	7.00	
	Primary	55.18	57.62	59.25	58.00	56.82	50.28
	Secondary	17.83	23.87	26.90	23.47	26.92	31.54
	Post-secondary	0.25	0.58	2.32	5.86	7.35	11.18
Education in years (mean)	5.02	6.03	6.90	7.18	7.9	8	
Child mortality (mean) Under 5 yrs. who died	-	0.32	0.29	0.24	0.22	0.16	
Wealth (%) Lowest	-	18.00	18.01	16.64	16.50	15.57	
	Second	-	19.02	19.61	18.00	17.56	17.56
	Middle	-	20.02	22.63	18.35	19.10	19.41
	Fourth	-	18.88	21.27	20.88	20.55	21.07
	Highest	-	24.07	18.48	26.13	26.29	26.39
Residence (%) Urban	13.91	17.76	23.22	25.09	25.44	40.83	

Sources: Authors own computation from DHS data

For the years 1998 to 2014, the percentage of women in formal employment increased from 17.90% in 1998 to 24.14% in 2014 indicative of a gradual increase in the proportion of women engaged in formal employment. The proportion of women in casual employment increased gradually from 7.11% to 12.62%, while those in informal types of employment decreased from 75.78% to 62.86% for the years 1998 and 2014 respectively. In the year 2003, there was an increase in informal employment and a consequent reduction of formal employment.

In 1989, a woman had an average of at least 5 years of schooling, which rose to 8 years by the time of the sixth DHS survey. In the period of the study, the total proportion of women with no education reduced from a high of 26.74% to 7.00% representative of an almost threefold reduction of women with no education between the periods 1989 to 2014. The percentage of women, with only primary education marginally reduced, from 55.18% to 50.28% in the same period, while the proportion with secondary education almost doubled rising from 17.83% to 31.54% between 1989 to 2014. The greatest change was in the proportion of women with a post-secondary education that was at 11.8% in 2014 up from a low of 0.25% in 1989.

The Under-five mortality rates per woman reduced progressively from an average of 0.32 in 1989 to 0.16 in 2014. This was consistent and steady with the greatest decline happening between the years of 1998 and 2003 as well as the period between 2008 and 2014.

The wealth index showed variations in all the wealth quintiles for the period of the study. The proportion of women in the lowest, second and middle quintile reduced steadily in the 25-year period from 18% to 15.75%, 19.02% to 17.56% and 20.02% to 19.41% respectively. There was an upward trend in women in the fourth and the fifth quintile, rising from 18.88% to 21.07% and 24.07% to 26.39% respectively.

The proportion of women living in urban areas rose progressively from 13.91% to 40.83% with an equal reduction of women living in rural areas, indicative of the increasing number of women moving to urban areas.

4.3 Econometric Results

4.3.1 Choice of Count Data Model

Fertility of women, determined by the total number of children ever born to a woman is a count variable, which needs to be analyzed by count data models (Greene, 2003). The choice of the type of model to apply is influenced by whether the dependent variable is under or overdispersed normally determined by the difference between the mean and the variance.

Table 4: Sample means and variance for DHS data sets for the years 1989 to 2014

Parameter	1989	1993	1998	2003	2008	2014
Mean	4.75	3.17	2.96	2.69	2.67	2.69
variance	8.14	9.93	8.66	7.73	6.96	6.39

Source: Author's computation from DHS data.

Table 4 shows that the fertility variable is over-dispersed since the variance of the total number of births for the women is greater than the mean of births (Gujarati, 2004) for all the periods of the study. Since over-dispersion is so common, several models have been developed for this kind of data, including the negative binomial, quasi-Poisson (Wedderburn, 1974), generalized Poisson (Consul, 1989), and zero-inflated (Lambert, 1992) models.

Another criterion for choosing the desirable model is whether there are excess zero counts. When the response variable has too many zeros, Lambert (1992) suggested the use of zero-inflated Poisson regression (ZIP) model. In a study of fertility zero counts are expected since some women may either have decided not to have children, others could be trying to have a child but not yet successful or some are infertile. In the various DHS survey data for this study, the observed percentages zero counts across the years are as shown in Table 5. Van den Broek, (1995) proposed a score test for zero inflation in a Poisson regression. A score test was therefore conducted using the Vuong test.

Table 5: Percentage of birth counts for the period 1989 to 2014

counts for	1989	1993	1998	2003	2008	2014
Ni	%	%	%	%	%	%
0	-	28.18	27.46	28.43	27.74	25.21
≥ 1	100	71.81	72.55	71.57	72.28	74.78

Source: Author's computation from DHS data

A zero-inflated Poisson model was estimated and there was evidence of zero inflation. The results for the inflated variables and the Vuong test scores (see table 6) was always significantly positive suggesting that the zero-inflated model was favored (Vuong, 1989). Since zero-inflated Poisson regression only works better when the data is not over-dispersed (Bruin, 2006.), it was not applicable in this study and thus the alternative models were either

to use, the zero-inflated binomial (zinb) regression or zero-inflated generalized Poisson (zigp) regression. Zero-inflated binomial models remain desirable if their alpha¹ results are greater than zero.

Table 6: Alpha results for zero inflated binomial Poisson regression

		Coef.	Std. Err.	z	P > z	95% Confidence interval	
1993	ln(alpha)	-2.13	0.07	-30.18	0.00	-2.27	-1.99
	alpha	0.12	0.01			0.10	0.14
1998	ln(alpha)	-2.09	0.07	-29.64	0.00	-2.23	-1.95
	alpha	0.12	0.01			0.11	0.14
2003	ln(alpha)	-2.34	0.08	-27.84	0.00	-2.50	-2.17
	alpha	0.10	0.01			0.08	0.11
2008	ln(alpha)	-2.67	0.10	-26.00	0.00	-2.87	-2.47
	alpha	0.07	0.01			0.06	0.08
2014	ln(alpha)	-3.14	0.07	-42.14	0.00	-3.28	-2.99
	alpha	0.04	0.00			0.04	0.05

Source: author's own computation from DHS data

Vuong, (1989) and Bruin, (2006) recommends that if alpha is only slightly different from zero then such difference could be regarded as allowable errors and zero-inflated Poisson can be used as the preferred model. That was exactly the case in all the five datasets used in this study and Zero-Inflated Poisson model was thus chosen as the model for the study. However, zero inflation does separate the zero response from the other count observations and only inflate the zeros that it considers to be excess. The conditions of choosing the zeros to retain are not quite clear though. Therefore, the hurdles model (Cameron and Trivedi 1998; Mullahy 1986; and McDowell 2003), which analyses all zeroes separately from other count observations were considered. In order to determine which hurdles model to apply, it was necessary to analyze the convergence between the two main competing models of Poisson-logit hurdle and negative binomial hurdle models. Both of them had similar Akaike's Information Criterion (AIC) values, however, the later failed to converge in the majority of the datasets when an

¹ This is the natural log of the over dispersion coefficient, alpha, if this coefficient is zero then the model is better estimated using Poisson regression model.

exposure variable was included, therefore, only the Poisson-logit hurdle model is appropriate for this study and the findings of this study reported based on this model.

Count data analyses tend to use exposure to count occurrences over time, area or volume (Hilbe, 2011). In this study, exposure was time in years. However, this was never uniform since each respondent has a different exposure from the other. A respondent specific exposure of let's say the difference between the age of the respondent at first birth for those who reported having given birth, and the difference between the age of respondents and when they attained the reproductive age of fifteen years for those who reported zero births. However, the application of this exposure variable encountered trouble with some datasets where convergence could not be achieved hence it was dropped for consistency purposes and log exposure was used instead. Variables of age at first birth and the actual age of the respondent at the time of the survey were then used as predictor variables for non-zero and zero counts respectively.

