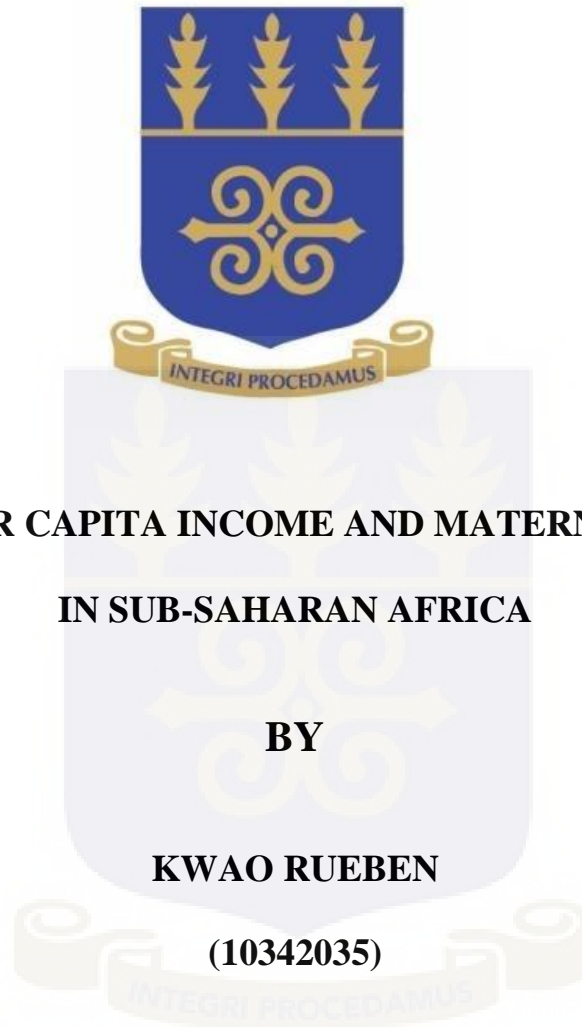


UNIVERSITY OF GHANA
COLLEGE OF HUMANITIES



EDUCATION, PER CAPITA INCOME AND MATERNAL MORTALITY

IN SUB-SAHARAN AFRICA

BY

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN
PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
MASTER OF PHILOSOPHY(MPHIL) ECONOMICS DEGREE**

JULY, 2017

DECLARATION

I hereby declare that, the research Education, Per Capita Income and Maternal Mortality in Sub-Saharan Africa is my own work under the guidance of my supervisors and that the sources of secondary information used or cited have been acknowledged by means of complete references. This thesis has never been presented either in whole or part to any institution for the award of any degree.

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ABSTRACT

While many studies have tested the theoretical essence of education or income on maternal mortality, none has studied these relationships in the long term. Researchers have paid very little attention to assessing the impact of income or education on maternal mortality in Sub-Saharan African countries with different income statuses. Using panel data on forty-three Sub-Saharan African countries over the period 1980 to 2010, along with the modernization theory, the study unravels the potential long term relationship that exists between education, per capita income and maternal mortality. The study employed Fully Modified Ordinary Least Square, Generalized Least Squares and Random Effect Model to ascertain any long run or short term relationship between income, education and maternal mortality. The study found that there exists a long run relationship between education, income per capita and maternal mortality. In the short term income per capita, education, skilled births attendance and fertility rate affected maternal mortality in Sub-Saharan Africa. The study also found significant variation in the impact of income per capita, education, skilled birth attendance and total fertility rate on maternal mortality. The study recommends investment in improving efficiency and productivity in both the private and public sectors to boost the income levels in the economy. Educational reforms that would improve female enrollment at primary schools are highly recommended. Finally, increased budgetary allocation to maternal health care units in the area of maternal health services like increased skilled birth attendance and postnatal care services in Sub-Saharan Africa is essential.

DEDICATION

I wish to dedicate this work to God, my parents, Mr Jacob Kwao Lartey and Mrs Dora Kwao, my siblings and friends for their patience, encouragement and unflinching support during the period of this research.

It is your prayers and words of encouragement that has brought me this far in education.

