UNIVERSITY OF NAIROBI

EFFECTS OF ECONOMIC DEVELOPMENT ON FERTILITY IN KENYA

BY

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DECLARATION

I, the undersigned, do declare that this research project is my original work and that it has not been presented for a degree award at the University of Nairobi or in any other university.

Signature:  Date: 22nd November 2023

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This research project is submitted for examination with our approval as the appointed university of Nairobi supervisors:

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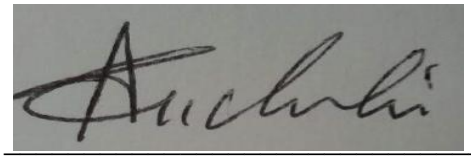
Signature:  Date: _November 23, 2023_____

Dr. Wanjiru Gichuhi

Dedication

This research project is dedicated to my family for their support in realizing this goal. Their prayers and support were instrumental in realizing my goal of academic success.

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ABSTRACT

The purpose of this research project was to study empirically the effects of economic development on fertility in Kenya. This was necessitated by the fact that Kenya's economy has been improving and the country recently was classified as middle lower income nation. Improvement in economy was coming at the backdrop of declining fertility rates in the country that was once considered to possess the highest fertility rates globally in the mid-1980s. Despite the changes that had taken place and the availability of quality data from census, no study had been done at the macro level to establish the effects of changes in Kenya's economy as a determinant of fertility rates as has been done in developed countries.

The study used demographic transition theory while applying threshold regression analysis to examine the relationship. The result confirmed the findings of other studies that economic development is a significant factor in fertility changes and that counties that were experiencing better economic performance had statistically significant lower TFR as opposed to counties that had lower CGDP. Economic development was however, more significant in low income counties than in higher income counties suggesting that at high income levels, other issues such as access to information becomes relevant in determining fertility rates. The study found out that in both low and high-income counties, CGDP had an inhibiting effect on total fertility rates even though the effects were more in counties with low income than in high income counties. Exposure to mass media was also found to have a negative effect on fertility. It was then concluded that economic development had a negative and significant effect on fertility in Kenya thus it was recommended that economic development programmes meant to improve county gross domestic product be enhanced as well as exposure to mass media.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Investigation into the effects of economic development on fertility has attracted the attention of researchers in various fields especially in demography and economics. These studies have mostly been taken in developed countries where data is available or undertaken in a panel approach, thus leaving less developed countries such as Kenya with unknown knowledge of the relationship. According to Alachkar & Eberstein, (1988), earlier studies found mixed results with the cross sectional analysis yielding positive or negative relationship and sometimes the relationship was insignificant. Still even with the little evidence, the available literature still provided mixed and inconclusive conclusions. As much as so many studies found proof of a strong link between fertility shrink and economic progress indicators, Bryant, (2007) maintained that the relationship was weaker than predicted by the previous studies. Other studies for instance Papagni, (2019) and Li, (2016), being guided by the low levels of TFRs in developed countries, looked into the relationship by conducting panel analysis of several countries both developed and developing including Kenya. This approach was however criticized by Manning & Samarayanake, (1995) that comparing countries which are so heterogeneous in several factors for instance levels of economic development, government policies, demographic policies and geographical sizes do not yield the required results. Comparing countries for instance China and Kenya with different population, government and health policies ends up in conclusions which are skewed.

Kenya has experienced a rapid decline in fertility from a high of 8 in the early 1980s to around 3.4 by 2019 which has been accompanied by rapid economic development in terms of GDP Per capita. Even though there has been a rapid reduction in TFR, there has also been challenges faced for instance between 1998 and 2003, the country experienced a stall in TFR (GoK et al., 2013; Mutuku, 2013). The stall was attributed partly to reductions especially in the intensity of economic advancement reflected in some of the development indicators such as changes in women's educational achievements, infant and child mortality as well as diminishing real per capita economic growth. As much as most studies allude to the fact that information access has

played a crucial role in fertility decline (Brinker & Amonker, 2013), this is still associated with the levels of development thus utilization of these information is possible only in a given set up.

Dow & Werner, (1983) did a study on the prospects for fertility decline in Kenya at the time when fertility rates in the country were considered one of the highest globally and they noted that despite family planning programs being introduced in 1967, very little had been achieved from it. They further noted that the program had no base for success in fertility decline until cultural and economic issues would set in to encourage new family values. By 1983 when this study was done, Dow and Werner (1983) noted that Kenya's urban middle class had started transitioning to emotional and economic nucleation that adopted a complex culture generally related to the industrial world. They gave an example of a situation where as Kenya advances economically, kinship ties loosen as nuclear family tightens and some families become more progressive than others economically. These scholars were however worried that should the kinship ties that existed in the country be left unchecked, then Kenya's fertility decline would be bleak and only to be left with the hope of greater economic development to someday later transform the ideology of high fertility. This hope was later investigated by Shreffler & Dodoo, (2009). The results from their study indicated that wealth flows, economic or emotional family nucleation was at a stage that was significant to promote the overall acceptable fertility behavior.

Dow et al., (1994) relied heavily on the Caldwell's argument on wealth flow to study the likelihood for fertility reduction in Kenya's rural areas. This was a follow up study to their earlier study where they foresaw a bleak future for Kenya's fertility to start declining. They found out that economic development and its effects on fertility were negatively related even though the indicators such as place of residence, education and economic categories essential for lower fertility were still weak.

Robinson & Harbison, (1995) noted that the decline in fertility levels in Kenya was far much faster than that experienced in Asia. They related the decline to changes in development factors such as attitude, education, advances in media and health and the urban life styles. Urban fertility

rates in Kenya have remained below national average throughout since 1970s. They faltered the early critics of Kenya's population program who relied on an in accurate economic model for predicting TFRs in the country. They further noted that the rapid modernization taking place in Kenya was in sharp clash with the traditional values and that modernization was winning in determining the declining trend of TFR. Modernization is increasing the cost of children whereas government's family planning programmes is reducing the cost of access to contraceptives. For example, they noted that around two generations ago, Kenya's most societies were outside cash economy whereas currently everybody within the country is in cash economy. Another notable change that led to the decline in fertility levels noted by Robinson & Harbison, (1995) was changes in land policy as an economic activity. By subdividing land and moving away from clan-based ownership to individual titles, the cost of land as a major production capital increased. The land redistribution policy had a lot of impact on family size decision making. Another significant factor that led to the decline was noted as government policy that emphasized compulsory education and the creation of enormous educational infrastructure. Eventually, education was adopted by all including unlearned parents thus since it increased the cost of children, and family sizes started declining.

Shreffler & Dodoo, (2009) did a qualitative study on the aspects of wealth transfers, such as land, and education and their roles in Kenya's fertility transition in rural areas utilizing Nyeri district as a case study. In Kenya, rural fertility has remained above national average throughout from the 1970s. The study explained how availability of land and norms guiding inheritance, opportunities to education and population pressure intertwined to shape fertility decline in Kenya's rural areas. As previously noted by Robinson & Harbison, (1995) about land sub division, Shreffler & Dodoo, (2009) further explained that since land inheritance is domiciled within the traditional system, subdivision resulted into land scarcity eventually culminating into diminishing farm sizes hence influencing fertility decisions at the family level with the effect of preference for smaller family sizes. The declining land productivity coupled with increasing opportunities outside farming which could only be accessed through proper education led to changes in intergenerational transfer. This is because schooling became an alternative to land for purposes of passing on wealth to the next generation. The expansion of education system in

Kenya was so rapid despite economic problems that made education expensive. Parents left with no alternative had to make great decisions on family sizes since land was becoming scarce and education was also expensive yet the only opportunity outside farming. Relating education to declining fertility levels in Kenya takes several dimensions for instance opportunity costs, delayed marriage, informed mother etc.

Based on the economic transformations that has been taking place in Kenya and considering the reduction in fertility levels, this study was aimed at analyzing if there existed any significant relationship between fertility rates and the magnitude of economic advancement as measured by County Gross Domestic Product (CGDP) per capita as well as other economic development indicators in Kenya.

1.2 Problem Statement

Kenya targets to achieve total fertility rate of 2.6 children per woman by 2030. According to GoK et al., (2013), some of the challenges the country faced in reducing fertility have been factors related to economic development such as low income and inequity, harmful social and cultural factors, inadequate integration of information services and illiteracy. However, as much as the challenges existed, the same report indicated that there were also opportunities for rapid fertility decline in Kenya such as through devolved system of government since 2013 and the free primary education programme amongst other opportunities. Devolution was meant to improve people's livelihoods across the country by improving health services and increased opportunities. Even though factors related to economic development were identified as some of the key drivers towards reduction of TFR, it has not been tested empirically in Kenya.

Studies that have tried to establish the relationship between economic development have mostly been done in developed countries for example (Manning & Samarayanake, 1995 ,Furuoka, 2010). However, studies that have factored developing nations have included them as part of panel data for example Papagni, (2019) and Li, (2016). Conclusions from the previous studies at the same time have either been inconclusive or showed mixed results where some found negative relationship whereas others showed positive relationship as noted by Bryant, (2007). The

approach taken by several studies of using panel regression has also been criticized for instance Manning & Samarayanake, (1995) stated the significance of conducting the consequences of economic progress on fertility in a homogenous environment that has got so many factors in common such as political, cultural and historical characters while at the same time exhibiting sub sectors that differ in socio economic aspects like income, education, level of poverty and urbanization. Due to inadequate or lack of studies on the effects of economic development on fertility in developing countries, there has been little knowledge on the relationship since the conclusions arrived at in developed countries might not be the same as those in less developed countries. Due to availability of data at the county level in Kenya which is a lower middle-income nation, this study aimed at examining the cross-sectional analysis of the effects of economic development indicators as measured by county gross domestic product per capita and other intervening variables on Total fertility rates in Kenya.

1.3 Research Questions

The research was driven by the key question of whether there were effects of economic development on fertility in Kenya.

Specific questions were as follows:

i. What were the direct effect of CGDP Per capita on Total Fertility Rates in Kenya?
ii. What were the indirect effects of CGDP Per capita on total fertility rates in Kenya?

1.4 Research Objectives

The primary objective of this research was to explore the effects of economic development in Kenya on Total Fertility Rates.

Specific objectives were as follows:

i. To determine the direct effects of economic development on Total Fertility Rates in Kenya.
ii. To determine the indirect effects of economic development on Total Fertility Rates in Kenya.

1.5 Justification of The Study

Studies on the effects of economic development on fertility have been anchored mainly on two conflicting schools of thought. The first school of thought concluded that economic development had negative effects on fertility whereas another school of thought especially from Malthus believed that economic development accelerated fertility (Heer, 1966). Previous studies on this relationship have also yielded mix results with some supporting the first school of thought while others supporting the latter. Most of these studies have however, been done in developed countries whereas developing countries such as Kenya have had limited studies geared towards understanding the relationship between economic development and fertility. This study will therefore add into the existing literature on the effects of economic development on fertility from the perspective of a developing nation.

Farooq & Simmons, (1991) noted that economic development is a critical exogenous variable that facilitates the consumption of various government family planning programmes. Thus, understanding the role of the exogenous factors such as economic development on fertility helps the government unravel some of the causal factors involved in fertility changes and implementation strategies for the family planning programmes. Even though population policy in Kenya is outlined in various sessional papers including sessional paper no 3 of 2012 that recognized the significance of the interaction between economic development factors and population dynamics, there have been limited empirical studies geared towards understanding the relationship in Kenya. This study was therefore meant to provide synopsis of the significance of economic development on fertility in Kenya which could then be used to enhance population policy programmes.

1.6 Scope and Limitation of the Study

Investigation into the effects of economic development on fertility levels takes various approaches determined mainly by the availability of data. Some of the approaches include analysis of panel data, cross sectional analysis, lagged time series analysis or even causal analysis. This study however, was limited to counties in Kenya using cross sectional analysis. As noted by Anker & Knowles (1980), studies at the macro level is sometimes limited by lack of

data in some areas. Since county information was available only for 2019 KPHC, the study only used cross sectional analysis. The use of cross-sectional data though considered strong, it has the weakness of failure to consider the lag effects of demographic variables to changes in economic variables.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Review of literature for this study first considered theoretical perspectives where demographic transition theory was reviewed as the theory that guided this study. Empirical review offered highlights into various related studies which included methods used, data sources, model specifications and results of the study. Finally, conceptual and operational frameworks are discussed that included explanations of the operational variables used in this study.

2.2 Theoretical Perspectives

The demographic transition theory (DTT) generally relates levels of economic development also referred to as modernization to levels of fertility that exists within a geographical area. Kenya is in the process of demographic transition as reported in the sessional paper number 3 of 2012 on population policy for national development (NCPD, 2012) and other studies (Ezeh, 2023; Blacker et al., 2005). Considered to have one of the outrageous Total Fertility Rates (TFR) not only in East Africa but globally of around 8 children per woman in the late 1970s and early 1980s, the country has witnessed a swift decline in fertility rate. This rapid decline in TFR is taking place at the time when the country's economic advancement has been improving tremendously with policies that are geared towards equity. Currently Kenya has the lowest TFR regionally of around 3.4 and at the same time is the biggest economy in East Africa.

Heer, (1966) did a study on economic progress and fertility and noted that there were two schools of population theorists who had contrasting views on the consequences of economic advancement on fertility. The first school believed that economic progress had a suppressing factor on fertility which was expressed in the theory of demographic transition. The second school was that of Malthus that believed economic development promoted fertility. Malthus ideologies were however criticized and found to be erroneous though at some point England and Netherlands experienced increasing fertility with increasing development (Heer, 1966).