4.3.2. Estimated Model Coefficients

Table 7 shows the coefficients for the predictor variables across the 20-year period that DHS surveys were conducted. The table reveals the direction and the kind of impact each of the determinants has and whether such impacts are statistically significant.

The extent to which the predictors impacted the response variable is examined by exponentiating the coefficients. In most regressions, this is through using commands on odds and risk ratios. However, this is not supported for analysis that involves the application of weighting of survey studies as the primary data source and this was examined by the eform (incidence ratios) and the results are indicated for in table 8. The interpretation of the results is discussed as follows below.

i. Number of Female Members

The number of female members in a household had a negative significant effect on fertility for all the years of the study among women who had reported zero births. An increase of one woman in a household of women with no births increased the odds of continued zero births among the women in the household for all the years and was statistically significant for all the years of the study. In 1993, a woman who had no child had a 37 less % chance of not having

a child that increased to 45.2%, 50.8% in 1998 and 2003 respectively before falling again to 42.3% and 39.1% in the subsequent years of 2008 and 2014 respectively.

In the group of women who had reported births, the effect of number of female members in the household was positive and mostly non-significant for all the years of the study with the exception of 2014. Among these women, the odds of reporting additional births were not consistently changing from 0.6% in 1993, rising to 1.5% in 1998, falling to 0.5% in 2003 before rising to 2% in 2008 and ending at 4.2% for the statistically significant year 2014 for every additional woman in the household.

ii. Age of Woman

The study involved women of the reproductive age 15 to 49 years of age who were classified into age brackets/ bands of 5 years. The impact of age on fertility was significant for all the women who had reported births for all the years with the exception being for women of the age 20-24, and 40-44 in 1993 who had reported births. Among the women who had reported zero births, age had a negative statistically significant effect on fertility for all the years of the study only being statistically insignificant for women of the ages 40-44 who had reported zero births in 1998.

In the group of women who had zero births, the impact of age on fertility had no effect for women of ages 15-19 and 20-24 showing zero odds for all the periods of the study. For women of 25-29 years of age had an approximately 98% less chance of reporting zero births in 1993 and 1998 that consequently increased to 99.3% in 2003 and 2008 and 99.7% in 2014 with an increase of an additional year. For women in the age 30-34, there was 93.9% less chance of reporting zero births in 1993, that reduced to 83.7% in 1998, increased to 93.7% in 2003, rising again to 97.6% in 2008 before dropping to 96.6% in 2014 with every additional year. This was similar for women in the ages of 35-39 who also had a similar trend for all the years of the study. For ages 35-39, there was a less likely chance of reporting zero births of 81%, 63.5%, 82.2%, 92.4% and 91.7% in the respective years of the study of 1993,1998,2003,2008 and 2014. Women of the age 40-44 had the smallest less likely chance of reporting zero births, in 1993 this was at 72.7% that reduced to 69.9% in 2014 though did not follow the same trend as the other age groups.

Table 7: Determinants of women fertility; Poisson-Logit Hurdle regression results (Coefficients and P-Values)

Characteristics		1993		1998		2003		2008		2014	
<i>Logit Results</i>		Coef	sig	coef	sig	coef	sig	coef	sig	coef	sig
Number of female members (Hz)		-0.461	0.000	-0.601	0.000	-0.709	0.000	-0.622	0.000	-0.496	0.000
Age in 5-year groups	15-19	-11.97	0.000	-11.16	0.000	-12.42	0.000	-13.41	0.000	-13.90	0.000
	20-24	-6.797	0.000	-6.583	0.000	-7.519	0.000	-8.583	0.000	-8.705	0.000
	25-29	-3.835	0.000	-3.753	0.000	-4.987	0.000	-5.814	0.000	-5.735	0.000
	30-34	-2.805	0.001	-1.809	0.000	-2.720	0.000	-3.744	0.000	-3.395	0.000
	35-39	-1.663	0.051	-0.980	0.017	-1.727	0.000	-2.578	0.000	-2.484	0.000
	40-44	-1.297	0.000	-0.092	0.863*	-0.343	0.000	-1.988	0.000	-1.201	0.000
Use of modern contraceptive (EC)		2.48	0.00	2.00	0.00	2.66	0.00	2.10	0.000	2.63	0.000
Formal Employment (LPe)		0.250	0.179	-0.166	0.530	0.018	0.946	-0.537	0.059	0.068	0.747
Informal Employment (LP)		0.584	0.001	0.387	0.123	0.553	0.016	0.187	0.376	0.657	0.001
Unemployed (LPun)		0.173	0.307	-0.287	0.213	-0.257	0.246	-0.532	0.008	0.056	0.745
Highest Education is Primary (EWp)		0.363	0.315	0.255	0.449	-0.355	0.110	0.243	0.524	-0.268	0.213
Highest Education is Secondary (EWs)		0.124	0.795	-0.435	0.346	-1.071	0.000	-0.242	0.631	-1.062	0.000
Highest Education is Tertiary (EWt)		-1.000	0.247	-1.268	0.057	-1.997	0.000	-1.222	0.043	-2.228	0.000
Poorest wealth quintile (WQ1)		0.145	0.345	-0.134	0.445	0.710	0.005	0.515	0.099	1.132	0.000
Poorer wealth quintile (WQ2)		0.323	0.052	-0.319	0.051	0.780	0.001	0.263	0.366	0.727	0.000
Middle wealth quintile (WQ3)		0.213	0.153	-0.182	0.261	0.527	0.019	0.163	0.563	0.624	0.000
Richer wealth quintile (WQ4)		0.030	0.848	-0.027	0.872	0.354	0.086	0.369	0.203	0.451	0.000
Residence in urban areas (Ru)		-0.774	0.000	-0.493	0.000	0.018	0.928	-0.361	0.133	0.081	0.906

Poisson Results

Number of female members (Hz)		0.006	0.361	0.015	0.067	0.005	0.543	0.020	0.075	0.041	0.000
Age in 5-year groups	15-19	-0.477	0.000	-0.537	0.000	-0.349	0.007	-0.596	0.000	-0.348	0.000
	20-24	-0.028	0.540	0.188	0.000	0.224	0.000	0.294	0.000	0.324	0.000
	25-29	0.157	0.000	0.275	0.000	0.363	0.000	0.375	0.000	0.419	0.000
	30-34	0.153	0.000	0.266	0.000	0.314	0.000	0.333	0.000	0.391	0.000
	35-39	0.136	0.000	0.215	0.000	0.225	0.000	0.252	0.000	0.278	0.000
	40-44	0.046	0.068	0.099	0.000	0.105	0.000	0.077	0.003	0.144	0.000
Use of modern contraceptive (EC)		0.063	0.000	0.032	0.016	0.004	0.786	0.029	0.136	0.070	0.000
Formal Employment (LPe)		0.027	0.113	0.019	0.612	-0.082	0.031	-0.017	0.667	-0.042	0.096
Informal Employment (LP)		0.069	0.004	0.102	0.001	-0.007	0.817	0.059	0.058	0.034	0.082
Unemployed (LPun)		0.120	0.000	0.114	0.000	0.062	0.041	0.119	0.000	0.044	0.016
Highest Education is Primary (EWp)		0.089	0.000	0.090	0.001	-0.005	0.835	0.060	0.092	-0.078	0.000
Highest Education is Secondary (EWs)		0.061	0.166	0.069	0.116	-0.093	0.018	0.006	0.921	-0.148	0.000
Highest Education is Tertiary (EWt)		-0.21	0.240	0.037	0.665	-0.072	0.247	0.121	0.158	-0.191	0.000
Total children died under 5 yrs (CM)		0.090	0.000	0.104	0.000	0.104	0.000	0.096	0.000	0.142	0.000
Poorest wealth quantile (WQ1)		0.088	0.000	0.034	0.128	0.319	0.000	0.362	0.000	0.403	0.000
Poorer wealth quantile (WQ2)		0.096	0.000	0.037	0.106	0.235	0.000	0.287	0.000	0.307	0.000
Middle wealth quintile (WQ3)		0.065	0.000	-0.005	0.808	0.195	0.000	0.225	0.000	0.224	0.000
Richer wealth quintile (WQ4)		0.057	0.002	-0.003	0.882	0.109	0.003	0.139	0.002	0.102	0.000
Residence in urban areas (Ru)		-0.244	0.000	-0.215	0.000	-0.077	0.029	-0.130	0.004	-0.084	0.000