May God almighty reward you greatly for the moral support you gave.



ACKNOWLEDGEMENT

I wish to express my true and sincere appreciation to the almighty God for His divine protection and guidance throughout my life and during the entire study.

My greatest appreciation also goes to my supervisors – Dr Alfred Barimah, Senior Lecturer of the Department of Economics, University of Ghana (Principal Supervisor) and Dr Ama Pokuaa Fenny, Institute of Statistical, Social and Economic Research (ISSER) University of Ghana (Co-supervisor) for their constructive critics, guidance, corrections and significant contributions they made during the entire execution of the thesis.

Finally, my thanks go to all my colleagues of the Department of Economics, University of Ghana and all my friends and families for their prayers, encouragement and inspiration, may God bless you all.

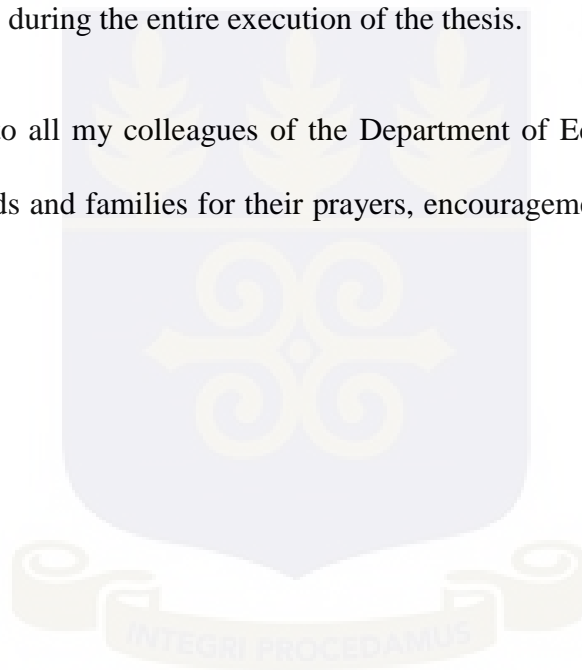


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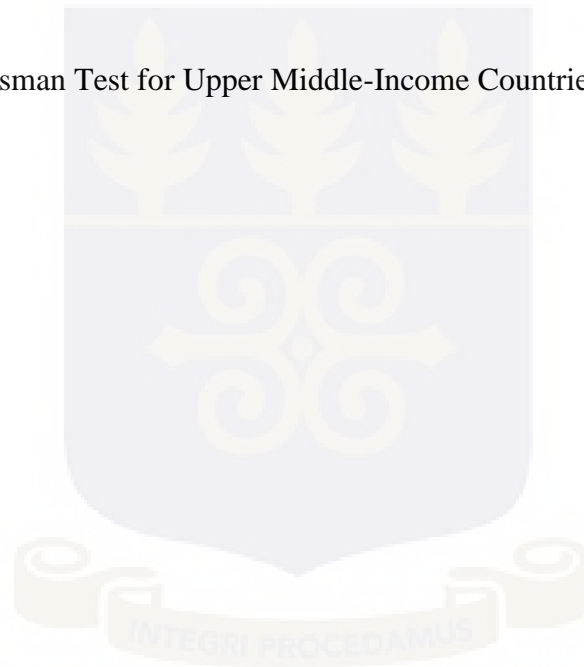
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LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
AFDB	African Development Bank
AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
ARDL	Autoregressive Distributed Lag
BSH	Births attended to by skilled medical professionals
DF	Dickey Fuller
DHS	Demographic and Health Surveys
ESSP	Education Sector Strategic Plan
FEM	Fixed Effect Model
FMOLS	Fully Modified Ordinary Least Square
GDI	Gross Domestic Income
GDP	Gross Domestic Product
GDP_C	Gross Domestic Product per Capita
GLS	Generalised Least Square
GNP	Gross National Product
HDI	Human Development Index
HIC	Higher Income Countries
HIV	Human Immune Virus
IMF	International Monetary Funds
IPS	Im, Pesaran and Shin Test
LDCs	Lesser Developed Countries