Recent studies that focused on the effects that economic development had on fertility have attributed a decline in fertility to economic advancement. DTT is generally defined as the process through which a country first experiences mortality decline followed by fertility rate decline as the country goes through modernization process measured majorly by increasing growth in per capita income. The theory is perhaps the oldest demographic theory and has been subjected to a wide debate by demographers as well as other scholars from various other fields such as economists and anthropologists. The formulation of Demographic Transition Theory was concluded by the office of population research based at Princeton. It was the culmination of the previous works by Warren Thompson in 1929, Landry in 1934, Carr-Saunders 1936 and later by Notestein about the ensuing population of the larger Europe including the Soviet Union (Kirk, (1996). Szreter, (1993) did a critical and logical history into the idea of fertility changes from the aspects of demographic transition and noted that DTT has remained at the center of population studies and a critical tool in the study of changes in fertility rates experienced in various areas in both developed and developing nations.

The demographic transition theory is organized into various stages. According to Gowariker, (1994) the theory is generally characterized into five steps irrespective of where it occurs. These include the first step that involves declines in crude birth rates accompanied by either luck or insignificant reduction in the rates of crude births. The second step involves natural growth where the variation between crude birth rates together with crude death rates increases naturally. In the third step, the natural growth reaches a plateau where birth rates begin to decline significantly. In the fourth step, the natural growth begins to decline as a result of birth rates declining faster than the death rates. Finally, in the fifth step, the natural growth rate declines faster culminating into zero signifying a balance between births and deaths. The transformation has been classified differently by various demographers. Due to difference in classification, the number of successive stages varies from a minimum of three to five with Anderson & Kohler, (2015) describing even the sixth phase . However, it is generally regarded as a triple stage process (Sukhija & Setia, 2022). The triple phases were viewed as the core economic and social shifts of either development or modernization (Teitelbaum, 1975).

Stage one also known as the pre-industrial phase of DTT is characterized by pre-modern societies that exhibits soaring birth rates as well as exorbitant rates of mortality. The high death rates in this stage is associated with traditional production systems majorly relying on agriculture. The stage is generally associated with poor sanitation, transport and medicine. As postulated by Goswami, (2022), there exists positive checks such as calamities, disasters and to a greater extent, the lack of advancement in preventive technology, mortality rates are high hence shorter life expectancy. Being a pre-industrial society, insufficient food, inadequate medical and healthcare facilities combined with both deficient sanitations together with hygiene are clear indicators of poor growth as a result of disease and starvation. Since this is a pre-industrial society, the high fertility rates in this stage is attributed to the viable benefits of children demand in agriculture being the main source of subsistence. In addition, the high TFR experienced in this phase also results from high illiteracy rates and low-income levels amongst women.

Stage two also known as the transitional phase distinctive mainly by the population surge. This phase of the transition theory is portrayed initially by diminishing mortality rates while retaining peak fertility rates. Goswami, (2022) indicated that scaling down fertility rates is due to continues economic expansion and advancements majorly in areas such as supply of food, medical, healthcare and generally disease control due to industrialization processes. At this stage, life expectancy improves whereas death rates generally as well as infant and under five rates of mortality decline significantly. This stage is mainly observed in developing countries. According to Teitelbaum, (1975), individuals in this stage start to control their fertility consciously and the birth rates begin declining gradually towards equilibrium with the already low mortality rates. Fertility decline lags behind mortality decline since all the traditional social and economic systems that favor high fertility has to be weakened and new institutions that favor low fertility emerge. Kenya is also in this stage of demographic transition as noted by Robinson, (1992) on his investigation into Kenya's fertility transition. Robinson pointed out that this was happening at the back-drop of earlier researchers such as Frank and McNichol who had termed Kenya's family planning programs as total failures

Stage three is marked by the beginning of decline in fertility. As stated by Teitelbaum, (1975), decline in fertility lags behind mortality decline owing to the fact that it could not occur until the conservative social and traditional economic executions were overcome and replaced by the modern economic order that favors reduction in fertility level. This new economic order is often referred to as the industrial and urban transformation. Stage four is marked by both low mortality and low fertility levels. This stage is mostly associated with developed nations. Fertility levels at this stage is mostly at below replacement level

The factors responsible for demographic transition are numerous. Srinivasan, (2011) noted that the underlying mechanisms that triggered the onset of both fertility and mortality declines were referred to as the forces of industrialization, modernization or development. He further noted that these terms included various issues such as rise in per capita income, transformation of agricultural to industrial society, modern education particularly of women, personal hygiene, improved public health and medical services, improved nutrition and secular view of life. As noted in the stages of transition, the declines in fertility had some time lag which was related to higher survival rates of children. In developing countries such as former colonies, Srinivasan, (2011) indicated that after they achieved independence, the newly formed governments embarked on the development of their populations by launching various programs aimed at revamping the economic and health conditions of their people which later would have an impact on fertility level. According to Becker, (1960) and Galor, (2012), the jump in per capita income before the onset of diminishing fertility led to the assumption that rise in income is a perquisite for fertility decline.

Galor, (2012) depicted a family as a social unit that derives some benefits out of consumption (c) as well as the number of children (n). The social unit is at the same time restricted with a single factor of time and derives earnings (y) when the whole available unit time is contributed to the labor market. If raising off springs is time consuming with expenses related to each offspring (τ) being a fraction of parent's unit capacity, then budget constraint for the household would be in the form of $c = (1 - \tau n)y$. This can then be re written as $\tau yn + c \leq y$, indicating that the price of an offspring is the opportunity cost of raising it, τy thus an increase in raising households earning

capacity generates two conflicting outcomes. First, the increment in y creates some positive income effects that leads to the number of children increasing (if children were normal goods). However, on the opposite the rise in y results into a negative substitution effect reflecting a rise in opportunity cost of raising children τy. The process is accompanied by what was noted by Caldwel in Dow et al., (1994) as the emotional nucleation which he said must either accompany or precede economic nucleation in the general transition to lower fertility. Dow et al., (1994) while doing an investigation on diminishing fertility in rural Kenya noted that the high levels of emotional nucleation stimulated demand for lower fertility and was responsible for the approval of planning of families to either postpone pregnancy or terminate.

Demographic Transition Theory remains one very strong theory in trying to understand the fertility changes that exists in an area at a macro level in relation to improved performance of various economies. As noted by Manning & Samarayanake, (1995), the literature related to issues on birth rates or fertility fall into two major classes i.e. literature that seek to investigate rates of individual fertility and ones that examines the aggregate interrelationship amidst fertility, educational attainment and economic expansion. Demographic transition theory has been used in several studies that seek to understand fertility levels and how it relates to economic development at a macro level. As postulated by Becker & Murphy, (1990), at relatively minimal stages of development, there existed an urge towards increased fertility and further away from educational achievement which eventually chokes economic expansion. They noted that it is mainly after some levels of human capital accumulation, for example, education having been attained would the benefits accrued to that venture eventually become self-sufficing. In a static or developing economy, birth rates are higher as children tend to be cheaper during recession (Davalos & Morales, 2017; Becker, 1988).

Some of the studies that have used demographic transition theory include Ryabov, (2015) who used demographic transition theory to study the interrelation between economic expansion in the United States and fertility. Manning & Samarayanake, (1995) relied heavily on the theory of demographic transition while undertaking the works of fertility rates in relation to the socio economic conditions in Missouri. Brinker & Amonker, (2013) equally utilized demographic

transition theory in his study of social and economic expansion and fertility trends among the Indian states. Poston & Gu, (1987) also used the DTT to study socio economic development, family planning and fertility in China

2.3 Empirical Literature Review

Some of the early studies on economic development and its effects on fertility were done by Adelman in 1963, Silver in 1967 and Barbara in 1971. Weintraub, (1962) pioneered the works of the roles played by economic advancement on fertility rates when he did an empirical study on the birth rate and economic expansion. Utilizing income per capita, proportion of population in agricultural production and infant mortality rates as explanatory variables indicating levels of development, he used the United Nations Demographic year book data and the United Nation statistical year book for thirty nations to answer the question of at what level were those variables related to changes in birth rates. In this study, the relationship between birth rates and all the three indicators used were found to be positive thus confirming the Malthusian theory. The study, however faced challenges which were noted by Weintraub (1962) such as multicollinearity among the dependent variables hence the coefficients given were not reliable. This work though formed the basis for which other studies on the effects of economic expansion on fertility levels would be carried out in future, it elicited a lot of debate on its viability. Okun, (1965) criticized Weintraub's work noting that it did not meet the required statistical and data thresholds. Okun faulted Weinstraub's use of cross-sectional analysis in trying to predict long run relations as weak.

Studies by Adelman, (1963) on an econometrics analysis of population growth used a regression analysis of the log model to examine the effects of economic development on fertility rates. The research utilized the data from the United Nations for 57 countries which had complete data. She used the number of live births per 1000 females belonging to the i^{th} age as the explained variables and real national income per capita, percent of labor force engaged outside agriculture, education index and density of the population as the explanatory variables capturing levels of economic development. She then applied the log regression analysis. However, in the process of obtaining the regression coefficients, she noted, a discrepancy in the statistical accuracy of the

data obtained from some countries. This forced weighting of the data using the Whipple index. From the regression analysis, it was generally apparent that the model covered between 50 to 70 percent of the variation in the response variable. The regression result showed a positive relationship between age specific fertility rate and par capita income with only the first two age groups being significant at 5 percent level. This was consistent with Weinstraub's (1962) result. However other variables i.e. percent of labor force employed outside agriculture, an index of education and the population density all showed a negative and statistically significant relationship. These two studies by Adelman (1963) and Weinstraub (1962) triggered so many studies on the area of economic development-fertility nexus.

Friedlander & Silver, (1967) conducted an investigation into the quantitative determinants of fertility behavior using a cross country approach. By using cross country approach, they sought to correct some of the flaws captured in the preceding studies by Adelman (1963) and Weinstraub (1962). This was done by bringing in homogeneity by doing different regressions on countries that had somehow similar characteristics. The choice of variables especially independent variable was such that it could permit causal interpretation. They noted that the ideal dependent variable ought to have been the desired number of conceptions, however the data on fecundity was not available for most countries. This forced them to use the closest alternative which they determined as the live births hence used quantity of live births per 1000 persons (crude birth rates). The independent variables were income as measured by national per capita income, child mortality as measured by the ratio of child deaths to the child population, population density, the level of education, urbanization, social reforms, the demographic gap, social mobility, substitutes for sexual intercourse as measured by radios per capita, the need for oral contraceptives, religious configuration, achievement motives, demonstration effects, the social position of women, diet, the clash of cultures and family structure. They concluded that the negative association that existed between income and fertility in under-developed nations could be as a result of a population trap. This problem occurs where countries move to levels of per capita income growth less than population growth rate.

Gendell, (1967) while working on fertility and development in Brazil found out that there was substantial economic and social development in Brazil between 1920-40 and 1960 but fertility remained constant. This therefore posed a question as to what level of development is necessary to have effect on TFR. The study utilized Census data where variables connected to fertility differentials and socio economic were considered. The study conducted a trend analysis of crude birth rates, children ever born and the fertility ratio against development indicators of place of per capita income, residence, socio economic status and education. The study was however marred by lack of reliable data since the census data was considered unreliable. Also, the methodology used could not relate the effects of development variables on fertility levels since they were analyzed independently. The study found out that a substantial economic development took place between 1920 -40 and that fertility remained fairly constant. He however, concluded that absence of correlation between development and fertility does not negate the hypothesis of negative correlation since there was no study done before to predict what level of development is necessary for fertility to decline.

Rao & Dey, (1968) conducted a study to examine the link between rates of birth and economic development by utilizing Japanese data. Their work was a deviation from the previous studies that applied inter country analysis to intra country analysis. The significance of doing the study for Japan was to conduct the study in a more homogenous environment while at the same time relying heavily on the works of Wenstraub (1962), Adelman (1963) and Okun's criticisms of Wenstraub's work. Applying cross sectional analysis as one used by Adelman (1963), he used a regression analysis with birth rates per 1000 population as the dependent variable. The initial explanatory variables were per capita income, farm population as percentage of total population and infant mortality rates which were later, in further analysis expanded to include marriage rate and an index of family limitation practices. Economic development was defined in this study as a process where various factors interact in a geographical area and ultimately lead to an improvement in the living standards. They argued that not all the time where there is a start in mortality decline, increased urbanization and increased uptake of education that there is an improvement in the living standards. They stressed that the impact of economic development on birth rates can be reflected only by including per capita income with no apparent need to include

all the suggested economic variables as suggested in other studies. They found out that income had a negative influence on fertility which contradicted Weinstraubs (1962) results. They also concluded that with a suitable long term or short-term models developed for each nation, the models would be of immense policy use for nations than conclusions from cross country studies.

While Rao & Dey, (1968) worked on Japanese data Drakatos, (1969) was also working on the econometric study of the factors of birth rate in less developed countries, using Greece as a case study. He noted that two methods have been followed in the study of the impacts of development on birth rates. He noted that the first method was majorly the application of time series data that covered a relatively long period to analyze the function of birth rate in a given country. The second method was majorly by testing hypothesis based on data from various countries collected at the same time. Drakatos (1969) used cross sectional data for distinguished geographical regions of Greece to do the study. He justified that this approach provides more accuracy to the results relative to time series. By also doing it at country level as opposed to cross country provided more reliable results due to the removal of the qualitative differences among countries. As much as the differences can as well be experienced locally, they are far much reduced in intra country than in inter country. The choice of variables to be used in the analysis was based mainly on other studies done before. The variables used were the birth rate for dependent variables as functions of the per capita income, proportion of reproductive population, proportion of rural population and the percent of the literate population who had attained the age of ten years old and above. Using the above variables, the empirical results showed that income per capita was negatively related to rates of birth. This was a deviation from some previous studies such as the ones conducted by Wenstraub (1962) and Adelman (1963) who found out a positive correlation linking fertility levels and economic development indicators.