*Bold: Not statistically significant

Table 8: Odds Ratio (eform) for the determinants of fertility

Characteristics		1993	1998	2003	2008	2014
Logit Results						
Number of female members (Hz)		0.630	0.548	0.492	0.537	0.609
Age in 5-year groups	15-19	0.000	0.000	0.000	0.000	0.000
	20-24	0.001	0.001	0.001	0.000	0.000
	25-29	0.022	0.023	0.007	0.003	0.003
	30-34	0.061	0.164	0.066	0.024	0.034
	35-39	0.190	0.375	0.178	0.076	0.083
	40-44	0.273	0.912	0.710	0.137	0.301
Use of modern contraceptive (EC)		11.95	7.37	14.23	8.13	13.82
Formal Employment (LPe)		1.284	0.847	1.018	0.584	1.071
Informal Employment (LP)		1.793	1.473	1.739	1.206	1.929
Unemployed (LPun)		1.188	0.751	0.773	0.587	1.058
Highest Education is Primary (EWp)		1.438	1.291	0.701	1.275	0.765
Highest Education is Secondary (EWs)		1.132	0.647	0.343	0.785	0.346
Highest Education is Tertiary (EWt)		0.368	0.281	0.136	0.295	0.108
Poorest wealth quantile (WQ1)		1.155	0.875	2.033	1.673	3.103
Poorer wealth quantile (WQ2)		1.382	0.727	2.181	1.301	2.069
Middle wealth quantile (WQ3)		1.237	0.834	1.695	1.178	1.866
Richer wealth quantile (WQ4)		1.030	0.973	1.424	1.446	1.569
Residence in urban areas (Ru)		0.461	0.611	1.018	0.697	0.990
Poisson Results						
Number of female members (Hz)		1.006	1.015	1.005	1.020	1.042
Age in 5 year groups	15-19	0.621	0.584	0.705	0.551	0.706
	20-24	0.973	1.207	1.251	1.342	1.383
	25-29	1.170	1.317	1.438	1.454	1.520
	30-34	1.165	1.305	1.370	1.396	1.478
	35-39	1.145	1.240	1.252	1.287	1.320
	40-44	1.047	1.104	1.110	1.080	1.154
Use of modern contraceptive (EC)		1.066	1.032	1.004	1.030	1.072
Formal Employment (LPe)		1.027	1.019	0.921	0.983	0.959
Informal Employment (LP)		1.072	1.107	0.993	1.061	1.035
Unemployed (LPun)		1.127	1.120	1.063	1.127	1.045
Highest Education is Primary (EWp)		1.093	1.094	0.995	1.062	0.925
Highest Education is Secondary (EWs)		1.063	1.072	0.911	1.006	0.862
Highest Education is Tertiary (EWt)		0.81	1.038	0.930	1.129	0.826
Total children died Under-5 yrs (CM)		1.094	1.110	1.109	1.101	1.153
Poorest wealth quintile (WQ1)		1.092	1.034	1.376	1.436	1.496
Poorer wealth quintile (WQ2)		1.101	1.038	1.264	1.333	1.359
Middle wealth quintile (WQ3)		1.067	0.995	1.215	1.252	1.251
Richer wealth quintile (WQ4)		1.059	0.997	1.115	1.149	1.107
Residence in urban areas (Ru)		0.783	0.807	0.926	0.878	0.919

Among women who had reported births, younger women in the age bracket of 15-19 years had a 62% chance of having an increased birth rate in 1993 which increased to 70% in 2014. Though the increase was not linear, this age bracket showed no distinctive pattern across the study periods, having an increased chance of 58.4%, 70.5%, and 55.1% in 1998, 2003 and 2008 respectively among women who had already given birth. Higher chances of increased births were highest among women in the age brackets of 25-29 who were 17.5% more likely to report a birth in 1993, that increased steadily to 52% in 2014. This was a similar trend among women of the ages of 30-34 and 35-39 who had a 16.5% and 14.5% more likely chance to report a birth in 1993 respectively that increased steadily to 47.8% and 32% more chance in 2014 respectively. The least impact was among women of the ages of 40-44 who were 4.7% more likely in 1993 that increased to 15.4% in 2014 when compared to the oldest age group of 45-49 years.

iii. Use of modern Family Planning Methods

The use of modern family planning methods had a positive effect on both women who reported zero births and those who had birthed. The effect was significant for all the years of the study for women who had not reported births. It was, however, not statistically significant for the women with births for the year 2003 and 2008.

The use of modern contraceptives among the women who had reported zero births resulted in 11 times more likelihood of reporting zero births in 1993 that even increased to 13 times more in 2014. Though this was not consistent across all the years of the study, the likelihood of reporting zero births was 7.3, 14.2 and 8.3 times more in 1998, 2003 and 2008 respectively.

For the women who had reported births, use of contraceptive meant that these women had a 6.6% increased chance of reporting an additional birth in 1993 that reduced to 3.2% and 0.4% in 1998 and 2003 respectively. This increased to 3% in 2008 and 7.2 % in 2014. The use of modern contraceptives led to a slight increase in fertility rates across the years of the study for the women if they had already reported births.

iv. Employment status

Employment status had a non-significant effect on fertility among the women who had reported zero births. For these women, being unemployed had a positive effect on fertility in

the years of 1993 and 2014 and a negative effect in the years of 1998, 2003 and 2008 with all being not statistically significant with the exception of the year 2008. In contrast, among women who had reported births unemployment had a positive statistically significant effect.

Being unemployed and having zero births meant that the woman had an 18% more likely chance of reporting zero births in 1993 this reduced, though not uniformly, to a 5.8% more likely chance in 2014. For the years of 1998, 2003 and 2018 this had reduced to a 75.1% chance in 1993, increased to 77.3% in 1998 before declining to 58.7% for women in the year 2003. Unemployment among women who had reported births had a 12.7 % increased rate of reporting an additional birth in 1993 which had reduced to 4.5% in 2014.

Formal employment had a mixed effect on fertility with a positive non-statistically significant effect on fertility in 1993 and 1998, with a negative significant effect in 2003. The effect remained negative in 2008 and 2014 but was still not statistically significant. Compared to the women in casual employment, being employed in formal employment had a 28.9% more likely chance to report zero births in 1993 that declined to 7.1% more likely chance in 2014 among the women no children while for women who had reported births there was a 2.7% increased chance of reporting a birth in 1993 that reduced to only a 98% of reporting births. For both cases of women with children and those with none, these reductions were not uniform having 84% chance, rising to a 1.8% increased chance before reducing to 58.4% chance in 1998, 2003 and 2008 respectively for women with no children and 1.9% increased chance, 92% chance before rising to 98.3% chance in the corresponding years of 1998,2003 and 2008 for women with children.