LICs	Lower Income Countries
LLC	Levin, Lin and Chu Test
LMICs	Lower Middle Income Countries
MANDATE	Maternal and Neonatal Directed Assessment of Technology
MDG	Millennium Development Goals
MDGs	Millennium Development Goals
MNCs	Multinational Corporations
MMR	Maternal Mortality Rate
MOH	Ministry of Health
MUAC	Mid-Upper Arm Circumference
OLS	Ordinary Least Square
PER	Primary School Enrolment Rate
REM	Random Effect Model
RNPE	Revised National Policy on Education
SDG	Sustainable Development Goal
SDGs	Sustainable Development Goals
SER	Secondary School Enrolment Rate
SSA	Sub-Saharan Africa
STIs	Sexually Transmitted Infections
TFR	Total Fertility Rate
UMICs	Upper Middle Income Countries
UN	United Nations
UNAIDS	United Nations Programme on HIV and AIDS
UNDP	United Nations Development Program

UNESCO	United Nations Educational Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
WDI	World Development Index
WHO	World Health Organization



CHAPTER ONE

INTRODUCTION

1.1 Background

The productivity of labour is relatively higher in richer countries than poorer countries; this can be attributed to the higher level of human capital in the richer countries. Hence, the reduction in maternal mortality would cause GDP to increase more in the richer country than the poorer one (Amiri & Gerdtham, 2013). Furthermore, investment in health in poorer countries could increase the GDP and decrease the gap between the rich and the poor (Amiri & Gerdtham, 2013). These findings imply that, countries with lower Gross Domestic Incomes (GDI) are bedevilled by poor health and lower human capital. Countries with lower GDI are often characterized by poor health service infrastructure and services than their richer counterparts. Countries with higher income can afford modern state of the art infrastructure and equipment for rapid health service delivery. These countries tend to have a better health outcome than lower income countries. For instance, Buor & Bream (2004) found that nations with sound economies as shown by the GNP per capita tend to have a better health status. Health outcomes like maternal mortality, infant mortality and life expectancy are much better in richer countries than poorer ones. High maternal mortality could be a sign of underdevelopment. Harrison (1997) asserts that high maternal mortality is an indicator of gross underdevelopment. He also concludes that issues of high maternal mortality will not go away as long as vital issues pertaining to mass poverty and inequality prevails. In addition, women in poorer nations might have a lower chance of seeking medical care, for instance, Mctavish et al, (2010) observed that, in nations with lower female literacy levels, women in poor

households were less probable to use maternal health care than those in poor households in high female literacy nations. This was because education helps women to better appreciate the benefits and importance of good health care and practices. Nations with higher female literacy may devote additional resources to providing maternal health care services along with maternal health care delivery methods. Finally, women in these countries have greater inheritance and ownership rights in lands and loans. Hence these women are more capable of accessing maternal health care since they would be able to afford these services.

Khandelwal (2015) found that GDP has both a short and a long-run impact on public health expenditure. This illustrates that, as an economy grows it turns to spend more on health care. As the expenditure on health increases, health outcomes are expected to improve (Gomisporqueras et al., 2016; Subramanian & Canning, 2009).

Poor health is detrimental to the progress of a country since productivity of human capital, educational attainment and innovative skills are curtailed. World Bank (1994) observed that the impact of poor health goes beyond just physical suffering and pain but stifles economic growth. In addition, when there is poor health, not just learning is restricted, returns to human capital diminishes and environmental and productive activities are limited. Poor health includes high maternal mortality, infant mortality and lower life expectancies amongst others. A country might not be able to attain a higher level of economic growth with a labour force that is crippled by high maternal mortality.

The Millennium Development Goal five (MDG 5) was targeted at improving maternal health. Maternal survival has meaningfully improved since the acceptance of the MDGs. The maternal mortality rate dropped by 45 percent worldwide in the period of 1990 and 2013, from 380

maternal deaths for every 100,000 live births to 210 (Ghana Statistical Service, 2015). It fell by 48 percent in Sub-Saharan Africa (SSA).