Janowitz, (1971) reviewed critically the works by Adelman (1962), Friedlander and Silver (1967) in the study of empirical repercussions of social and economic development on fertility rates. She reiterated the sentiments of Drakatos (1967) by indicating that there were two approaches to this type of study statistically. The first approach was to study the effects over time within a country or secondly for the studies to be carried at one point for different nations at

differing levels of socio-economic development. She noted that the latter has been used by several studies maybe as a result of availability of data from the united nations and lack of data over time to allow for time series analysis (see the works of Adelman (1963), Weintraub 1961, Drakatos (1966). Janowitz noted that there was no attempt from the studies of Weintraub (1962) and Russet (1964) to establish whether the calculated regression equation was capable of measuring the impacts of economic expansion on fertility. The use of cross section analysis to explain changing levels of fertility rates required a further look to ascertain its viability. Thus, this paper utilized cross sectional model to study the effects of economic development indicators as measured by per capita income, expectancy of life and the proportion of labor force engaged in agriculture on Gross Reproduction Rate (GRR). After running the first regression and correlation analysis, high correlation between income and life expectancy and between income and illiteracy levels of women was noted thus life expectancy and illiteracy levels were retained. Different regression analysis was then done, and the result showed a negative relationship. However, Janowitz (1971) warns that care should be taken while using cross section analysis to make prediction since the regression coefficients vary over time.

The early scholars faced various challenges such as lack of data, and methodological approaches. Later scholars for example Manning noted that with the availability of data and improved analysis techniques, there is need to revisit the studies of the links between economic expansion and fertility. Various methods for instance the application of cross-sectional analysis has overcome the storm and is still being applied. To improve on the early methods of analysis, other new methods such as panel data analysis are conveniently and easily utilized in the various studies investigating the effects that economic advancement had on fertility.

Guest, (1974) studied the components of crude birth rate and their relationship to economic advancement and noted that there were some problems with the outcome variable of the previous studies. He realized that studies by Adelman, (1963), Weintraub, (1962), Friedlander & Silver, (1967) used either crude birth rates, gross reproduction rate or child to woman ratio, the general fertility rate and age specific fertility rates without demographic standardization. He faltered the use of such variables due to their heavy reliance on other factors not considered while doing

comparison. For example, the use of crude birth rates in a place that has high number of children or old people do not depict a true picture of the situation. He however noted that the choice of dependent variables had majorly been determined by the availability of data. He corrected the anomaly by decomposing crude birth rates by the use of multiple standard regression. He then used path analysis to check the effects of economic expansion indicators on standardized crude birth rate. In his summary, he concluded that the proportion of the work force in agriculture has a significant effect in the variation of crude birth rates.

Poston & Gu, (1987) after realizing that despite China's one child policy introduced in 1978, China still exhibited variability in fertility across its 28 provinces. It is out of this that they did a study on socio economic advancement and family planning in relation to fertility in China. The grounds for the study was that previous studies on fertility patterns in China had concentrated on the country excluding its sub regions and at the same time, the effects of economic development on fertility levels had never been done empirically for China. With the objective of examining the degree to which fertility was affected by the socio-economic development including family planning factors in China, the study utilized cross sectional data from the census conducted in 1982 provided by the Statistical Bureau of the State. As opposed to previous studies that had issues with data reliability, the census data utilized was described as detailed and accurate at the sub regional level. The use of cross-sectional analysis was described as a weakness in this paper but justified that the only accurate data for the study in China was only from the 1982 census data. It was noted that previous studies have been conducted by lagging the development indicators. The regression analysis had TFR as the outcome variable with predictor variables being per capita industrial productivity, percentage urban, percentage total population literate, population density, total life expectancy, percent employed female outside agriculture and family planning variables. The regression results confirmed their previous theory that fertility rates were negatively related to various economic development indicators as well as family planning indicators. The result obtained in this study corroborated other cross-sectional analysis and of significance was the absolute effect of economic progress on fertility and the indirect effects through family planning programmes.

Alachkar & Eberstein, (1988) did a cross sectional study to find how economic development affects total fertility rates for 126 nations at the macro level. They used data from the world bank. Total fertility rate was used as the response variable to measure fertility. The main predictor variable was the GDP per capita with other independent variables used as intervening. These intervening variables were percent enrolled in secondary school as a percent of population ages 12-17 and infant mortality rates. The study then applied regression analysis that takes into consideration the intervening variables analysis also known as the path analysis. To separate the countries based on their levels of development, the study applied classification used by the world bank of low-income economies, followed by lower middle, then upper middle and finally industrial market economies. The results indicated that mean TFR in the lowest income countries was 3.5 times higher than the industrial market economies and was monotonic from lowest to highest. The study concluded that the strength of income fertility relationship varied with the level of development.

Manning & Samarayanake, (1995) used regression analysis on their study of fertility rates and its relationship to socio-economic conditions in Missouri to test the hypothesis of whether there were economic events whose presence drastically affected fertility rates in the county. The purpose of the research was to comprehend the consequences of economy wide socio-economic forces on fertility in a more homogenous environment. The use of a country as a homogeneous environment necessary for this type of study had earlier been echoed in studies by Rao & Dey, (1968) and Drakatos, (1969). Using the data obtained from the county tapes of 1990 US Census for Missouri, the study utilized income variables, county educational achievement as well as economic fulfillment, race indicator, measures of population living in the rural, mean age and factors explicit to women. The county per capita income was utilized as an indicator to evaluate the effects of added income on birth rates within the county. This variable was significant in this study as it did not only measure the family's mean capacity to provide for additional child but also the capacity to meet the additional child's educational requirements. In the final analysis, the study found out that counties which are fully rural had a positive relation between secondary education and fertility. But in counties with urban rural mix, the same variable acted differently and showed a negative relationship.

Siddiqui, (1996) did an analysis of the cross-country impact of economic factors on fertility behavior using weighted data across different age cohorts. This was guided by the previous studies on international comparison of fertility behavior that have assumed the feedback of fertility levels to indicators of economic development to be equivalent over all age cohorts and that effects which were specific to a given country had no control on parameter approximations of the fertility model. He noted that fertility is determined by factors that are either biological, economic or non-economic and the effects vary in different age groups. He used general fertility rate as the outcome variable and socio-economic indicators as independent variables which included income, female literacy, infant mortality, young dependency, urbanization and family planning indicators. The results showed that literacy levels for women and urbanization had an outstanding and inhibiting effect on fertility levels across all age cohorts. However, changes in other socio-economic indicators such as GDP per capita differed across age cohorts. The results revealed that changes in income had a positive insignificant effect on older people whereas the young cohorts had a significant and negative correlation.

Bryant, (2007) sought to provide evidence that there were minimal interrelations connecting fertility decline and the indicators of economic progress. In his study of the fertility fall theories and the proof from modernization factors, he claimed that fertility decline has been more of a diffusion effect rather than economic development. In this study he advanced three main arguments which was used with various examples to confirm the arguments. The three issues were: socioeconomic theories could not explain the decline in fertility levels in countries with moderate scores on development factors; the association between development indicators and fertility levels were weaker as speculated by the theories of socioeconomic development; and finally, that, due to the diffusion of new ideas, the nexus between indicators of development and fertility levels have shifted. To strengthen his argument on the first proposition Indonesia and Bangladesh were used as examples where there were significant fertility declines despite not having attained socio-economic change necessary to alter the costs and benefits of bearing children. He further noted that those theories that connected economic development and fertility found it difficult to explain fertility declines in less developed countries. For the second proposition about economic development being a weaker predictor of fertility levels, he cited

North Vietnam and Bangladesh as having attained fertility levels far much below what could be speculated from the scores of development indicators, whereas Syria and also Iran had far much higher fertility levels than could be predicted. He confirmed this proposition by conducting a regression model with development indicators as predictors of fertility levels to which the results were positive. To confirm proposition three about the shift over time of the correlation between development factors as predictors of fertility levels, he carried out an actual and predicted fertility levels between 1960 and 2000 and found a huge difference to which he concluded was evidence enough to show that there is a shift between the relationships.

Potter et al., (2002) did a study on development and fertility in Brazil where they used micro data obtained from the Brazilian Censuses. Since census data was capable of providing them with reliable data for the years 1960, 1970, 1980 and 1991 at the regions, they applied both fixed effect time series analysis and cross-sectional data analysis. They noted that one of the drawbacks of conducting this type of investigation has always been the lack of reliable data within countries. The driving factor for this study was that Brazil experienced a decline in fertility levels at the time when economic development was also improving driven by rapid urbanization and industrialization. Some of the notable changes were increased production and consumption of consumer goods, increased investment in transportation and communication infrastructure, advancements in education and medical services. Aggregation was performed between rural and urban in 518 micro regions since changes in fertility and development differed. They used TFR as the response variable. For covariates they selected socio economic indicators that would reflect the transformation in Brazilian economy. The independent variables were child mortality, electrification, female labor force participation, female education and the catholic fraction. The cross-sectional analysis showed that there was difference of fertility response to economic indicators in rural and urban, but both had negative relationship. Fixed effect analysis enabled them to trace changes in fertility across time within each area. The sign of coefficients was found to be the same as in cross sectional analysis. They concluded that broad changes in economic development indicators accounts well for the changes in fertility.

The study of fertility levels and how it is affected by economic development indicators in Brazil have attracted various researchers who use various approaches to determine the relationship. While Gendel (1967) study was driven by constant fertility levels in Brazil despite improved economic conditions, Junior et al., (2013) followed with another study on development and fertility in Brazil where they posed a question whether there was fertility reversion for more developed municipalities. The study was driven by the observation that in the recent past, Brazil observed a simultaneous rapid increase in economic development as well as a decline in TFR from 6.2 in 1940 to 1.86 in 2010 as well as a decline in its population growth. They noted that Brazil faced a decline in TFR despite lack of aggressive family planning campaigns or policies. They noted that fertility decline in Brazil withstood both the economic boom and severe economic recession in 1980. According to Faria, (1997), four main economic development issues were behind fertility decline in Brazil namely; universalization of the mass communication and social security programs, credit policies and urbanization. Junior et al applied the threshold regression analysis developed by Hansen in 2000 and used by Furuoka, (2010) to study the fertility development relationship. They used TFR as the dependent variables and human development index indicators as the explanatory variables. Utilizing most recent data in the Brazilian municipalities and applying Hansen's threshold model, the analysis proved the hypothesis that higher economic development is linked to lower fertility.

Jemna, (2015) used vector auto regression analysis to study causality relationship that existed between economic advancement and fertility rates in Romania at the regional level. The objective was to mainly analyze how fertility was affected by economic growth in Romania in the post-communist period. To achieve this, he applied dynamic analysis based on cointegration analysis. The key variables used were the TFR and GDP Per Capita. Other control variables were educational level, economic growth, urbanization, production structure and secularization. Education was measured as the percent of adult with only high school educational attainment, bachelor's degree and percent of county who are graduates. Production structure was measured by the proportion of female labor force engagement. These variables' data were obtained from Romania's Institute for National Statistics. The result showed that GDP Per capita had a positive influence on fertility whereas fertility had a negative influence on Per capita GDP.

Studies involving fertility development nexus in the United States attracted the interest of various scholars in the recent past. These studies have applied different approaches to arrive at various conclusions. Furuoka, (2010) used threshold regression method of analysis to study fertility and development relationship in the United States. The method of threshold regression analysis is applied either in time series or cross section analysis and is powerful in splitting the data into various regimes which can then be used for further analysis. The rationale for this method was that United States was the only country that TFR had gone below replacement level but again rose up to the replacement level of 2.1. The study used TFR as the explained variable and GDP Per capita as the only explanatory indicator. Empirically, the study found out that there was remarkable and inhibiting relationship between per capita GDP and TFR at lower levels of income below the threshold value. However, as economies continue to improve, fertility levels again begin to rise.

Ryabov, (2015) studied the development and fertility nexus at the county level of the United States utilizing data obtained from various sources. The American Community Survey (ACS) provided data for all the independent variables except health whereas the National Centre for Health Services (NCHS) provided data for TFR (dependent variable). The main objective of this study was to find whether there was any linkage between total fertility rate and the geographical distribution of human development in the United States at county level. Even though the rationale of the study was mainly because there has not been any empirical work specifically devoted to the connection between fertility and development in the United States, Furuoka had done a similar study though used different approach. United States being a highly developed country, the possibility that these relationships could operate in different ways were high. While Furuoka, (2010) applied threshold regression analysis, Ryabov applied explorative analysis to determine the best explanatory variables where wealth, health and education were determined. Variables for health were then found to be female and male life expectancies at birth. For wealth, median income per capita and households with below poverty income levels. For education, percentage of adults aged 25 years and above with below high school education and those with bachelor degree and above scored highly and were picked. To account for fertility difference between races, a racial-ethnic variable was also included and also the place of residence as

urban, suburban and rural counties. Analyses using multivariate were then carried separately for urban counties, peri urban counties and rural counties. Results of the study indicated that there was a negative association between fertility and the various development indicators selected for sub urban, rural counties and the united states. However, for urban counties, the results were inconclusive.