Informal employment had a positive and statistically significant effect for all the years except 2003, where the effect was negative and not statistically significant and 2014 where the effect though positive was not statistically significant for women who had reported having births. For those women who had not reported births engaging in informal forms of employment had a positive statistically significant effect with the exception of the years of 1998 and 2008 where the effect was not statistically significant. In comparison to the women employed in casual employment, women with no children were 79.3 % more likely to report zero births 1993, that further increased to 92% in 2014. Among the women who had reported births, there

was a 7.2 increased chance of reporting an additional in 1993 that reduced to only 3.5% in 2014.

v. *Education*

Effect of primary education was not statistically significant for women who had reported no births for all the years of the study. This was a sharp contrast for the women who had reported births where primary education had a positive statistically significant effect for all the years with the exception of 2003 where it had a negative non-statistically significant effect and 2008 where although it had a positive effect it was not statistically significant. Women with primary education and no children, unlike their uneducated counterparts, had a 43.8% more likely chance of reporting zero births in 1998 but this had reduced to only 76.5% chance in 2014. For those who had reported births, had a 9.3% increased chance of reporting additional births that reduced to a 92.5% chance of additional births in 1993 and 2014 respectively. In both cases, this change was not consistent for the years of 1998, 2003 and 2008.

Secondary education among women who were yet to give birth had a negative effect on fertility for the years of 1998 through to 2014 for these women. This was not the case for the women who had reported births where education had a positive impact on fertility for all the years with the exception of 2003 and 2008 where the effect was negative. For both cases, these effects were not statistically significant for 1993, 1998 and 2008. When compared to women with no education, there was 35.3%, 65.7%, 21.5% and 65.4% less likely chance of reporting zero births among the women who were yet to give birth in the years of 1998, 2003, 2008 and 2014 respectively. In 1993, the women with children had a 6.3% increased chance of reporting additional births that rose to 7.2% increased chance in 1998 before falling to an 86.2% chance of reporting additional births. This changed in 2003 and 2008 where the women showed a decreased chance of 91% and 96% respectively when compared to women with no education.

Tertiary education had a negative impact on fertility among women with no children. This was statistically significant for the years 1998, 2003, 2008 and 2014. For women with reported births having a tertiary education was not a statistically significant determinant of fertility for the period 1993 to 2008 had only a negative statistically significant effect in 2014. When compared to women with no education, there was a 63.2% likely chance of reporting zero births in 1993 among women who had reported zero births that increased steadily to 90% in

2014. Women who had reported births had 81% chance of reporting an additional birth in 1993, 3.8% increased the chance for births in 1998, a 93% chance in 2003 a 12.9% increased chance in 2008 with an overall 12% decreased the chance that they were likely to report an additional birth in 2014.

vi. Child Mortality

Child mortality had a statistically positive impact on the fertility of women in all five studies. Though the incidences of child mortality had shown a drastic decline over the period of the study, it increased the likelihood of additional births by 15.3% in 2014. This was characterized by a steady rise likelihood from a low of 9.4% in 1993, through 11% in 1998 and 10.9% in 2003 to a decline of 10% in 2008. The impact of child mortality was only among women who had had births and not for women with zero births.

vii. Wealth status

The wealth status had a positive impact on fertility among the women who had reported zero births. With the exception of 1998 where the impact was negative various quintiles in all the other year's reported positive impacts that were largely not statically significant with the exception of 2014 where the wealth status became a statistically significant determinant. For women who had reported births, wealth status was a statistically significant determinant of fertility for all the various quintiles for all the years of the study. The 1998 study had the highest prevalence rate of negative impacts on fertility though none was statistically significant. The lowest and the second lowest wealth quintile had the highest positive impacts to fertility when compared to women in the highest quintile.

In comparison to the richest quintile, the poorer and the middle wealth quintiles had the highest impact on fertility among women who had reported zero births with both being 2 times likely to report zero births among women with no birth in 2003. The poorest quintile was 3 times likely to report zero births in 2014 while it was 2 times likely for women in the poorer quintile in 2014. For women with children, the highest impact was among women who were in the poorest quintile who had a 9.2% higher chance of reporting additional births in 1993 that rose to an increased chance of 49.2% in 2014.

The impacts reduced as the women got richer for both cases with the least impact observed among women in the richer quintile who had 5.9% increased the chance for additional births in 1993 that had increased, though not steadily to 10.7% in 2014 for women with births. For women with zero births, it was from a likelihood of 0.3% increased chance of reporting zero births in 1993 to 56% likelihood in 2014.

viii. Place of residence

Being a resident in an urban area had a negative impact on fertility for women who had zero births for 1993, 1998 and 2008 and positive for the years of 2003 and 2014. The effect was statistically significant in the initial years up to 2003 before becoming insignificant for 2008 and 2014. Among women with births, residing in the urban area had a statistically significant negative effect on woman's fertility for all the years of the study.

In 1993, women living in urban areas were 22 % less likely to have an additional child compared to their rural counterparts, which declined to 20% in 1998. However, this chance declined to 8% in 2003 before rising to 13% in 2008 before settling at 9% in 2014. For women with no children, there was 64% less likely chance to report zero births in 1993, 39% less likely chance in 1998 and 31% less likely chance in 2008. However, this was different for the other periods of 2003 where these women had a 1.8% increased chance of reporting zero births and 91% chance in reporting zero births in 2008.

4.3.3. Relative Importance of women fertility determinants

The age of the woman was the most important determinant of fertility and remained consistent across all the years of the study, with the most important age group being the women between the ages of 15-19. The second most important determinant of fertility was child mortality across all the years of the study, this was followed by education which was consistent for the first two study periods before falling to fourth important determinant in the 2003 period and then back to third most important for the other periods. Wealth quintiles, use of modern contraceptives and employment were the other important determinants of fertility in the same order respectively among the eight predictors showing negative influences on the rates of birth. The least determinants of fertility were the place of residence and the number of female members of the household respectively.

4.4 DISCUSSION

4.4.1 The determinants of fertility at the individual woman level in Kenya

Eight factors were considered as important determinants of individual woman fertility in Kenya and they were tested for their significance to this effect. The selection of the factors (number of female members in a household, the age of the woman, type of employment, use of modern family planning methods, child mortality, wealth status, and place of residence-urban or rural) was thus justified since they produced statistically significant results. Their consideration as key determinants of fertility is consistent with a number of previous studies that have identified these particular set of as useful determinants of fertility in women. These are among determinants that were considered by Mboup and Saha, 1998; Moeeni *et al*, 2014; Kirk, 1996; Becker and Lewis, 1973; Odwe, 2014 in their respective studies on fertility.

a. Age of a woman

Age group of the woman is a significant predictor of fertility. Highest birth rates were common and observed among women of the age group 25- 34 years, which is consistent throughout the five study periods. For the years 1993, 2003 and 2008, it was the age group 25-29 followed by 30-34 while in study periods of 1998 and 2014, it was the age groups of 30-34 followed by 25-29 that had the highest birth rates. These trends are consistent with fertility reports of the Kenya Demographic Health Surveys (KDHS) for the periods covered in the study (NCPD and CBS; 1993; NCPD and CBS, 1998; CBS *et al*. 2004; KNBS and ICF Macro, 2010; KNBS and ICF Macro, 2014)

b. Child Mortality

Through the entire period of study, a general trend on the reduction of child mortality saw a steady reduction in the fertility rates. However, this trend was different among women with higher child mortality rates who exhibited higher rates of fertility rates. The works of Raivio (1990) who had written that the demographic transition theory claimed that the reduction of the mortality of children below the age of five should be followed by the reduction of fertility, while Doepke (2005) stated that total fertility rates fall as child mortality declines support these results.