Even though a global target of 95 deaths per 100,000 live births by 2015 has not been met, some significant progress has been made. This is evident in the global maternity ratio dropping from 380 per 100,000 live births in 1990 to 210 deaths per 100,000 live births in 2013 (Ghana Statistical Service, 2015). In addition, according to the UNDP & NDPC (2015) estimates from 1990– 2013, the worldwide maternal mortality ratio decreased by 44 percent from 385 deaths to 216 deaths per 100,000 live births. This translated into an impressive annual average rate reduction of 2.3 percent. Though this is encouraging, it is still below half of the 5.5 percent annual rate required to accomplish the three-quarters reduction in maternal mortality target for 2015. Also according to the Kassebaum et al.,(2016) while critical progress has been made in some key MDG targets, for example, poverty eradication, education and access to safe water, the general pace of advance, is inadequate to accomplish a large portion of the MDGs, for example, under-five, newborn child and maternal mortalities and additionally enhanced sanitation facilities by the deadline of 2015.

The Sustainable Development Goals (SDG's) was a far-reaching, broad and individuals focused arrangement of all inclusive and transformational objectives and targets (Donoghue et al., 2015). These goals were meant to be achieved socially, economically and environmentally in a balanced manner. Progress made by the MDGs has been uneven especially across, particularly in Africa. However, MDG targets pertaining to maternal, newborns, child and reproductive health still remain off-track. SDG's were expected to complement the achievements of MDGs made in decreasing newborns, child and maternal mortality by terminating all avoidable deaths before 2030 (Donoghue et al., 2015). SDG 3 sub-section one,

targets that, by 2030, global maternal deaths must be reduced to less than 70 per 100,000 live births. In order to achieve this target, the goals have also included measures of widespread well-being coverage through access to safe, quality and moderate fundamental medicine and immunizations for all.

As part of its objectives, the SDGs were to increase health financing, development, training and retaining of the health workforce in developing countries (Donoghue et al., 2015). Countries were thus encouraged to conduct regular and comprehensive reviews of advancement at the national and sub-national levels. These reviews are expected to draw on commitments from indigenous individuals, civil society, the private sector and different partners in accordance with national conditions, strategies and needs.

Reductions in Maternal Mortality Rate (MMR) can be attributed to a commitment on the part of the government to commit part of her resources to spending on health care infrastructure and services. Some form of health expenditures incurred by the government include training more health service personnel, building hospital facilities and extension of community health services and the procurement of equipment for health care delivery. These expenditures alongside health service investment are expected to improve maternal health outcomes. For instance, Kirigia et al, (2006) found that inter-sectoral activities, for example, growing educational opportunities, enhancing living and working conditions, and expanding access to water and sanitation could significantly improve health outcomes within even one generation.

In addition, Aram (2009) found that higher maternal mortality can be reduced by regular antenatal visits. Buor & Bream (2004) and Ronsmans & Wendy (2006) also found that availability of skilled professionals and timely health medical care were instrumental to the reduction of maternal deaths.

The major risk factors for maternal mortality include illiteracy, poverty, poor nourishment, low weight preceding pregnancy, negligible weight gain amid pregnancy, first pregnancy or higher than fourth pregnancy, maternal age more youthful than twenty or more older than thirty-four years, poor result of earlier pregnancies, contaminations (e.g. STIs and HIV/AIDS) and ailments amid pregnancy (e.g. iron deficiency, tumor of the cervix), female genital mutilation, unintended pregnancies and dangerous abortions, smoking, and insufficient medical care amid pregnancy and delivery (Walsh et al.,1993).