Bastiaans & Romaniello, (2016) investigated the role played by education, life expectancy as well as Gross Domestic Product Per capita on fertility rates. The data utilized for the study included a panel of 141 countries which was inclusive of Kenya from the world bank spanning for 31 years between 1975 and 2005. Total fertility rate was taken as the dependent variables whereas explanatory variables included socio economic development indicators of GDP Per capita, life expectancy, education and under 5 mortality rates. Analysis of panel regression with both year and country fixed effects was then used to ascertain the outcome of various socioeconomic indicators on TFR. The outcome obtained was a U-shaped curve and TFR responded negatively to per capita GDP, infant mortality and also life expectancy. The U-shaped curve indicated that fertility tends to increase again with very high levels of socioeconomic development. However, some limitations were noted in the paper which included failure to utilize proxies for issues such as institutional differences and labor market situations that existed amongst countries. Another limitation was that GDP Per capita was not based on the purchasing power parity because of lack of data on inflation levels of various countries.

Researching on economic crisis as a driving force behind fertility decline in poor areas of Colombia, Davalos & Morales, (2017) used the economic theory of fertility and found out that periods that were associated with recession were also associated by increased fertility in rich areas as opposed to poor areas. He used data obtained from the Colombian vital registration system to calculate TFR and National Department for Statistics of Colombia (DANE) to obtain data on GDP Per capita. The application of panel data regression for 32 states in Colombia between the year 1998 to 2013, made it possible to analyze the effects of economic crisis at various levels on TFR. The study indicated that women who are less involved in economic

activities have enough time to give birth to more babies as opposed to women who are economically engaged.

From the reviewed literature, it can be confirmed that studying the effects of economic advancement on fertility rates have been inconclusive to date. Various approaches have been applied by various researchers and scholars. Investigations into this area has involved either cross sectional or time series analysis. Both analysis of time series and cross-sectional analysis have been done both in inter country and cross-country analyses.

2.4 Conceptual Framework

The linkage between economic expansion and fertility rates has been done notably by Easterlin. The conceptual framework that guided this study was based on the Easterlin's economic framework for fertility analysis. According to Alachkar & Eberstein, (1988), in the process of economic achievements, income changes together with other intervening economic and demographic variables and hence the effects of economic development on fertility can hardly be differentiated from the effects of other variables. Easterlin (1983) noted that the effect of income may be related to fertility directly or through other intervening variables. In the long run, income

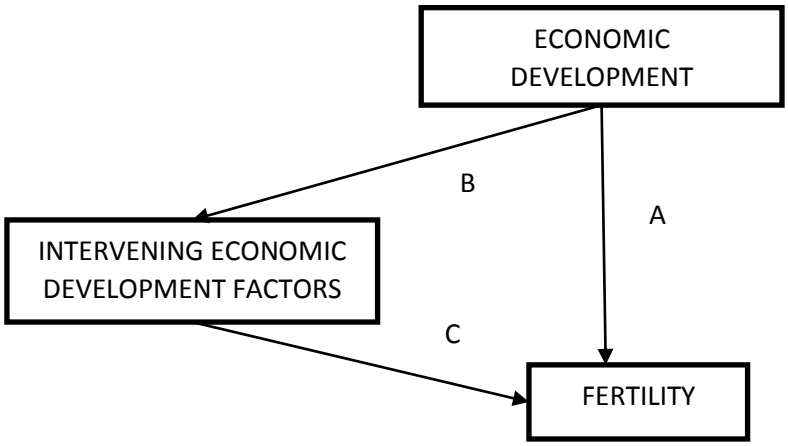


Figure 2.1: Conceptual Framework

Source: Easterlin Economic Framework

changes are attributed to changes in the intervening variables. As postulated by Poston & Gu, (1987), economic development provides an aggregate influence either directly or indirectly through other demographic determinants. The economic development environment provides structures as well as institutions that are geared towards influencing reproductive motivation and fertility.

From figure 2.1, the direct outcome of economic development on fertility is depicted by path A. Path B and C represents the economic development effects on fertility through the intervening economic development determinants. From the theoretical perspectives, it is hypothesized that economic development has a negative relationship with fertility even though this is not always the case. (Alachkar & Eberstein, 1988) observed that various studies have been conducted on the effects of income on fertility with mixed results, some showing positive, some negative and others inconclusive.

2.5 Operational Framework

The operational framework used in this study was developed from the Eastelin's economic framework for fertility analysis (Easterlin, 1975). The framework utilized for this research (figure 1) focuses on the economic advancement factor as measured by CGDP Per capita) and its direct effects on the level of fertility as measured by TFR in Kenya and indirectly through the intervening economic development variables.

The outcome factor being the fertility level, there is need to apply a robust measure of fertility. Various methods are used to measure fertility. Some of the measurers include crude birth rates (CBR), general reproductive rates (GRR), age specific fertility rates (ASFR), and TFR. Crude birth rate is defined as the number of live births per 1000 population. Crude birth rate is majorly affected by the age composition of the population thus not a pure measure of fertility levels. Age specific birth rates is the number of births per 1000 females in the i^{th} age group. ASFR is also influenced by the age composition of the population and therefore not a very good measure of fertility levels. Total Fertility Rate-TFR being the mean number of children born to a woman

assuming the prevailing age specific birth rates remains constant throughout her child bearing period of 15-49 years. TFR takes into consideration the mean values thus considered as the best measure of fertility rates.

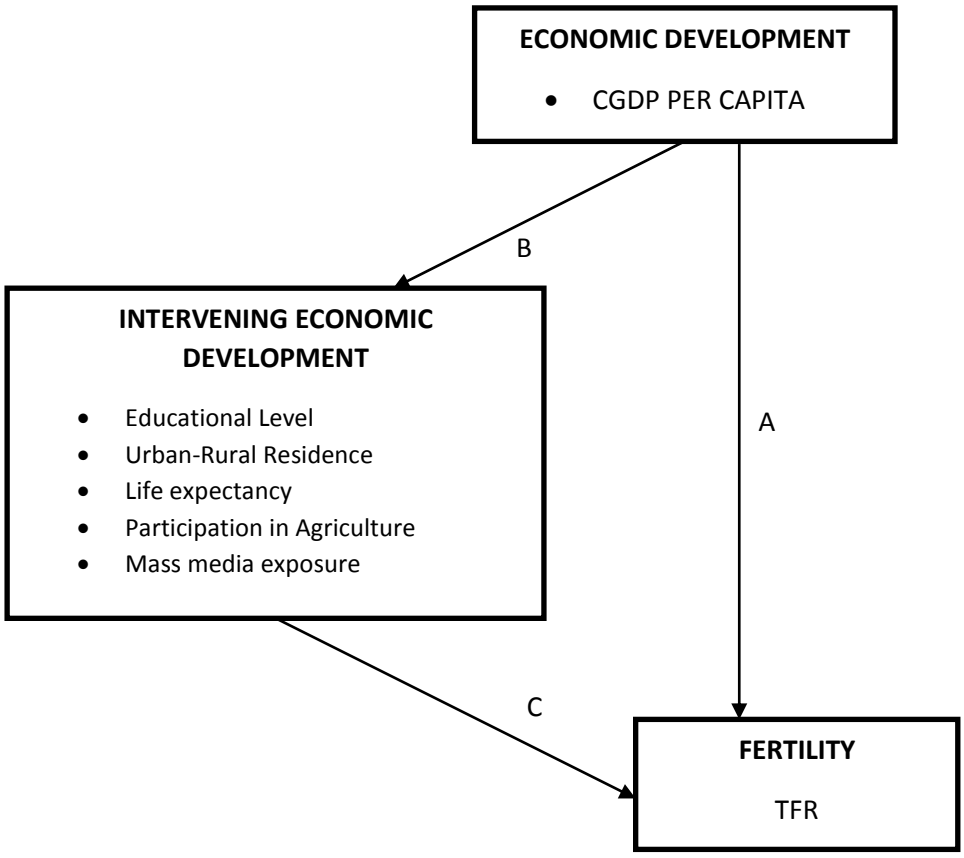


Figure 2.2: Operational Framework

Source: Modified from Easterlin Economic Framework

CGDP Per capita is the measure of the average income earned per person in a county within a year. It is the equivalent of GDP Per capita at the national level. As indicated by (KNBS, 2022a), CGDP per capita is used as the proxy measure of economic development. In nearly all research concerned with the nexus between economic development and fertility, GDP Per capita has been

used as the main explanatory variable (See Ryabov, 2015, Bastiaans & Romaniello, 2016, Brinker & Amonker, 2013).

Intervening factors includes the educational level, urban-rural residence, life expectancy, employment status and mass media exposure. Panth, (2021) indicated that economic development goes beyond rise in GDP per capita to include other fundamental changes in the structure of an economy. The implied changes include institutional framework, capital structure and infrastructure meant for the population to achieve higher standards of living. Miladinov, (2020) highlighted that life expectancy is an indicator of population health and that it also summarizes the entire population mortality rates across all age cohorts i.e. children, adolescent and adults. He further noted that all countries whether poor or rich would strive to improve the health of their population while at the same time reducing mortality. In Kenya currently, the average life expectancy is 63 years. Urban rural residence is the fraction of people who either reside in urban or rural areas. According to Forty et al., (2022), urbanization is negatively related to fertility. Siddiqui, (1996b) also found a significant negative relationship between TFR and urbanization. This is because in urban areas, children tend to contribute less to family income as opposed to agricultural societies in the rural. In addition to income contribution space for housing is expensive in urban areas but there is easy access to health services where various methods of family planning methods are available. As economies grow, there tend to be more opportunities in urban areas as opportunities diminish in the rural areas. Growth of economies and modernize through economic development, leads to increased demand for well trained work force. As land sizes diminish and greater opportunities are only available outside traditional production system, demand for education rises. As indicated by GoK et al., (2013), time taken in education has the effect of postponing marriages and having educated mother also helps in child survival and greater bargaining power within the family. The most influential factor has been the female education. GoK et al., (2013) indicated free primary and subsidized secondary education as great enablers of fertility decline.

According to Junior et al., (2013), universalization of mass communication played a critical role in spreading fertility decision behaviors from more developed to less developed parts of the

region. According to Junior et al, the spread of new ideas and social interaction mainly related to development have had effects on fertility changes in Brazil. Forty et al., (2022) reiterated that mass media is a significant aspect of development which enables audiences to identify themselves with ideas different and far away from them. In relating fertility and access to mass media, Forty et al., (2022) utilized the diffusion model where people, communities and even countries interact, thus advancing information on awareness and technological aspects in regard to contraception and fertility ideals. The ideas and ideals received are then reinterpreted to acquire contemporary meaning in various contexts eventually necessitating or constraining actions that appertains to autonomy of women including fertility choice. Friedlander & Silver, (1967) referred to this as the demonstration effect where people in developing nations shifts their consumption based on developed nations. KPHC 2019 census collected various aspects as concerned access to mass media that included phone ownership, internet access, television ownership and even radio.

2.6 Operational Definition of Variables

Table 3.1 gives the description and measurement of variables. The outcome variable for the study was the total fertility rates (TFR). TFR is the expected number of children a woman is predicted to have over her reproductive period if the prevailing age specific fertility rates are factored.

The explanatory variable for this study were selected based on their significance in other related studies on economic development and fertility levels. These variables were grouped into two categories. The first category was the county Gross Domestic per capita which was also the key indicator of interest in this study used to measure level of economic development. The second category of explanatory variables included the intervening variables used to measure the indirect effects of CGDP per capita on fertility. These indicators included educational attainment, urban rural residence, life expectancy and mass media exposure. Table one below gives the description of the variables used in this study.

Table 3.1: Description of variables

Variable	Description	Measurement
Dependent (Outcome)		
tfr	Total Fertility Rate. The measure of fertility level	The sum of ASFR per county
Economic Development		
cgdp	County GDP Per Capita. This is the measure/indicator of economic development.	County GDP divided by the county population
Intervening Factors		
ed	Highest level of education attained for residents per county. Level of literacy.	Percent of the people who have attained secondary and higher educational level
ur	Level of urbanization within the county	Percent of urban population in the county
le	Life expectancy is the average number of years a child born today expects to live.	Average county life expectancy as given in KPHC 2019
pa	Participation in Agriculture	Percent household employed in agriculture
mm	Access to information technology eg Television, radio, phones	- Proportion of households with access to radio

CHAPTER THREE

DATA AND METHODS

3.1 Introduction

This chapter discussed sources of data and methods as well as models utilized to achieve the objective of the study of the effects of economic development on fertility in Kenya. Sources and quality of data was first highlighted followed by the methods used for analysis. The empirical model as well as descriptive analysis methods were discussed and finally the ethical considerations of the data used.

3.2 Data Sources

The study applied available secondary data for the 47 counties in Kenya. These counties were generally at different stages of economic development and also possessed variability in their fertility levels. Data on County GDP Per capita were obtained from KNBS (2022) publication on Gross County Product (GCP). The main objective for producing county GDP was to provide synopsis of county performance in terms of economic structurers and their relative size. The calculations of GCP was based on top down method where the national GDP was appropriated to counties by the distribution key approach. Data on TFR and other intervening variables were acquired from the 2019 Kenya Population and Housing Census (KPHC) reports. The aim of KPHC 2019 was to gather information on size, composition, spatial distribution, levels of mortality, fertility and migration, educational attainment, rate and pattern of urbanization and household compositions of the population. Census data does not entail sampling hence no sampling techniques applied.