c. *Education Attainment*

Women with more years of schooling have lower fertility rates. The underlying assumption here is that these women probably prioritize their studies, which takes much of their time consequently delaying their onset of giving birth. Longer years spent educating oneself is likely to translate to formal employment that may require longer working hours for these women consequently hindering family production. In the study, post-secondary education had the highest negative influence for all periods of the study compared to all the other levels of education. The decline in fertility rates as observed is also consistent with other studies such as Mboup and Saha (1998) that showed that fertility declines are evident among women with higher education in Ghana, Kenya, and Namibia.

d. *Wealth status*

The wealth status increases the fertility of the woman though to varying degrees depending on the wealth quintile. With the exception of the 1993 period, all the other periods show that women in the poorest quintiles have the highest fertility rates while those in the richest quintiles also have positive fertility rates but experience a much lower rate than their poorer counterparts' experience. Reviews conducted by Skirbekk (2008), concludes that before the onset of fertility decline individuals of higher social standing are frequently recognized to have more children compared to individuals of lower social standing. However, with a decline in fertility levels, high status is then associated with relatively low fertility rates that culminate into a full-blown halt as fertility continues to decline. Similarly, Colleran *et al.*, (2015) wrote that prior to the demographic transition, wealthy and high-status people typically have higher fertility than poorer and lower status people do. Based on the results it follows that Kenya is at the initial stages of demographic transition since wealth is a positive predictor of fertility but women in the lower quintiles have a higher fertility rate compared to those in the higher wealth quintile.

e. *Use of Modern Contraceptives*

In all the periods of the study, the results showed that use of modern contraceptive positively relates to fertility rates, meaning that a woman who uses modern contraceptives was likely to have more children, though at a much lower rate compared to those either using traditional or

not using contraceptives at all. It is an unexpected result since contraceptives in the sub-Saharan context function to regulate birth in terms of spacing or in terms of halting of birthing altogether (National Research Council, 1990; Blacker *et al.*, 2005) and should have a negative impact on fertility. This was the case when the exposure variable was excluded from the regression. Perhaps it is due to how data on this variable is being collected since the current use of contraceptive is the preferred way of utilizing the information on contraceptive. It is, therefore, possible that while a woman may be using contraceptive currently, she probably will have not used it in the last 5, 10, or even 20 years ago. Collecting data on contraceptive use should, therefore, match every question on births by an individual woman.

f. Employment

Lack of a form of employment or having informal employment significantly increases the likelihood to have a higher birth rate compared to having casual or formal employment; this is consistent with a study by Van den Broeck & Maertens (2014) in Senegal where they found that female employment has a significant negative effect on fertility rates. Similarly, Malek & Idris (2016) found that women involvement in the informal economy does affect fertility rate positively. However, there is also evidence that unemployment also leads to low fertility rates. Da Rocha & Fuster (2006) while conducting a study on OECD countries found that unemployment encourages females to postpone and space births which, in turn, reduces the total fertility rate.

g. Place of residence

Women living in urban areas have low fertility rates compared to their rural counterparts across all the periods of study. This variable showed a consistent outcome in all periods indicating distinguishing it as a stable variable having a negative coefficient throughout the five study periods. These results are consistent with studies conducted by Mboup and Saha (1998) that showed that fertility declines are evident in urban areas among women in Ghana, Kenya, and Namibia. While this study did not endeavor to assess the causality between urban residency of the women and the women having low birth rates, other studies have attempted to investigate the causes. Lapham and Mauldin (1987) in such an endeavor noted that different fertility regulation mechanisms such as termination of pregnancies, use of modern contraceptives, and delayed marriages have contributed much towards fertility reduction in

urban areas circumstances that are not available in rural areas to play similar roles in most of Sub-Saharan Africa.

h. Number of female members of a household

Presence of other female household member's increases fertility rates among women who have begun childbearing though it negatively relates to fertility for women who do not have children. Ketkar (1979) in a study on determinants of fertility in Sierra Leone observed that where an extended family system prevails, it reduces the homemaker's burden and the household's cost of rearing children. Therefore, the greater the number of members of the extended family living in the household the greater will be its fertility, particularly female members since the rearing of children is traditionally entrusted to females.

4.4.2 Relationship between the number of children ever born and its correlates

Majority of the fertility determinants have not changed over time, these include the age of the woman, child mortality and the level of education. The use of family planning methods also seems to be stable across the years of the survey. However, other determinants have shown a shift across the years. Wealth quintile, for instance, appears to be transitioning into a major fertility determinant in recent years compared to the earlier survey years of 1993, 1998 and early 2000. For the subcomponents of this variable, the lowest and second lowest quintiles all of which have a positive impact on fertility indicate that poorer women are having higher fertility rates compared to the same category of women in the 1990s.

Unemployment and informal employment indicate a positive relationship with fertility rates across the years indicating a most significant effect of employment on overall fertility rates. However, the strength of this positive predictor is steadily declining in comparison to other predictors as the years of survey change. There was a bigger impact in the early years of 1993 compared to the year of 2014, indicating that the country could be following in the footsteps of the OECD countries where unemployment is linked more directly to low fertility rates (Da Rocha & Fuster, 2006). However, this argument is highly superficial since the trend is in relation to the other predictors in the study since both unemployment and informal employment remain positive predictors of fertility rates in all periods.

The place of residence was a major determinant of fertility in the surveys conducted in 1993 and 1998. In 2003, among the fertility determinants considered in this study, it turned out to be least important. While in the 2003 to 2008 period it gained some ground in terms relative importance but still ranked lower than where it ranked in the first two surveys even for the 2014 period. Urbanization is a key factor in fertility decline generally Martine *et al*, (2013) suggested that fertility rates are usually lower in urban areas compared to rural areas because of increased age at marriage, greater contraceptive use, declining infant and child mortality, which are commonly associated with urban areas.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Summary of findings

The purpose of this study was to examine how the correlates that determine individual fertility have changed over the period of 1989 to 2014, relying heavily on DHS survey data. The study sought to answer the questions of what determines fertility at the individual woman level in Kenya and how these factors have changed over time.

The objective of the study was achieved by applying a Poisson-logit hurdles model for the DHS data sets. The results indicate that among women who had given birth the number of female members in the household, the age of the woman, education level, wealth status, use of modern contraceptives, under-five child mortality all have a positive effect on determining the fertility of the woman once they have started having children. Achieving tertiary education and living in urban areas for these women seemed to have negative impacts on fertility. As time progressed, from 1993 to 2014, the odds of reporting additional births increased for the woman, who had an extra female member in the household, as she got older especially if she was between the ages of 20 to 40 years, and if she had attained tertiary education or had lost a child who was yet to reach five years. Engaging in any kind of employment or having attained either primary or secondary education also resulted in declining odds of reporting additional births for the woman.

Conversely, for women who had not yet given birth, the number of female members in the household, the age of the woman, and residing in the urban areas had a negative effect on the overall fertility. All the other variables had a positive effect, with the largest effect observed among women using modern contraceptives. Over time, between 1993 and 2014, the odds of reporting zero births decreased as the women became older especially if she was between the ages of 30 to 44, as she became more and more educated, and if she was unemployed or was in formal employment. On the other hand, the odds increased among those who used modern contraceptives, who were engaged in informal employment, who were living in urban areas and across women in all wealth quintiles with the greatest rise reported among women in the poorest quintile.