Kinney et al., (2010) in their study of why and where mothers and newborns in Sub-Saharan Africa die, found that majority of the world deaths occur in Sub-Saharan Africa with main causes identified as pregnancy and childbirth complications like haemorrhage, hypertension, sepsis, and obstructed labour. Furthermore, WHO (1999) discovered that 24.1 % deaths were credited to haemorrhage, 15.9% to sepsis, 12.3% to the hypertensive issue of pregnancy, 8.2% to obstructed labour, 13.3% to fetus removal, and 26.2% to other maternal conditions. The role of education in the reduction of maternal mortality cannot be underestimated. Education turns to affect the reaction of women to health care services. Buor & Bream (2004) found that the educational attainment of women influences their usage of all kinds of health services. They further found that, it turns to affect their usage of contraceptive and their total fertility rate. Moreover, education is a strong factor in a mother's use of prenatal care facilities. Here educated women turn to appreciate the benefits of prenatal care than uneducated women. They also affirmed that, better-educated women prefer delivery at a place with skilled medical personnel. Interestingly, the Educational status of the mother reduces maternal mortality (McCarthy & Maine, 1992). Educated women are also less likely to die in childbirth (Kinney et al., 2010). More so, women in countries with higher literacy turn to appreciate and utilize more maternal health services. Mctavish et al, (2010) observed that women dwelling in nations

with higher literacy rates will probably utilize maternal health care, after adjusting for national economic development and individual socio-demographic factors. Furthermore, they attested that, nations with higher female education may likewise commit more resources to the provision of maternal health care services along with a range of maternal health care delivery models, including doctors, medical caretakers, and traditional birth attendants.

Coburn et al., (2014) observed that, female education is related to more extensive utilization of health services, especially prenatal care and may reduce child marriage. It likewise has a tendency to enhance access to data about nourishment, birth separating, regenerative well-being, and vaccinations.

Education also serves as a medium of receiving good health care services. Majgaard & Mingat (2012) observed that primary and secondary education each improves the probability of accepting professional assistance at delivery. These discoveries stipulates that, literacy contributes toward more prominent acknowledgement of health services such as the contraceptive provision and skilled assistance with delivery. Returns from education benefits girls than their male counterparts. He also affirmed that educational attainment is related to better health and welfare in adulthood, especially for girls. Women who completed primary or secondary schooling are more probable than women with no schooling to take advantage of certain health services. Sede & Irekpitan (2014) found that, increase in secondary school enrolment rate reduces MMR by 28%.

The contribution of women to economic growth in Africa cannot be overemphasized. Women support families through their industrious labour by rendering services like cash crop farming, subsistence farming and other enumerative work for household members, providing sanitary services, tending the sick members of the household and educating the children. Most

importantly, women also cook for the family. Therefore, the loss of a mother through death or disability robs the household of the nurturer, breadwinner and defector household head (Kirigia et al., 2006).

Furthermore, Sede & Irekpitan (2014) observed that, women are highly effective as executives in the private and public sectors. They also observed that, women are capable of adding value to discussions on policy and are more capable of managing household budgets, loans and savings if given the opportunity.

1.2 Problem Statement

Maternal deaths are deaths that might have occurred if a woman is pregnant and had suffered some complications of pregnancy or childbirth (McCarthy & Maine, 1992). Maternal Mortality Rate (MMR) measures the annual number of deaths from pregnancy-related causes per 100,000 live births (Coburn et al. 2014). A large number of women die annually as a result of pregnancy-related complications such as severe bleeding (haemorrhage), hypertensive diseases, infections and abortions.

It is also estimated that women die from certain causes that are avoidable. Kassebaum et al., (2016) estimated that, more than 250,000 women died during or following pregnancy in 2015, most of which were preventable deaths. These deaths could have been prevented if the needed investment were made into infrastructure and human resource training. Alvarez et al (2009) estimated that, more than 500,000 women die every year in the world due to complications linked to pregnancy or childbirth, half of them reside in Sub-Saharan Africa (SSA). Even though the global average has decreased drastically, the numbers of deaths in developing