According to KNBS, 2019, KPHC for the first time integrated high technology which included the application of mobile phones for data collection that improved speed and quality of data since captured data was forwarded in real time. Techniques of evaluation of census data to assess errors such as content and coverage were applied, and necessary corrections made to ensure completeness and accuracy. The census applied latest technology in data collection and compilation which improved on its accuracy hence reliability. Integration of quality assurance

throughout the process of census from data collection to processing and final production of reports ensured improved the quality of reports (KNBS, 2019)

3.3 Methods of Data Analysis

Analysis of data involved both descriptive and inferential. The analysis used both excel and statistical software R because of their robustness in statistical analysis and R being an open source with a big community improves its functionality. Descriptive and regression analysis and various tests on variables were done to ensure only relevant variables are included for final analysis.

3.3.1 Descriptive Statistics

Descriptive analysis involved calculating the averages and standard deviations of the various variables used. This involved descriptive of the data, measurers of central tendencies and spatial analysis.

3.3.2 Empirical Model

Long run relationships between population variables and economic factors can statistically be investigated either through analysis of time series or through transverse study (Adelman, 1963). For analysis of time series, a panel data investigation needs to be done across several geographical areas over a long period. The greatest disadvantage of this method in demographic analysis is that at times it does not take into consideration disparities in the age and distribution of sex over time (Adelman, 1963). The alternative to time series analysis is the cross-sectional analysis where variables are investigated at the same time. Using this method, the various effects of economic development such as industrial development, income, life expectancy, on fertility is established quantitatively in average. Aldeman (1963) indicated that the advantage of cross-sectional analysis is that the variation in characteristics among different geographical areas and reduced degree of interplay among the explanatory variables allows for much more precise deduction of regression coefficient as opposed to analysis of time series.

The study therefore relied on the strength of cross-sectional threshold regression analysis to establish the economic development effects on total fertility rates in Kenya. Since its development by Hansen, (2000), threshold regression analysis have been applied to demographic studies especially ones that seek to investigate the relationship between economic development and fertility (Furuoka, 2009, Furuoka, 2010).

The empirical model for this study is derived from Furuoka, (2010) which links TFR to GDP Per Capita. Equation 1 below indicates the association between the outcome variable (TFR) and the explanatory variable (County GDP Per Capita) and the intervening variables.

TFR= $\alpha_0 + \beta_1 cgdp + \beta_2 X_i + \varepsilon$ (1)

Where,

TFR = Total Fertility Rates per county

cgdp = County Gross Domestic Product

X_i = Vector of intervening variables

i = county and

ε = error term

Applying the Hansen's threshold regression model, equation 1 can be split into two to form two regimes as given in equation 2 and 3 below.

$y_i = \theta_1 x_i + e_{1i}$ if $q_i <= \gamma$ (2)

$y_i = \theta_2 x_i + e_{2i}$ if $q_i > \gamma$ (3)

To establish the threshold effect, the following hypothesis is tested, where, θ is the slope variable.

Ho: $\theta_1 = \theta_2$

H1: $\theta_1 \neq \theta_2$

The null hypothesis was the linear regression depicting linearity or lack of two regimes whereas the alternative hypothesis depicts non-linearity. In the case of alternative hypothesis, then there exist two regimes, nonlinear threshold regression.

Equation 2 and 3 can be rewritten into equation 4 below which is well suited to test the threshold hypothesis. Equation 4 helps capture the presence of county gdp per capita as the threshold variable and other intervening variables.

$$TFR = \left\{ \begin{array}{l} \alpha_0^1 + \beta_1^1 cgdp + \beta_i^1 X_t + \varepsilon,\ cgdp_t <= \gamma \\ \alpha_0 + \beta_1^2 cgdp + \beta_2 X_t + \varepsilon,\ cgdp_t > \gamma \end{array} \right\} \quad (4)$$

Where, $cgdp_t$ is the threshold factor that was used to divide the sample into two or more regimes. γ is the unknown cgdp per capita value that was used to calculate the boundary. It enabled the counties to be split into two regimes, some below and some above the value of γ. under the null hypothesis of $\theta_1 = \theta_2$ then, the model turns into linear and reduces to equation 1. However, under the alternative hypothesis of $\theta_1 \neq \theta_2$, then the effect of cgdp per capita will become β_1^1 and β_1^2.

If there exists a double threshold or even more, then equation 4 can be re written as follows in equation 5 and the same hypothesis tests applied.

$$TFR = \left\{ \begin{array}{l} \alpha_0^1 + \beta_1^1 cgdp + \beta_i^1 X_t + \varepsilon,\ cgdp_t <= \gamma \\ \alpha_0 + \beta_1^2 cgdp + \beta_i^2 X_t + \varepsilon, \gamma < cgdp_t <= \gamma \\ \alpha_0 + \beta_1^3 cgdp + \beta_i^3 X_t + \varepsilon,\ cgdp_t > \gamma \end{array} \right\} \quad (5)$$

Under alternative hypothesis, then equation 4 can be re written and estimated as follows in equation 6:

TFR= $(\alpha_{01} + \beta_{11} cgdp + \beta_{21} Xi)$d{cgdp<= γ} + $(\alpha_{02} + \beta_{12} cgdp + \beta_{22} Xi)$d{cgdp> γ} +ε (6)

In case of more than one threshold value as in equation five, then equation 6 is re written to capture the additional regression.

3.3.3.1 Hansen's Cross-Sectional Threshold Regression Analysis

Hansen, (2000) developed a model of splitting sample into two regimes where it is not given a priori. Data is collected in various methods for instance world bank has a way of classifying countries based on GDP Per capita, economic base or market organization. The classification helps in reflecting the differences in their economic base thus there exists low income economies, lower middle income economies, upper middle income and even industrial market economies. Where such classification does not exist, it becomes difficult to know how to split data. Where such classifications do not exist such as the one for world bank, then a decision has to be made at what point should the data be split. (Hansen, 2000) developed a threshold method to assist in sample splitting into two regimes. This approach can be used either for time series or cross-sectional data. The cross-sectional threshold regression analysis enables splitting the data into regimes

In the threshold regression analysis, the first step was to test the hypothesis for null linearity Ho: $\theta_1 = \theta_2$ against the alternative hypothesis of non-linearity as depicted in equation 4 using the minimized sum of squared errors by applying the F test.

$$F_1 = \frac{S_0 - S_1(\gamma)}{\sigma^2}$$

Where S minimizes the sum of squared errors. If the null hypothesis is rejected, then there exists evidence that the model is non-linear and thus estimating equation 5 becomes relevant. Otherwise failure to reject the null hypothesis would signify linearity thus estimating equation 1 would be the most appropriate.

3.3.3.2 Intervening Variable Model

Alachkar & Eberstein, (1988) noted that income as a cause of fertility is also a cause of other factors which also have different consequences on fertility. They gave examples of other factors as education, female labor force participation, rural-urban composition etc. To analyze both the direct effects of CGDP Per capita on TFR and the indirect effects of CGDP Per capita through the intervening variables, a regression analysis will have to be done that takes into consideration the effects of intervening variables.

Mackinnon et al., (2002) highlighted the statistical method used to test a model where the explanatory variable (x) affects the explained variable (y) either directly or indirectly through another intervening variable (z). The basic and structural equation for the intervening variable is given below in equation 7-9.

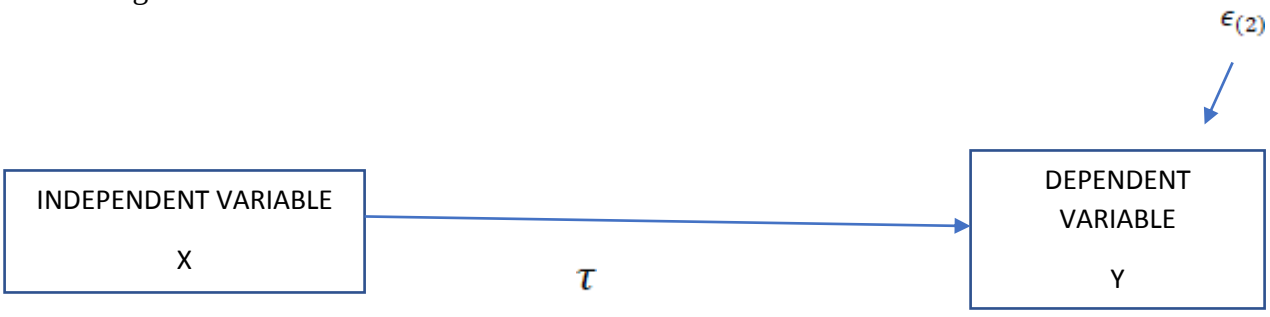
$$Y = \beta_{0(1)} + \tau X + \varepsilon_1 \qquad 7$$

$$Y = \beta_{0(2)} + \tau' X + \beta_1 Z + \epsilon_2 \qquad 8$$

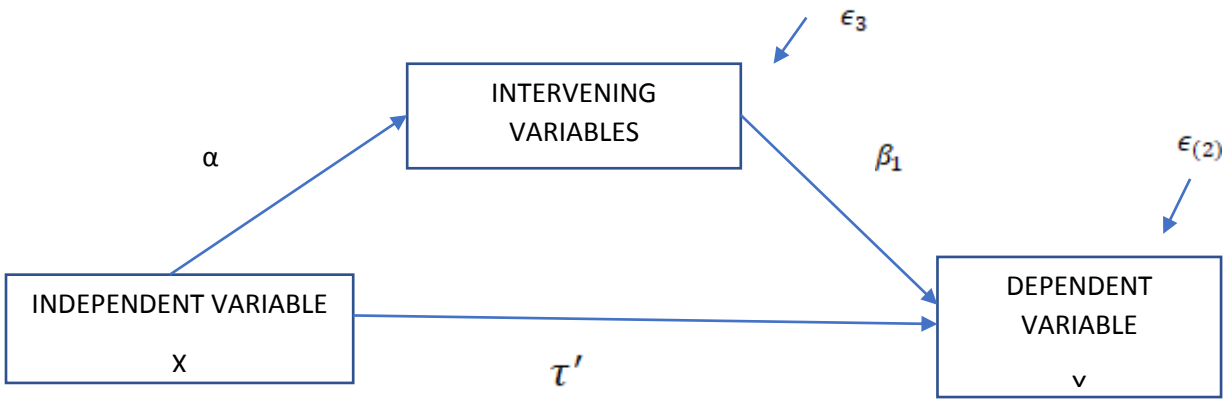
$$Z = \beta_{0(3)} + \alpha X + \varepsilon_3 \qquad 9$$

Where, X is the independent variable, Y the dependent variable and Z the intervening variable. $\beta_{0(1)}$, $\beta_{0(2)}$, $\beta_{0(3)}$ denotes the population regression intercepts. Equations 7, 8 and 9 can be illustrated in a path model as shown below in figure 3.1

From the path shown, τ represents the relationship between predictor factor (X) and outcome factor (Y), while τ' represents the same relationship but takes care of the adjustment by the intervening variable.



$$Y = \beta_{0(1)} + \tau X + \varepsilon_1 \qquad 7$$



$$Y = \beta_{0(2)} + \tau' X + \beta_1 Z + \epsilon_2 \qquad 8$$

$$Z = \beta_{0(3)} + \alpha X + \varepsilon_3 \qquad 9$$

Figure 3.1: Intervention Analysis

To show the effects of independent variables and the intervening variables to the outcome variable, equation 7 is run to test the significant effect of explanatory variable (X) on the response variable (Y). Next, there should be a significant effect of explanatory variable (X) on the intervening variable (Z) by testing for the significant of equation 8. Third, the intervening variable should be significantly related to the response variable when both are predictors by testing significance effect of equation 8. Finally, the co-efficient of predictor variable (τ') to the response variable must be greater in absolute value than the coefficient of explanatory variable through the intervening factors to the response variable (β_1).

The intervening effects was then calculated by taking the difference between the co efficient of X in equation 7 and 8 (τ - τ'). By taking the difference between the coefficient of X in equation 8 and equation 7, the reduction in the effect of explanatory variable on the response variable when adjusted for the intervening variable is established. The significance of that effect is then tested

by dividing the standard error of the difference and the ratio compared to standard normal distribution.

The standard error used in the significance test followed equation 10 as given below

$$\sigma_{\alpha\beta} = \sqrt{\sigma_{\alpha}^{2}\beta^{2} + \sigma_{\beta}^{2}\alpha^{2}} \qquad (10)$$

The result obtained from equation 10 was then compared to the standard normal distribution table.

3.4 Test of Hypothesis

This study had two hypotheses tested based on the objectives of the study

Ho: β_{11} = 0 There is no significant effect of county GDP Per capita on TFR

Ho: β_{21} = 0 The intervening variables have no significant effects on TFR

3.5 Ethical Consideration

This study relies strictly on secondary data provided in the various publications of KNBS. KNBS at the time of conducting the 2019 KPHC adhered to all ethical issues related to census and was done according to the existing laws of data collection in Kenya. KNBS (2020) reported that 2019 KPHC adhered to legal framework and was done according to the constitution of Kenya 2010. Other legal frameworks included both the statistics amendment act, 2019 and 2018 Population census order which stipulated how respondents and enumerators were to interact.