5.2 Conclusion

Declines in fertility rates are not only a function of economic development. Socio-cultural traditions, access to resources, use of contraceptive, unemployment, and levels of education also play a critical role in determining how and when women bear and rear children (UNFPA, 2005). The focus of this study was on the economic dimensions of the determinants of fertility and the scope has been restricted to within this border. The regression results show that fertility trends in Kenya is on a declining trend and possibly at the onset of the demographic transition. There are hosts of determinants which are stable in determining fertility given that they are obstinately the most important predictors of fertility rates in the twenty-year period for both cases of women with children as well as those with no children. These are the age of a woman, under-five child mortality, and education. Other important fertility determinants have shown inconsistent patterns in their influence on fertility over the same period for both cases of women. These include the wealth quintile, use of modern contraceptives, employment, place of residence and household size. With this in mind we can say that the determinants that increase fertility in Kenya include; child mortality, age of woman, lower wealth quintile in relation to the higher quintile while those that reduce fertility include: level of education, residence in urban areas, use modern contraceptives in relation to non-use, higher wealth quintile in relation to lower wealth quintile.

5.3 Recommendations

Demographic transition theory by Kirk (1996) and neo-classical microeconomic theory (Becker and Lewis, 1973) suggests that in case there is a need for a policy orientation towards the decline, the government needs to concentrate efforts by acting on factors that cause high fertility and vice versa. Kenya aims to reduce fertility and mortality rates and reduce population growth rate in order to harmonize with the economic growth and social development envisioned in Vision 2030 (Government of Kenya, 2013).

The findings of this study state that education is an important determinant of fertility. This study proposes that for purposes of aligning with the overall objective of lowering fertility, promotion, and availability of access to higher levels of education should be given to both women who have given birth as well as those who are yet to give birth. The focus should be

on achieving higher completion rates for both primary and secondary education among girls enrolled in schools.

Use of modern contraceptives has also been established as an important determinant of fertility. Active sensitization on both knowledge and proper use should be encouraged for all women in the childbearing age. Especially among younger women who had not yet given birth as the use of modern contraceptive was established to have a very strong impact on fertility among women who had not given birth.

Child mortality has been identified as having a significant impact on fertility among women who have given birth. Strengthening of existing maternal and child health care systems and services, as well as the establishment of new maternal and child health care centers in non-existent areas, should be advocated for. By availing better health care services in form of medical treatment, child care education, as well as child nutrition, under-five child mortality will be reduced further and thus result in a reduction of fertility.

The study also proposes the institutionalization of policy measures that would assist with the creation and promotion of employment opportunities among women consequently elevating them from poverty and low-income levels. These should aim at reducing unemployment among women as well as providing prospects for non-casual employment opportunities.

5.4 Areas for future research

Future research needs to be conducted to understand the dynamics of middle-aged women, aged between 20-40 years, and fertility as they continue to attain higher levels of education. The study also recommends that further research needs to be conducted on the use of “current contraceptive use” as a measure of contraceptive prevalence. In the absence of respondents tracking, as is the common practice, the information obtained from a single survey may not be adequate in capturing the effect of contraceptive use on fertility where the total number of children ever born to a woman is used as the main dependent variable. Contraceptive use questions should also be captured in the same manner as child death variable or the number of years that a woman has been using contraceptives to compliment the current practice.

References

- Ahmed, H. M. S., 2010. Non-Market Returns to Women Education in Sudan: Case of Fertility. *Journal of Comparative Family Studies*, 41(5), pp. 783-798.
- Ajayi, A. and Kekovole, J., 1998. Kenya's Population Policy; From Apathy to Effectiveness. In: J. Arudh, ed. Do Population Policy Matter? *Fertility and Politics in Egypt, Kenya and Mexico*, p.113-156, New York, Population Council.
- Aksan, A.-M., 2014. Effects of Childhood Mortality and Morbidity on the Fertility Transition in Sub-Saharan Africa. *Population and Development Review*, 40(2), pp. 311 - 329.
- Ali, K., 1985. Determinants of Fertility in Developing Countries. *Pakistan Economic and Social Review*, 23(1), pp. 65-83.
- Anyara, E. and Hinde, A., 2005. *Fertility Transition in Kenya: A regional Analysis of the Proximate Determinants*. Kent, Paper prepared for the British Society of Population Studies Annual Conference, 12-14 September 2005, University of Kent at Centebury.
- Askew, I., Ezeh, A., Bongaarts, J. and Townsend, J., 2009. Kenya's Fertility Transition: Trends, Determinants and Implication for Policy and Programmes, Nairobi: Population Council.
- Becker, G. S. and Lewis, H. G., 1973. On the Interaction between the Quantity and Quality of Children. *Journal of Political Economy*, 81(2), pp. 279 - 288.
- Becker, G. S. 1960. An Economic Analysis of Fertility, in *Demographic and Economic Change in Developed Countries*, Universities National Bureau Conference Series 11, Princeton: Princeton University Press, 1960, pp. 209--240.
- Benefo, D. K. and Pillai, K. V., 2005. The Reproductive Effects of Family Planning Programs in Rural Ghana: Analysis by Gender. *Journal of Asian and African Studies*, 40(6), pp. 463-477.
- Blacker, J. et al., 2005. Fertility in Kenya and Uganda: A Comparative Study of Trends and Determinants. *Population Studies*, 59(3), pp. 355-373.
- Bruin, J. 2006. newtest: command to compute new test. UCLA: Statistical Consulting Group. <http://www.ats.ucla.edu/stat/stata/ado/analysis/>.
- Budescu, D. V. 1993. Dominance analysis: A new approach to the problem of relative importance of predictors in multiple regression. *Psychological Bulletin*, 114, 542 - 551.
- Caldwell, J. C. et al., 1999. The Bangladesh Fertility Decline: An Interpretation. *Population and Development Review*, 25(1), pp. 67-84.
- Caldwell, J. C., Orubuloye, I. O. and Cadwell, P., 1992. Fertility Decline in Africa: A new type of Transition? *Population and Development Review*, 18(2), pp. 211-242.
- Cameron, A. C. and Trivedi, P. K. 1998. *Regression Analysis of Count Data*. New York: Cambridge University Press. Hilbe, J. 1999. sg102: Zero-truncated Poisson and negative binomial regression. *Stata Technical Bulletin* 47: 37–40. In *Stata Technical Bulletin Reprints*, 8, 233–236. College Station, TX: Stata Press.