nations are amongst the highest in the world since about 99 percent of the deaths are in these nations (WHO, 2012). Furthermore, WHO (2012) estimated that more than half of the death of women as a result of maternal death happens in Sub-Saharan Africa with almost one third occurring in South Asia. Furthermore, developing nations are the most hit by maternal mortality issues. According to UNICEF (2009), most of the death associated with pregnancy and childbirth occurred in developing nations where the maternal mortality ratio is 14 times higher than that of developed nations. Moreover, Alvarez et al (2009) observed that, the MMR in SSA for 2005 was estimated at 835 deaths per 100,000 live births. UNICEF (2009) established that Sub-Saharan Africa (SSA) has the utmost level of maternal mortality of any world region with 920 deaths per 100,000 live births. Each year, an estimated 529,000 maternal deaths occur. Alvarez et al (2009) further found that maternal mortality ratio for Sub-Saharan Africa was projected to be nearly 1,000 per 100,000 live births, almost twice that of South Asia, four times as high as in Latin America and the Caribbean, and nearly 50 times higher than in industrialized nations. In Sub-Saharan Africa, the combined maternal mortality ratio for severe bleeding, hypertensive diseases and infections is staggering at almost 500 deaths per 100,000 live births, compared with fewer than 300 per 100,000 in South Asia, just over 100 in Latin America and the Caribbean, and four per 100,000 in developed nations (Coburn et al., 2014). Of an estimated 166,000 deaths from haemorrhage globally each year, an estimated half occur in Sub-Saharan Africa and more than a third in South Asia. Coburn et al., (2014) observed that while maternal mortality has nearly been halved worldwide since 1990, Sub-Saharan Africa accounts for 56% percent of maternal deaths, At 500 deaths per 100,000 live births, the region has the highest maternal mortality rate in the world. Kinney et al., (2010) observed that nearly 4.7 million mothers, newborns and children die each year in SSA. Additionally, WHO (2012) estimated that almost 99 percent of maternal deaths occurred in the

developing regions. Furthermore, it was observed that Sub-Saharan African countries accounted 546 deaths per 100,000 live births or 210,000 maternal deaths a year and this accounted for 66 percent of all maternal deaths per year worldwide.

Most Sub-Saharan African countries are bedeviled with alarming maternal mortality ratios. First of all, Nigeria accounts for one of the highest numbers of maternal mortality in SSA. According to Harrison (1997), maternal mortality in Nigeria was estimated to be 1,000 per 100,000 births in 1987. Additionally, according to Kirigia et al., (2006) Rwanda and Burundi accounted for the highest rate of MMR hovering around 1,300 per 100,000 live births in SSA. This was closely followed by the Gambia with 1,050 per 100,000 live births, Eritrea with 1,000. Comoros, Burkina Faso, Guinea Bissau, Congo and Guinea with 950, 930, 910, 890 and 880 per 100,000 live births were amongst the highest in SSA. The 2008 Ghana maternal survey reported maternal mortality of 451 maternal deaths per 100,000 live births in 2001. Ghana's institutional maternal mortality as at 2010, 2011, 2012 and 2013 stood at 164, 174, 154 and 155 respectively per 100,000 live births (MOH, 2014).

Previous studies have not examined the long-term effect of education or income on maternal mortality. In spite of the devastating impact of maternal deaths, studies have moved away from trying to understand the long run effect of a country's income per capita or education on maternal mortality due to unavailability of data and data porosity (Shen & Williamson, 1999). With the requisite data between 1980 and 2010, the current study is better equipped to ascertain the transitional impacts of maternal mortality over time.

Furthermore, studies have shown that there is gross underreporting of maternal mortality rates. This situation is largely, attributable to poor record keeping in some health facilities and institutional lapses that make the tracking of maternal death difficult if not impossible (WHO,

2010). According to Harrison (1997) unbooked complications and emergencies during births far outweighs booked ones. Furthermore, unbooked emergencies remain the high risk of maternal deaths in Nigeria. These emergencies often lead to high cost of treatment and hospital stays. With already higher MMR in SSA, underreporting further deepens its woes.

Education influences the levels of maternal mortality. Studies have shown that countries with higher literacy rates have relatively lower maternal mortality ratios (Bhalotra & Clarke, 2014; Harrison, 1997). These studies have shown the impact of education on maternal mortality in the short term. Literacy rate in a country also increases the utilization of maternal health resources (McTavish et al, 2010). Unlike the other studies done above, education takes time to affect maternal mortality and hence just ascertaining the impact in the short term might not give an idea of the entire situation. It is crucial to ascertain the long run effect to give a true reflection of the actual relationship. Hence, the current study would move a step further to ascertain if education has an impact on maternal mortality over time since education takes time to have any meaningful impact on MMR. The current study would ascertain if the relationship is inverse over the time period 1980 to 2010. According to the study, the long run refers to the time period from 1980 to 2010. In the long run, educated women are able to effectively utilize maternal services and practise healthy lifestyles during pregnancy and this reduces their chances of being exposed to complications at birth, consequently leading to a reduction in maternal deaths and hence maternal mortality ratio.