CHAPTER FOUR

EFFECTS OF ECONOMIC DEVLOPMENT ON FERTILITY IN KENYA

4.1 Introduction

This chapter focuses on the analytical results and discussions based on establishing empirically the effects of economic development on fertility in Kenya. Descriptive analysis was first outlined followed by the empirical analysis. The analysis included the results based on threshold regression model which also incorporated intervening variables. The results of the study are discussed in the last part of the chapter.

4.2 Descriptive Analysis

The data for the dependent and the six explanatory variables used for the analysis was obtained from different sources for each of the 47 counties which was the unit of analysis for the study and is summarised in table 4.1 below. The data in this table revealed wide variations across the counties. TFR was used as the dependent variable to measure the levels of fertility in Kenya. Nationally, Kenya had a TFR of 3.4 with Kakamega, Taita taveta, Nakuru and Nyandarua counties having similar TFR of 3.4. Nairobi County had the least TFR of 2.5 whereas Mandera County had the highest TFR of 8.0 followed closely by Marsabit County with a TFR of 7.0. Thus, TFR had a wide range of 5.5 with a total of 25 counties having TFR of 3.4 and below whereas the remaining 22 counties had TFR of above national of 3.4.

The explanatory variable for the study was County Gross Domestic Product (CGDP) which was the main factor used to measure economic development and was given in Kenya Shillings (KShs). Kenya had a Gross Domestic Product Per Capita of KShs 197422 with Nairobi City County having the highest CGDP of 588329 which was ten times more than Mandera County that had the least CGDP of 58857. A total of 13 counties had CGDP of above 197422 with 34 counties having their CGDP below the national average. Eight counties had CGDP which was below 100,000 with only two counties having CGDP of above 300,000. There was however a wider margin between Nairobi City county and the rest of the counties where the range between Nairobi City County and Mombasa County which was second was 199704 and the range between Nairobi City County and Mandera being 529472.

Table 4.1: Descriptive Statistics for the Study of Economic Development on Fertility in Kenya

County/Kenya	TFR	CGDP Per Capita	Percent household radio ownership	Percent farming	Life expectancy at birth	Percent Household with Sec + Educ	Percent Population in urban
Kenya	**3.4**	**197422**	**56.9**	**52.3**	**63.6**	**26.7**	**31.2**
Nairobi_City	2.5	588329	53.4	2.1	63.9	50.8	100.0
Nyamira	2.7	178815	62.7	73.0	60.8	34.9	8.3
Kirinyaga	2.7	202611	66.6	68.5	65.5	36.5	22.3
Machakos	2.7	209117	63.1	57.5	60.9	37.0	29.1
Kiambu	2.7	220247	61.4	26.9	66.8	47.6	70.6
Makueni	2.8	110750	62.7	79.1	60.3	30.4	7.8
Kisii	2.8	146063	58.5	71.4	61.5	33.1	12.0
Tharaka_Nithi	2.9	143144	58.4	78.1	67.1	29.9	8.3
Meru	2.9	204496	53.4	64.5	65.2	25.4	9.0
Embu	2.9	228175	62.9	71.7	64.4	33.5	12.5
Nyeri	2.9	255077	74.3	66.2	71.1	41.9	19.9
Mombasa	2.9	388621	47.4	3.3	68.4	37.6	100.0
Uasin_Gishu	3.0	192660	60.1	46.4	67.7	37.9	43.9
Kericho	3.1	169022	60.3	73.2	60.5	30.8	10.4
Kisumu	3.1	206446	65.0	48.9	58.6	32.7	38.1
Kitui	3.2	112276	55.1	81.9	62.3	23.0	4.8
Nandi	3.2	158668	60.3	74.7	65.2	27.5	6.7
Muranga	3.2	171089	70.7	72.7	61.4	33.2	11.2
Kajiado	3.3	128103	55.0	30.9	60.7	34.3	55.7
Bomet	3.3	157237	62.1	81.3	60.9	27.7	3.2
Kakamega	3.4	109181	62.0	77.4	64.8	25.2	9.9
Taita Taveta	3.4	178703	55.9	59.0	65.2	24.0	27.5
Nakuru	3.4	213503	61.1	46.0	63.7	34.8	48.4
Nyandarua	3.4	220486	72.4	78.4	60.6	32.6	10.4
Busia	3.5	93188	54.5	74.8	64.3	23.2	12.7
Siaya	3.5	99772	65.5	77.5	57.5	23.6	8.6
Vihiga	3.5	132336	61.6	79.3	61.0	27.4	9.9
Homa_Bay	3.6	101645	63.0	74.0	55.6	24.7	10.0
Bungoma	3.6	115955	62.1	78.2	66.9	27.7	11.4
Kilifi	3.7	137007	37.8	54.0	58.5	18.9	27.1
Trans_Nzoia	3.7	153044	57.3	62.7	66.2	27.8	18.0
Laikipia	3.7	170667	63.3	60.8	65.6	30.4	24.6
Elgeyo_Marakwet	3.7	230690	52.7	75.0	60.2	26.7	4.5
Migori	3.9	102800	59.8	70.8	55.6	22.1	15.0
Baringo	4.0	107300	51.8	70.5	67.2	24.5	11.3
Lamu	4.0	224694	37.3	49.2	66.5	20.7	27.4
Isiolo	4.1	93719	39.1	41.8	59.9	16.1	46.9
Kwale	4.3	125352	42.6	62.4	59.5	14.9	14.6
Garissa	4.4	65298	47.8	33.7	59.0	6.3	25.1
Narok	4.6	135432	59.0	75.4	59.9	16.6	8.7
Samburu	4.9	90737	29.4	65.5	63.0	11.1	15.2
Tana River	5.2	87443	28.4	51.4	57.4	11.8	24.7
West_Pokot	5.6	110627	33.8	77.3	59.4	13.2	5.1
Turkana	6.4	111100	12.1	37.2	58.0	7.5	15.2
Wajir	6.7	60764	54.2	49.6	59.4	5.5	22.7
Marsabit	7.0	123342	27.8	50.5	60.3	9.1	23.3
Mandera	8.0	58857	45.0	49.8	58.9	6.0	31.2

Source (KNBS, 2019 KPHC Vol I page 7, vol IV pages 136,350 ,462, Vol VI page 40, vol VII page 36, Vol IX page 13 and GCP 2021 page 12)

There were five intervening variables used as given in table 4.1 from the forth column to eighth column namely: percent household radio ownership, percent household farming, life expectancy at birth, percent population with secondary and above education and percent population living in urban areas. Household radio ownership was used to indicate access to information. In the entire country, about 57 percent of households had access to radio with Nyeri County having the highest household radio ownership of 74 percent. Twenty-six (26) counties had household radio ownership above the national level of 57 percent whereas 21 counties had below 57 percent household radio ownership. Turkana County had the least and the only county with below 10 percent household radio ownership of only 12 percent. Participation in Agriculture showed that 52.3 percent of Kenyan households participated in Agriculture. Despite Nairobi and Mombasa being 100 percent urban, there were some minimal participation in Agriculture with less than 5 percent involved in Agriculture. However, Kitui County and Bomet County manifested highest percentage of household participation in agricultural activities. 15 counties had below national participation in agriculture whereas 32 counties had more than 52 percent households participating in Agriculture.

Kenya had a mean life expectancy at birth of around 63 years with Nyeri County having the highest mean life expectancy of 71 years. Migori and Homabay counties had the least mean life expectancy at birth of around 55 years. Overall, 28 counties had life expectancy of below 63 whereas only 19 counties had life expectancy of above 63. In terms of education, 26.7 percent of Kenyans had attained secondary and above level of education with Nairobi County having half of the population having achieved secondary and above education. Five counties namely, Wajir, Mandera, Garissa, Turkana and Marsabit had less than 10 percent of their population having achieved Secondary and above educational level. Twenty-three (23) counties had below national educational level whereas 24 counties had above national educational level. Urbanization level nationally was at around 30 percent with Mombasa and Nairobi City counties having a 100 percent levels of urbanization. 13 counties had urbanization levels below 10 percent with Bomet County being the least urbanized county with only 3 percent of the residents staying in urban.

The spatial distribution of TFR and CGDP in Kenya was further highlighted as given in figures 4.1 and 4.2 respectively across the counties. A general pattern of the distribution of TFR is depicted whereby counties with TFR up to 3.4 are clustered together except for Mombasa, bordered by counties with TFR between 3.4 and 5.

Counties with TFR above 5 were distributed in the far-flung northern parts of Kenya apart from Tana River being at the coast. Analysis of the spatial distribution of CGDP also revealed the same pattern as one for TFR. Counties having CGDP above 150,000 are clustered around central, northern, southern and parts of coastal Kenya. Counties with below 100,000 were mostly found in North Eastern Kenya with Siaya and Busia being in the Western parts of Kenya. Most counties that had TFR below 3.5 also had their CGDP at above 150,000 with only Kisii, Tharaka-Nithi, Kitui and Makueni having CGDP of between 100,000 to 150,000. However, Laikipia, Elgeyo Marakwet, Lamu and Trans – Nzoia had CGDP of above 150,000 but with a TFR of 3.5 – 5. All counties with CGDP of below 100,000 had TFR of above 3.5. Comparison of county TFR distribution and County CGDP distribution in figure 4.1 and 4.2 indicates a general pattern whereby counties with CGDP above 150,000 generally had TFR of below 3.5 and counties with CGDP below 100,000 had their TFR above 5.0. It is important to note that counties with TFR of 3.4 and below had relatively higher incomes from the comparison. This will nonetheless be subjected to statistical test to establish the significance.

Spatial County Distribution of Total Fertility Rate in Kenya

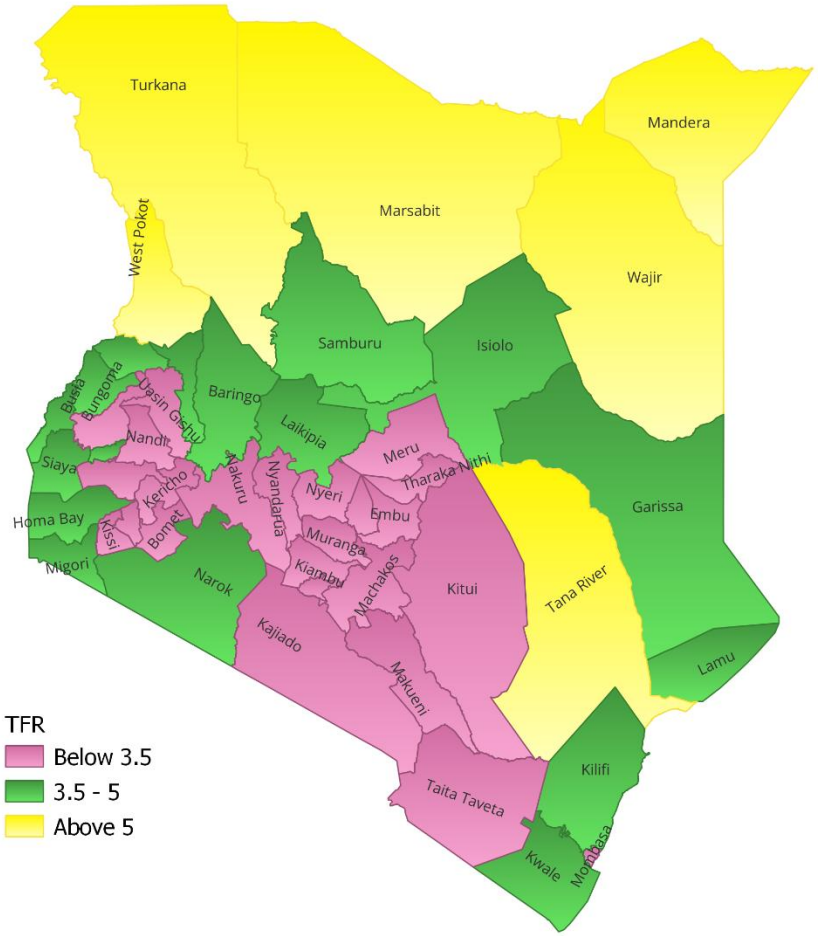


Figure 4.1: County Total Fertility Rate Distribution in Kenya

Source: Authors own digitized maps

Spatial County Gross Domestic Product Per Capita Distribution in Kenya

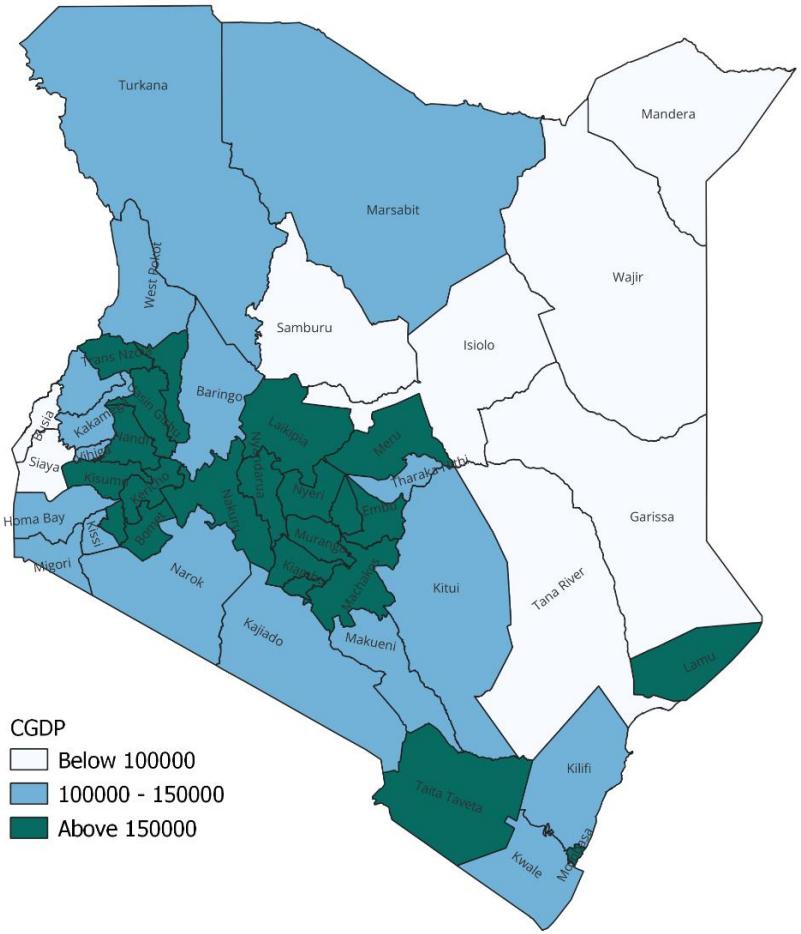


Figure 4.2: County Gross Domestic Product Per Capita Distribution in Kenya

Source: Author's own digitized maps

4.3 Association Between Total Fertility Rate and the Independent Variables

Measurers of association are important in establishing the relationship that exists between explained variables and explanatory variables as well as the relationship among the independent variables. This study employed a regression analysis with six independent variables thus establishing the degree of relationship among variables was necessary to check whether independent variables had any relationship with the independent variables. In addition, this was crucial to check the existence of multicollinearity hence determining whether to conduct multicollinearity test if independent variables were found to be highly correlated. Measure of association was done using the bivariate correlation analysis.