- Casterline, J. B. and El-Zeini, L. O., 2014. Unmet Need and Fertility Decline: A Comparative Perspective on Prospects in Sub-Saharan Africa. *Studies in Family Planning*, 42[2] pp.227-245.
- Central Bureau of Statistics (CBS) [Kenya], Ministry of Health (MOH) [Kenya], and ORC Macro. 2004. Kenya Demographic and Health Survey 2003. Calverton, Maryland: CBS, MOH, and ORC Macro.
- Cervellati, M. and Sunde, U., 2007. Human capital, mortality, and fertility: A unified theory of demographic transition, IZA working Paper 2905.
- Chani, M. I., Shahid, M. and Hassan, M. U. 2011. Some socio-economic determinants of fertility in Pakistan: an empirical analysis. Munich Personal RePEc Archive (MRPA), MRPA Paper No. 38742.
- Cleland, J. and Wilson, C., 1987. Demand Theories of the Fertility Transition: An Iconoclastic View. *Population Studies*, 41(1), pp. 5-30.
- Colleran H, Jasienska G, Nenko I, Galbarczyk A, and Mace R. 2015. Fertility decline and the changing dynamics of wealth, status and inequality. *Proc. R. Soc. B* 282: 20150287. <http://dx.doi.org/10.1098/rspb.2015.0287>
- Consul, P. C. 1989. Generalized Poisson distribution: properties and applications. Marcel Dekker, New York, New York, USA.
- Cutright P., 1983, The ingredients of recent fertility decline in developing countries, *International Family Planning Perspectives*, 9(4), pp. 101-109
- Da Rocha, J. M., and Fuster, L. (2006). Why are fertility rates and female employment ratios positively correlated across OECD countries? *International Economic Review*, 47(4), pp.1187-1222.
- Debpuur C. *et al.*, 2002. The impact of the Navrongo Project on contraceptive knowledge and use, reproductive preferences, and fertility, *Studies in Family Planning*, 33(2), pp.141–164.
- Diamond-Smith N. G., Moreau C., and Bishai D. M., 2014. Reducing Unintended Pregnancies: A Microsimulation of Contraceptive Switching, Discontinuation, and Failure Patterns in France. *Studies in Family Planning*, pp. 45[4]:429-441.
- Doepke, M. 2005. Child mortality and fertility decline: Does the Barro-Becker model fit the facts? *Journal of Population Economics*, 18(2), 337-366.
- Easterlin, R. A., 1975. An Economic Framework for Fertility Analysis. *Studies in Fertility Planning*, 6, pp. 54-63.
- Easterlin, R. A., 1978. The Economics and Sociology of Fertility. A synthesis. In: C. Tilly, ed. *Historical Studies of Changing Fertility*. Princeton: Princeton University Press, pp. 57-133.
- Emereuwaounu, E. U. and Emereuwaounu, E. U., 1984. Determinants of Fertility: A Regression Analysis on Kenya Data. *Genus*, 40(3/4), pp. 77-96.
- Ezeh, A. C., Mberu, B. U. and Emina, J. O., 2009. Stall in fertility decline in Eastern African Countries: regional analysis of patterns, determinants and implications. *Philosophical Transactions of the Royal Society*, 364, pp. 2991-3007.

- Fang, H., Eggleston, K. N., Rizzo, J. A. and Zeckhauser, R., 2012. Jobs and Kids: Female Employment and Fertility in China. *HKS Research Working Paper Series*, RWP10-011.
- Feldman, B. 2005. Relative Importance and Value, unpublished manuscript (Version 1.1, March 19, 2005). Available online at <http://www.prismanalytics.com/docs/RelativeImportance050319.pdf>
- Findley, S. E., 1980. A Suggested Framework for Analysis of Urban-Rural Fertility Differentials with an Illustration of the Tanzanian Case. *Population and Environment*, 3, pp. 237-261.
- Freedman R., and Berelson B., 1976. The record of family planning programs, *Studies in Family Planning*, 7(1) pp.1-40.
- Fullop, M., 1977. A survey of Literature on the economic theory of fertility behavior. *American Economic Journal*, 21, pp. 5 - 13.
- Glassman, M. B. and Ross, J. A., 1978. Two Determinants of Fertility Decline: A Test of Competing Models. *Studies in Family Planning*, 9(7), pp. 193-197.
- Goldberg, H. I, McNeil, M., and Spitz, A., 1989. Contraceptive use and fertility decline in Chogoria, Kenya. *Studies in Family Planning*, 20 (1), pp 17-25.
- Government of Kenya, 2013. Kenya Population Situation Analysis, Nairobi: Government of Kenya.
- Greene, W. H., 2003. *Economic Analysis*. 5 ed. Upper Saddle River, New Jersey: Prentice Hall.
- Gujarati, D. N., 2004. *Basic Econometrics*. 4 ed. London: The McGraw Hill.
- Hammerslough, C.R., 1992. Proximity to Contraceptive Services and Fertility Transition in Rural Kenya. *International Family Planning Perspectives*, 18(2) pp. 54-58
- Hilbe, J. M. 2011. *Modeling count data*. Springer Berlin Heidelberg. pp. 836-839
- Imai, K. S. and Takahiro, S., 2014. Recent Changes in Micro-Level Determinants of Fertility in India: Evidence from National Family Health Survey Data. *Oxford Development Studies*, 42(1), pp. 65-85.
- Jain A.K., 1985 The impact of development and population policies on fertility in India, *Studies in Family Planning*, 16(4) pp.181-198.
- Jain, A. K., and Ross, J. A., 2012. Fertility Differences Among Developing Countries: Are They Still Related to Family Planning Program Efforts and Social Settings? *International Perspectives on Sexual and Reproductive Health*, 38(1), pp15-22
- Jejeebhoy S.J., Santhya K. G., and Zavier A. J.F., 2014. Demand for Contraception to Delay First Pregnancy among Young Married Women in India. *Studies in Family Planning*, 45(2). pp. 183-201.
- Kabubo-Mariara, J., Mwabu, D. & Ndeng'e, G., 2009. *The Consequences of fertility for Child Health in Kenya: Endogeneity, Heterogeneity and Application for the Control Function Approach*.: University of Nairobi.
- Kalemli-Ozcan, S., 2003. The uncertain lifetime and the timing of human capital investment. *Journal of Population Economics* 21(3), pp 557-572.
- Kenya National Bureau of Statistics (KNBS) and ICF Macro. 2010. *Kenya Demographic and Health Survey 2008-09*. Calverton, Maryland: KNBS and ICF Macro.

- Kenya National Bureau of Statistics (KNBS) and ICF Macro. 2014. *Kenya Demographic and Health Survey 2008-09*. Calverton, Maryland: KNBS and ICF Macro
- Kenya National Bureau of Statistics (KNBS), 2010. *The 2009 Kenya Population and Housing Census*, Nairobi: Kenya National Bureau of Statistics.
- Ketkar, S. L., 1979. Determinants of Fertility in a Developing Society: The Case of Sierra Leone. *Population Studies*, 33(3), pp. 479-488.
- Kingsley, D. and Blake, J., 1956. Social Structure and Fertility: An Analytical Framework. *Economic Development and Cultural Change*, 4(4), pp. 112-134.
- Lambert, D. 1992. Zero-inflated Poisson regression, with an application to defects in manufacturing. *Technometrics* 34 pp.1–14.
- Lapham R.J., and Mauldin W.P., 1984. Family planning program effort and birthrate decline in developing countries, *International Family Planning Perspectives*. 10(4), pp.109–118.
- Lata, G. and Maitra, P., 2001. Two Aspects of Fertility Behaviour in South Africa. *Economic Development and Cultural Change*, 50(1), pp. 183-199.
- Lesthaeghe, R. and Surkyn, J., 1988. Cultural Dynamics and Economic Theories of Fertility Change. *Population and Development Review*, 14(1), pp. 1-45.
- Lesthaeghe, R., 1983. A Century of Demographic and Cultural Change in Western Europe: An Exploration of Underlying Dimensions. *Population and Development Review*, 9(3), pp. 411-435.
- Malek N. B. A., and Idris Z.Z., 2016. *Women's Informal Employment and Fertility Rate: A Concern On Population Growth*. Penang, Malaysia, A Paper Prepared for presentation at the 3rd Kanita Postgraduate International Conference on Gender Studies. 16-17 November 2016.
- Martine, G., Alves, J. E., and Cavenaghi, S. (2013). *Urbanization and fertility decline: cashing in on structural change*. London: IIED
- Mauldin W.P., Berelson B., and Sykes Z., (1978) Conditions of fertility decline in developing countries, 1965-75, *Studies in Family Planning*, 9(5): 90-147
- Mboup, G. and Saha, T. 1998. Fertility Levels, Trends and Differentials. *DHS Comparative Studies* No. 28. Calverton, Maryland: Macro International Inc.
- McDowell, A. 2003. "From the help desk: hurdle models." *The Stata Journal* 3(2), pp 178 – 184 Stata corporation
- Merrick, T. W., 2002. Population and Poverty: New Views on an Old Controversy. *International Planning Perspectives*, 28(1).
- Moeeni M, Pourreza A, Torabi F, Heydari H, and Mahmoudi M. 2014. Analysis of economic determinants of fertility in Iran: a multilevel approach. *International Journal of Health Policy and Management*, 3(3), pp. 135-144.
- Muia E.G. *et al.*, 2003. An analysis of Training in the Provision of Family Planning Services in Factors that Contribute to the Utilization of Quality RH Care: Findings from Further Analysis of the Service Provision Assessment of 1999: June 12. :22-36., Nairobi: Ministry of Health, National Council for Population and Development-Ministry of Planning and National