4.3.1Bivariate and Correlation Analysis

The bivariate analysis was done to establish the relationships between the dependent and each of the six dependent variables. Table 4.3 gives the bivariate and correlation results with significance levels. Pearson correlation results showed that TFR was negatively and significantly related to CGDP at 1 percent significance level as expected. TFR was also negatively and significantly related to percent household radio ownership, life expectancy and educational level at 1 percent significance level as expected. However, TFR was negatively but not significantly related to urbanization and percent household participation in agriculture.

Correlation coefficient among the explanatory variables are also provided in table 4.2. CGDP was found to be positively and significantly related to life expectancy, education and urbanization at 1 percent significance level whereas it was negatively and significantly related to percent household participation in agriculture at 1 percent significance level. However, CGDP was positively and insignificantly related to radio ownership. Radio ownership was positively and significantly related to both percent household agricultural participation and education at 5 percent and 1 percent respectively whereas it was positively and insignificantly related to life expectancy. Percent household participation in agriculture was negatively and significantly related to urbanization as expected, however negatively and insignificantly related to both life expectancy and education. Life expectancy was positively and significantly related to education at 1 percent significance level whereas it was positively and insignificantly related to urbanization. Percent population with secondary and above level

of educational attainment was found to be positively and significantly related to urbanization as expected.

Table 4.2: Bivariate Correlation Analysis for the Study of Economic Development on Fertility in Kenya

Correlations

		tfr	cgdp	radio	agric	life	educ	urban
tfr	Pearson Correlation	1	-0.0485**	-0.664**	-0.109	-0.415**	-0.838**	-0.132
	Sig. (2-tailed)		.001	.000	.466	.004	.000	.375
cgdp	Pearson Correlation	-0.485**	1	0.214	-0.504**	0.422**	0.708**	0.654**
	Sig. (2-tailed)	0.001		0.149	0.000	0.003	0.000	0.000
radio	Pearson Correlation	-0.664**	0.214	1	0.356*	0.272	0.676**	-0.097
	Sig. (2-tailed)	0.000	0.149		0.014	0.064	0.000	0.514
agric	Pearson Correlation	-0.109	-0.504**	0.356*	1	-0.111	-0.126	-0.918**
	Sig. (2-tailed)	0.466	0.000	0.014		0.458	0.398	0.000
life	Pearson Correlation	-0.415**	0.422**	0.272	-0.111	1	0.518**	0.252
	Sig. (2-tailed)	0.004	0.003	0.064	0.458		0.000	0.088
educ	Pearson Correlation	-0.838**	0.708**	0.676**	-0.126	0.518**	1	0.402**
	Sig. (2-tailed)	0.000	0.000	0.000	0.398	0.000		0.005
urban	Pearson Correlation	-0.132	0.654**	-0.097	-0.918**	0.252	0.402**	1
	Sig. (2-tailed)	0.375	0.000	0.514	0.000	0.088	0.005	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlation analysis for the independent variables manifested significant relationship between some independent variables thus, it became essential to subject the variables to multicollinearity test by applying the Variance Inflation Factor (VIF). Multicollinearity test was necessary to establish existence of interrelationships between independent variables and to exclude variables if any which were highly correlated. The test was done using the Vector Inflation Factor (VIF). VIF aids in determining the correlation strength between independent variables. VIF is a preferred multicollinearity test above correlation matrix due to its strength in determining the correlation of a variable with a group of other explanatory variables. VIF ranges from 0 but has no upper limit. VIF factor of between 1 and 5 shows collinearity but is negligible and has no effect (Shrestha, 2020). However, VIF factor above 5 is high enough to render the regression spurious thus need to exclude the variable. The test was done in stages

by dropping variables with high VIF values until only variables with VIF factor below 5 were obtained. Table 4.4 gives a summary of the three VIF tests done to establish multicollinearity.

Table 4.3: Collinearity Test for Independent Variables for the Study of Economic Development on Fertility in Kenya

	Collinearity Statistics					
	Tolerance	VIF 1	Tolerance	VIF 2	Tolerance	VIF 3
County Gross Domestic Product	0.304	3.291	0.307	3.254	0.459	2.180
Percent with Secondary + Education	0.168	5.938	0.183	5.476		
Percent Urban	0.072	13.799	0.490	2.043	0.512	1.952
Percent Household Radio Ownership	0.315	3.172	0.345	2.900	0.820	1.220
Percent Household in Agriculture	0.076	13.075				
Life Expectancy at Birth	0.717	1.395	0.718	1.393	0.787	1.271

The first test was done with all the variables and results given on the VIF 1 column of table 4.3 above. The results indicated that percent with secondary and above education, percent urban and percent households in Agriculture had high correlation with a VIF factors of 5.9,13.8 and 13 respectively above the limit of 5. This showed that the values with VIF above 5 could be predicted by other explanatory variables within the model. From the descriptive analysis, it was realized that counties that were more urbanized had the least agricultural production which could be the reason behind high collinearity.

The second test was done by excluding percent of household engaged in agriculture and results given in column VIF 2 of table 4.3 above. The result showed that VIF value for Percent urban reduced to 2.0 which was below 5.0 after dropping percent of household in agriculture variable. However, percent with secondary and above level of education was at 6 which was above 5. From the descriptive analysis, Nairobi county had most residents with secondary and above educational attainment, thus it is possible that most educated people leave rural areas for urban thus, the source of correlation. This prompted carrying out a third test by excluding proportion with secondary and above education and results given in column VIF 3 of table 4.3 above. The results in the third test had all the VIF values of below five indicating stability in the model. After running this analysis, only CGDP, percent urban, percent household with radio access and life expectancy were tested for their intervening effects on TFR.

4.4 Effect of Economic Development on Total Fertility Rate in Kenya

The purpose of this research was to determine the effects of economic development on fertility rates in Kenya. To achieve the objective, regression analysis was undertaken and results given in table 4.5. The first and second regression analysis were fitted without intervening variables that involved the analysis of the effect of CGDP on TFR with and without threshold regression. The third and fourth regression included the intervening variables where also the threshold effects were taken into consideration.

Threshold regression analysis is crucial where classifications such as the one for world bank economic classification of nations with low income, middle income and high income do not exist. Where such classification as the case in Kenya's county economy do not exist, then a decision has to be made at what point should the data be split. The model helps answer the question of whether regression functions across all observations in a sample are identical or fall into discrete classes. Hansen (2000) developed a threshold method to assist in sample splitting into two or more regimes. The first process in threshold analysis is to test for the threshold existence point and its significance and to identify how many. This was done using the sequential F statistics summarized in table 4.4 below which minimizes the sum of squared errors.

Table 4.4: Significance Test for Threshold Using County Gross Domestic Product Per Capita

Sequential F statistics Determined Breaks = 1			
Break Test	F-Statistics	Scaled F statistics	Critical Value**
0 vs 1*	11.19558	22.39116	11.47
1 vs 2	3.264989	6.529978	12.95

* Significant at the 0.05 level
** Critical Values

The first stage involved testing non-existence of threshold point against existence of a single threshold (0 vs 1). The scaled F statistics obtained was 22.4 which was greater than the critical value of 11.5 thus rejecting the null of no threshold value. The second stage tested the existence of one a single threshold against two (1 vs 2) and the scaled F statistics obtained was 6.5 which was lower than critical value of 12 .95 thus failing to reject the null of existence of only one threshold value. It was therefore concluded that there was only one significant threshold break which was significant at 5 percent level with a scaled F statistic of 22.4 that was greater than the critical value of 11.5.

4.4.1 Effect of County Gross Domestic Product and Intervening Variables on Total Fertility Rate in Kenya

After testing and establishing the existence of one threshold point, regression analysis was done without threshold and with threshold regression using CGDP as the threshold factor which divided the data into two regimes and were named low income counties and high-income counties. Table 4.5 gives the summary of the regression analysis both with and without threshold. While establishing the direct effect of CGDP on TFR, the threshold CGDP value was found to be KShs 102,800.3 with 9 counties being below the CGDP threshold value and 38 counties above the CGDP threshold value. However, when the intervening variables were introduced, and the intervening variables allowed to vary across the threshold, the threshold value was also readjusted and became slightly lower at 99,772.14 as indicated in table 4.5. This meant that only 7 counties were categorized into lower income whereas forty counties were in higher income. Conducting the analysis by introducing threshold values revealed differences in the direct and indirect effects of CGDP in different regimes. The introduction of threshold variable improved the value of Pearson r squared to 0.78 which meant that 78 percent of the deviations in fertility were explained by the model.

The first regression analysis done was to establish the direct effect of CGDP on TFR without intervening variables. The regression result without threshold revealed that CGDP had a negative and significant effect on TFR at one percent significance level. The result showed that a one shilling increase in CGDP led to a 0.000007 reduction in TFR thus to reduce TFR by one required approximately an increase in CGDP by 142857. The model had an R squared value of 0.24 which indicated that 24 percent of variation in TFR were explained by the variations in CGDP. On the application of threshold regression, the effect of CGDP on TFR is higher in counties experiencing low income compared to counties experiencing higher income indicating non-linearity. With a one shilling increase in CGDP, TFR reduces with a value of 0.00008 thus a reduction of TFR by one required an increase in CGDP by 12500 and the effect is significant in low income counties at 1 percent level. In high income counties however, a one shilling increase in CGDP reduces TFR with 0.000004 which meant that CGDP of 250,000 was required to reduce TFR by one. and even though lower, the effect was still significant at 5 percent significance level. In low income areas, when there is completely no income, the region is bound to have a TFR of 11.19 whereas in high income regions, with no income, TFR would be 4.32.

Table 4.5: Regression Results of Total Fertility Rate on County Gross Domestic Product per Capita and Intervening Variables Without and With Threshold

	WITHOUT THRESHOLD				WITH THRESHOLD							
					REGION 1: LOW INCOME COUNTIES				REGION 2: HIGH INCOME COUNTIES			
	Coefficient	Std. Error	t - stat	Sig.	Coefficient	Std Error	t - stat	Prob	Coefficient	Std Error	t - stat	Prob
Regression of Total Fertility Rate on County Gross Domestic Product					CGDP < 102800.3 (N = 9)				102800.3 <= CGDP (N = 38)			
County gross domestic Product per capita	-0.000007	0.000	-3.72	0.001	-0.000076	0.00	-4.00	0.000	-0.000004	0.00	-2.58	0.013
Constant	4.866000	0.329	14.77	0.000	11.192470	1.61	6.95	0.000	4.320283	0.34	12.69	0.000
R Squared	(0.24)				(0.47)				(0.47)			
Regression of Total Fertility Rate on County Gross Domestic Product and Intervening Variables					CGDP < 99772.14 (N= 7)				99772.14 <= CGDP (N = 40)			
County gross domestic Product per capita	-0.000005	0.000	-2.69	0.007	-0.000111	0.00	-3.96	0.000	-0.000002	0.00	-1.19	0.241
Percent urbanization	0.522899	0.730	0.72	0.474	2.097674	2.96	0.71	0.483	-0.482736	0.68	-0.71	0.481
Percent household radio ownership	-0.050482	0.010	-5.17	0.000	-0.072054	0.03	-2.07	0.046	-0.056798	0.01	-6.55	0.000
Life expectancy	-0.045471	0.036	-1.28	0.201	0.175172	0.19	0.90	0.372	-0.024036	0.03	-0.80	0.429
Constant	10.069780	2.081	4.84	0.000	5.930415	9.88	0.60	0.552	8.725124	1.78	4.89	0.000
R Squared	(0.57)				(0.78)				(0.78)			

In brackets are R Squared Values

The effect of CGDP on TFR when intervening variables were introduced led to some adjustments whereby the results indicated that the effect of CGDP on TFR without threshold reduced from 0.000007 to 0.000005 as indicated in table 4.5 above. Even though the effect was reduced, it remained significant and negative at one percent significance level thus holding other factors constant, a one shilling increase in CGDP leads to a reduction of TFR by 0.000005 which meant that CGDP of 200000 was required to reduce TFR by one. In low income counties, CGDP had a negative and significant effect on TFR at one percent significance level translating into 0.0001 reduction in TFR with a unit increase in CGDP thus an increase of CGDP of 10000 was required to reduce TFR by one. However, in high income counties, the effect of CGDP became insignificant though had negative effect. By conducting the analysis, the reduction in the effect of explanatory variable on the explained variable when modified for the intervening variable is established. The model without threshold had an r squared of 0.57 which showed that at least 57 percent of variations in TFR were explained by the model.

The effects of intervening variables were also established thus, the effect of access to information through radio was sought while holding other factors constant both without and with threshold regression analysis. Regression analysis without threshold result showed that a one unit increase in radio ownership reduced TFR by 0.05 at 1 percent significance level, while keeping other factors constant which meant that reducing TFR by one would require approximately 20 more households to own a radio. When threshold regression was done access to information was found to have a negative and statistically significant relationship TFR in low income counties at five percent significance level. This meant that a unit increase in radio ownership led to 0.07 percent reduction in fertility which meant that to reduce TFR by one, around 14 more households would be required to have access to radio. Access to information remained highly significant in high income counties at 1 percent significance level.

Holding other factors constant, the effect of life expectancy on TFR was established both without and with threshold regression. Regression analysis without threshold revealed that life expectancy had a negative but insignificant effect on TFR. A one-unit gain in life

expectancy led to 0.045 unit decrease in TFR. Regression with threshold, however revealed different effects in low- and high-income counties. In low income counties, the effect was positive and insignificant with a one-unit gain in life expectancy leading to an increase in TFR with 0.17 units. However, in high income counties, the effect was negative but remained insignificant with a one unit increase in life expectancy leading to a reduction of TFR with 0.024 units.

The effect of urbanization on TFR while holding other factors constant was also established both without and with threshold regression. The effect of urbanization was found to be positive and insignificant showing that a one percent gain in urbanization led to a 0.5 percent gain in fertility. In low income counties, the effect of urbanization was positive and insignificant. In high income counties, the effect changed to negative but remained insignificant.

4.5 Discussion

The aim of this research was to find the effects of economic development on fertility levels in Kenya. This was to be attained by addressing the questions whether there were direct effects of CGDP on TFR and whether there were indirect effects through intervening variables on TFR. The result showed that economic development as measured by CGDP had an inhibiting effect on fertility levels in Kenya. The effect was however different between low income counties and high-income counties. Even though, both had negative relationship, the result showed that CGDP had a strong and significant effects on low income counties as well as in high income counties. Similar outcome was found by Furuoka, (2009) who applied the same technique of threshold regression and found out that countries with lower GDP had a strong negative relationship between GDP and TFR whereas countries with higher GDP had a negative but weaker relationship. The threshold value therefore, indicates a non-linear relationship between CGDP and TFR. At low income counties, the slope of the relationship is steeper than that for high income counties. This is an indication that an increase in income in low income counties have more effect than in relatively high-income counties. The effects of increase in income becomes weaker as counties become more economically stable.

Furuoka, (2010) indicated that there exists a trade-off between the quantity of children and the quality of children in the course of economic advancement. Becker & Murphy, (1990)

defined the children's quality as a child's human capital level which gets expensive with economic development. The outcome of this study however, contradicted the conclusions of Guttmacher Institute, (1984) that modernization processes was a major factor in rising fertility levels in Kenya. Instead, this study found empirically that modernization is in fact an inhibiting factor to fertility in Kenya even if the effects vary in various levels of economic development.

The second question for the study was whether other development indicators used in this study such as urbanization levels, access to mass media through radio ownership, participation in agriculture and life expectancy had an indirect effect on TFR. By introducing the intervening variables, the effect of CGDP on TFR reduced but remained significant. This happened because of some weak collinearity that exists between CGDP and other intervening variables. Exposure to radio was significant and negative in both low and high-income counties. Access to mass media plays a significant function in educating the population on modern ways of life. Westoff et al., (2011) also found a significant effect of access to information and indicated that access to mass media through listening to the radio had a negative and significant effect on reproductive behaviour. By listening to the radio, people get a window to the outside world which is critical in making informed decisions.

Guetto et al., (2023) also found a significant effect of access to radio while analysing fertility and media narratives of the economy where he found out that news, specifically reports related to the economic status of a nation were associated with fertility. Negative economic news was however, established to have a negative influence on fertility rates. Guetto et al., (2023) concluded that in an economic uncertainty era, people were bound to be affected by both economic constraints and social narratives about the future when making long term decisions such as fertility. The results also confirms what Forty et al.,(2022) postulated that mass media is a significant enabler for people to relate themselves with people and values different and far away from them. As Kenya develops economically, individuals with access to radio are increasing and this exposure has the effect of informing several decisions which shapes the quality of life of citizens. Even though exposure to media had more effect on high income, the results showed that exposure to radio was also significant at low levels. In high income group access to media strengthens their knowledge on contraceptive use which is a

derived demand as was discussed by Shelus et al., (2018). At high income level, information becomes a powerful tool in making decisions. Kenya government have been at the forefront of encouraging family planning programmes and demystifying the myths that accompanied the various approaches thus people can make informed decisions as concerns the type of family they desire. Junior et al., (2013), and Forty et al., (2022) recognized the key role played by mass media as being influential as well as educative. They indicated that universalization of mass media was a key factor in spreading fertility behavior from more advanced areas to less advanced areas.

Life expectancy and levels of urbanization were however found to be insignificant. The insignificance of these variables which have been found to be influential in other studies is of great concern. Urbanization was found to generally be positively related to TFR as well as in counties experiencing low income whereas they were negatively related in counties experiencing high income. This could be attributed to generally low levels of urbanization in Kenya such that the effect is negligible or quality of urbanization. This is explained by the change in symbol after introducing threshold regression. The negative relationship of urbanization and Fertility in high income counties is generally explained by the demographic transition. Many studies for example White et al., (2008) did a study on the urbanization as an indicator of fertility in Ghana's Coastal areas and found out that urbanization was related to low fertility because of norms related to urban areas such as postponed unions, implicit costs such as educational attainment and employment.

Positive relationship of urbanization and TFR generally and in low income counties mirrors the studies of Nag et al., (1980) in their work on modernization factors on fertility. They indicated that urbanization and related processes are catalysts of fertility reduction mainly through birth control practices and deferred marriages. However, they found out that the same processes might have positive effects on fertility especially in the preliminary stages of modernization. Nag et al., (1980) indicated that this happens out of factors related to modernization which were attributed to positive relationship. Some of the factors were shrinking breast feeding which acted as a primary factor to early recommencement of postpartum ovulation and menorrhea, scaling down in executing postpartum abstinence, furtherance in handling and medication of venereal diseases specifically sexually transmitted

diseases leading to reduction in cases of sterility and finally, adequately and well-nourished girls tend to have early menarche age. Urbanization in Kenya is still in its early stages with only about quarter of the population residing in urban areas. The effect that urbanization has on fertility relies on several factors and most important is the quality of urban living. KNBS, (2022) reported that Nairobi for example had approximately 19 percent of its residents living in informal settlement associated with poor access to several social and health amenities.

Life expectancy gives the general health status of a country and have been used as an indicator of the general rates of mortality as well as under five rates of mortality. The procedure of calculating life expectancy relies heavily on mortality rates and survivability. Survival rates especially through reduction of under-five mortality rates is a clear indication of improved health conditions which culminates into increased life expectancy. Life expectancy at birth as per 2019 KPHC was 60 for males and 66 for females giving an average of 64 years. Even though not significant, generally, the kind of relationship that emanated from the analysis shows a positive relationship in low income counties and a negative relationship both generally and in high income counties. An improvement in health conditions and general wellbeing in low income counties first is capable of hiking fertility before realization that improved living conditions also comes with sustainability.

Generally, an improvement in economic development has got multiplier effects that spills over to family dynamics. As economy grows, reliance on land or traditional production methods become unsustainable. Shreffler & Dodoo, (2009), noted the societal changes that took place in Kenya as Kenya's economy started growing and movements towards family nucleation away from collective community responsibility. They noted that economic advancements brought changes that were not favorable for large families as land became scarce and the only way out was through education in order to access economic opportunities outside traditional systems. Kenya has been at the verge of economic development which has meant improvement in physical infrastructure that includes hospitals, roads and various forms of information sources. The effects of these improved facilities and services were anticipated to have a negative effect on Kenya's fertility levels as was noted by NCPD (2012). With advancement in medical services, maternity wards have been accessible thus reducing maternal as well as infant mortality.

As much as educational attainment and farming were not subjected to further analysis due to model specification problems, the bivariate analysis revealed that education was significant and had a negatively correlation with TFR and positively related to urbanization and radio ownership. Most fertility studies have attributed fertility decline to advancement in educational attainment of societies for example Bastiaans & Romaniello, (2016), Adelman, (1963) and GoK et al., (2013).

CHAPTER FIVE

SUMARRY, CONCLUSIONS AND RECCOMENDATIONS

5.1 Introduction

This chapter highlights the study summary and conclusions of findings and finally offers recommendations based on the results and study process. The summary of the study of the effects of economic development on fertility in Kenya is given first followed by the conclusions from the study findings. Finally, recommendations are given in two parts that covered both for policy and for further research.

5.2 Summary

The purpose for this research project was to analyse empirically the effects of economic development on fertility in Kenya by applying threshold regression analysis and intervening factors of fertility. The study used demographic transition theory and was conceptualized by Easterlin Economic framework for fertility analysis with emphasis on demand for children. Economic development was measured by County GDP whereas the indicator for fertility levels were Total Fertility Rates. Intervening variables were used to control for the effect of CGDP on dependent variable. The objective of the research was attained by analysing data obtained from the 2019 KPHC and KNBS report on county gross domestic product.

The threshold regression analysis model validated splitting the country into two regimes based on their levels of county gross domestic product, which were then named as low-income and high-income counties. Low income counties were generally counties that had CGDP per capita below 100,000 whereas high income counties were those with CGDP per capita above 100,000. This method helped in determining economic development variables' effects on fertility at different levels of income. The results found out that economic development is an important factor in Kenya's fertility rates determination. Before the introduction of intervening variables, it was found that county gross domestic product was generally a significant indicator of the levels of fertility and the negative relationship was highly significant. After threshold regression analysis, CGDP per capita remained significant at both low and high levels of county income.

The inclusion of intervening factors into the model lowered the influence of CGDP per capita on fertility but still it still remained significant generally and in counties with low income. The effect of CGDP per capita however became insignificant in counties experiencing high income after the introduction of intervening variables. Intervening variables in this study were considered based on the indirect effects of CGDP on TFR through the intervening variables. Access to information through radio ownership was found to be significant whereas factors such as life expectancy and urbanization were found to be insignificant. This study however did not explore what kind of information was being accessed through ownership of radio.

The study results indicated that as the counties progresses economically, fertility tend to diminish. Counties that had higher CGDP on the other hand had lower TFR whereas counties that had lower CGDP experienced higher TFR but both had declining fertility with levels of CGDP per capita. Correlation analysis showed that income expansion has a positive effect on some other factors that have been revealed to have some negative influence on fertility too for instance access to information, educational levels and urbanization. Life expectancy and levels of urbanization which were considered as factor determining fertility were found not to be significant in determining fertility in Kenya.

5.3 Conclusion

The results from this study ascertained that economic development is a significant factor in determining the levels of Kenya's fertility which concurs with the demographic transition theory. Even though counties with low income experienced higher TFR whereas counties with high income experienced lower TFR, increase in income plays a significant role in low income counties as compared to relatively high-income counties. The results revealed that when counties attain a CGDP of around KShs 100,000, the effect of income become less but, access to information become significant. This indicates that government programmes geared towards improving the general well-being of its citizen such as improvement in levels of income have got the effects of reducing fertility levels naturally, especially in low income areas, even if that was not the main objective of the programme. In places with relatively high income with CGDP of above 100,000, improvement in access to information become relevant.

5.4 Policy Recommendations

The application of threshold regression analysis helps in determining the break points and the effects of predictor variables on explained variables in different regimes. The threshold regression had split the country into two regimes at CGDP of around 100,000, which were then categorised as low income and high-income counties. In low income counties, it was found that the effect of economic development as measured by CGDP was more than in high income counties. It is therefore recommended that economic development programmes geared towards improving county GDP be enhanced.

On the other hand, radio ownership was found to be more significant in high income counties compared to low income counties. Therefore, there is need to provide more information concerning fertility management for instance the need to shift more focus on the proximate determinants of fertility. NCPD (2012) acknowledged the significance of enhancing advocacy on information, education and communication (IEC) as a way of improving information as well as knowledge base on issues related to population inclusive of fertility related.

5.5 Recommendations for Further Research

This study applied cross sectional analysis that even though is a strong analytical model, has some weaknesses specifically on luck of effectively finding the lag effects of CGDP on fertility levels. This is because of fertility decisions tending to lag behind economic development. As data at the county level become more available, there would be need to further investigate the economic development effects on fertility by applying lag techniques. Also, this study faced some data limitation since only one population census had data available at county level, this could be overcome by utilising time series analysis as more data becomes available at the county level.

The study found a significant relationship between access to radio ownership and TFR. This might require further analysis to determine what kind of programmes are influential in

determining fertility rates. Some works have been done in this areas especially the works of Guetto et al., (2023) which tried to relate how news was related to fertility dynamics in Italy.

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