- Mullahy, J. 1986. Specification and testing of some modified count data models. *Journal of Econometrics* 3, pp.341–365.
- Murthi, M., Guio, A.C. and Preze, J., 1995. Mortality, Fertility, and Gender Bias in India: A District-Level Analysis. *Population and Development Review*, 21(4), pp. 745-782.
- Mutuku, A. M., 2013. *Fertility Transition and its Determinants in Kenya: Evidence from 1993 and 2003 KDHS*. Nairobi: A Ph.D. thesis for the award of the Degree of Doctor of Philosophy in Population Studies.
- National Coordinating Agency for Population and Development (NCPAD)., 2010. Rapid Population and Development, Nairobi, Kenya: National Coordinating Agency for Population and Development.
- National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development [Kenya]), and Macro International Inc. (MI). 1994. Kenya Demographic and Health Survey 1993. Calverton, Maryland: NCPD, CBS, and MI.
- National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). 1999. Kenya Demographic and Health Survey 1998. Calverton, Maryland: NDPD, CBS, and MI.
- National Research Council. (1990). Developing new contraceptives: Obstacles and opportunities. National Academies Press.
- Nguyen-Dinh, H., 1997. A socioeconomic analysis of the determinants of fertility: The Case of Vietnam. *Journal of Population Economics*, 10(3), pp. 251-271.
- Njonjo, K. S., 2010. Youth Fact Book; Infinite Possibility or Definite Disaster. Nairobi: Institute of Economic Affairs (IEA) and Friedrich-Ebert-Shiftung.
- Odwe, G. O. (2014). *Fertility and Household Poverty in Kenya: a comparative analysis of Coast and Western Provinces* (Doctoral dissertation, University of Nairobi).
- Ojaka, D., 2008. *The Fertility Transition in Kenya: Patterns and Determinants*. (Ph.D. Dissertation: University of Montreal).
- Okech, T. C., Wawire, N. and Mburu, T. K., 2011. Contraceptive Use among women of Reproductive Age in Kenya's City Slums. *International Journal of Business and Social Science*, 2(1), pp. 22-43.
- Parikh, K. S. and Gupta, C., 2001. How Effective is Female Literacy in Reducing Fertility? *Economic and Political Weekly*, 36(35), pp. 3391-3398.
- Parr N. J., 1998. Changes in the factors affecting fertility in Ghana during the early stages of the fertility decline. *Genus* 54 (1/2). Published by Università degli Studi di Roma "La Sapienza"
- Phillips J.F. *et al.*, 1988. Determinants of reproductive change in a traditional society: evidence from Matlab, Bangladesh, *Studies in Family Planning*, 1988, 19(6):313–334.
- Raftery, A. E., Lewis, S. M. and Aghajanian, A., 1995. Demand or Ideation? Evidence from the Iranian Marital Fertility Decline. *Demography*, 32(2), pp. 159-182.

- Raivio, K. 1990. How does infant mortality affect birth rates? (editorial). *DUODECIM*, 106(17), 1187-9.
- Republic of Kenya, 2010. Population Stabilization: Kenya Case: Government Printers, Nairobi
- Republic of Kenya, 2012. Sessional Paper No. 3 of 2012 on Population for National Development, Government Printers, Nairobi
- Sather, Z. A., Loyd, C. B., Mete, C. and Haque, M. U., 2003. Schooling Opportunities for Girls as a Stimulus for Fertility Change in Rural Pakistan. *Economic Development and Cultural Change*, 51(3), pp. 677-698.
- Schultz, T. P., 1985. Changing World Prices, Women's wages, and the Fertility Transition: Sweden, 1860-1910. *Journal of Political Economy*, 93(6), pp. 1126-1154.
- Schultz, T. P., 2005. Fertility and Income. Yale University: *Economic Growth Center Discussion Paper no.925*.
- Searchinger, T., Hanson C., Ranganathan J., Lipinski B., Waite R., Winterbottom R., Dinshaw A., and Heimlich R., 2013. Achieving Replacement Level Fertility. *Working Paper, Installment 3 of Creating a Sustainable Food Future*. Washington, DC: World Resources Institute. Available online at <http://www.worldresourcesreport.org>
- Senona, R., 2008. Analysis of Socio-economic factors influencing fertility in South Africa. Pretoria, South Africa, A Paper Prepared for presentation at the 1st Africa Conference of Young Statisticians.
- Skirbekk, V. 2008. Fertility trends by social status. *Demographic Research*, 18(5), 145-180.
- Soares, R. R., 2005. Mortality reduction, educational attainment, and fertility choice. *American Economic Review*, 95(3), pp.580-601.
- Thuku G. K., Gachanja P. and Obere A., 2013. The Impact of Population Change on Economic Growth in Kenya, *International Journal of Economics and Management Sciences*, 2(06), pp. 43-60.
- United Nations Population Fund (UNFPA), 2005. Levels, Trends and Determinants of Lifetime and Desired Fertility in Ethiopia: Findings from EDHS 2005
- Ushie, M. A., Agba, A. M., Olumodeji, E. O. and Attah, F., 2011. Social-cultural and economic determinants of fertility differentials in rural and urban Cross Rivers State, Nigeria. *Journal of Geography and Regional Planning*, 4(7), pp. 383 - 391.
- Van den Broeck, G., and Maertens, M. 2014. Does female employment reduce fertility rates? Evidence from the Senegalese horticultural export sector. Ljubljana, Slovenia, A Paper Prepared for presentation at the EAAE 2014 Congress 'Agri-Food and Rural Innovations for Healthier Societies'
- Vuong, Q. H. 1989. Likelihood ratio tests for model selection and non-nested hypotheses. *Econometrica* 57, pp. 307-333.
- Wang, W. and Famoye, F., 1997. Modeling household fertility decisions with generalized Poisson regression. *Journal of Population Economics*, 10, pp. 273-283.
- Wedderburn, R. W. M. 1974. Quasi-likelihood functions, generalized linear models, and the Gauss-Newton method. *Biometrika* 61, pp. 439-447.

- Winkelmann, R. and Zimmermann, K. F., 1994. Count Data Model for Demographic Data. *Mathematical Population Studies*, (4), pp. 205 - 221.
- World Bank, 2014. World Development Indicators Database. [Online] Available at: www.worldbank.org [Accessed; January 2016].
- Wooldridge, J. M., 2004. Introductory Econometrics-A Modern Approach. 5th ed. Cengage Learning. United States of America
- Zhang, J., 1990. Socioeconomic Determinants of Fertility in China a Microeconomic Analysis in China. *Journal of Population Economics*, 3(2), pp. 105-123.
- Zurayk, H., 1979. A Two-Stage Analysis of the Determinants of Fertility in Rural South Lebanon. *Population Studies*, 33(3), pp. 489-504.