Losses due to maternal mortality deprive the nation of its vital human capital and labour force needed for economic growth and development. Empirical works of Barro (1991) suggest that economic growth as measured by GDP affects the health outcomes of a country. An increase in GDP per capita leads to an improvement in the standards of living of people in a country in

the long run. Over time, as the standards of living improves, citizens are able to access and afford quality medical care. Women are also able access improved maternal health services during pregnancy and at birth. Improved medical services like antenatal care, increased supervision at birth leads to proper detection and treatment of complications at birth, which often reduces maternal deaths and hence maternal mortality ratio. Furthermore, an increase in GDP per capita enables a country to improve maternal health services by procuring sophisticated equipment. An improvement in maternal health services improves maternal health outcomes in the long run, since complications are properly diagnosed and treated even during pregnancy or at birth. Hence maternal mortality ratio is also reduced.

The level of income an economy has might give an impression of the health status of that country. For instance, in high-income countries, the maternal deaths are 1 in 3,300 as compared to 1 in 42 in the low-income countries. Studies have also looked at the impact of GDP on maternal mortality in the short term, however, the impact is more meaningful in the long run than the short run. Hence, the current study would ascertain if the relationship between income and maternal mortality occurs over time since the factors that determine MMR are transitional and takes time to manifest. The statistics on maternal mortality ratios in SSA indicate that, some countries in SSA might benefit more from the association between education or income on maternal mortality than other countries. The current study will ascertain the relevance of this assertion.

1.3 Research Questions

The study addresses the following research questions:

1. Are there any long-run relationships between income and maternal mortality in SSA?
2. Are there any long-run relationships between education and maternal mortality in SSA?
3. How does income or education affect maternal mortality in SSA with different income status?

1.4 Research Objectives

1. Examine the long-run impact of income on maternal mortality in SSA.
2. Examine the long-run impact of education on maternal mortality in SSA.
3. Compare the impact of income or education on maternal mortality in SSA with different income status.

1.5 Significance of the study

The study seeks to understand if the impact of income or education on maternal mortality is just temporal or permanent as predicted by the modernization theory adopted in the study. Education takes time to have an impact on maternal mortality, therefore, studying its impact over time reveals the entire transitional effects. Furthermore, increase in income from economic growth is expected to have a transformative effect on all sectors of the economy including the health service sector. This effect according to the modernization theory, takes place over time and hence the study would ascertain the empirical essence of this assertion.

The study would serve as a guide and contribute to the literature on understanding the contributions of income or education to improving maternal health outcomes.

The study would also inform policy on the right mix of government safe motherhood policies and interventions that can reduce maternal mortality in SSA. The study would also inform policy on the needed interventions in the educational sector to effectively utilize the returns to education on maternal health. Finally, the study would inform researchers on the crucial role income plays in improving gains in maternal health and how these gains can be realized.

1.6 Organization of the Study

The research was organized into six chapters. Chapter one contains the background of the study, problem statement, the objectives of the study, research questions, significance of the study and organization of the study.

Chapter two focused on a review of relevant literature based on the theoretical and empirical relevance of the study. Chapter three dwells on a trend analysis of income, education and maternal mortality in SSA. Chapter four was devoted to the methodology. This chapter contains the theoretical and empirical framework for the study with data requirements as well as analytical tools that were employed in the research. Chapter five consists of data analysis and its interpretation.

The sixth chapter captures the recommendations of the work not forgetting the summary of the findings and conclusions as well as the References and the various Appendixes.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter explores various theories as well as empirical reviews on the effect of income and education on maternal mortality. Attention is also paid to the techniques adopted in the literature reviewed. Theories that link education or income with maternal mortality includes the modernization theory, economic dependency theory, gender stratification and the risk prevention theory. The literature is reviewed based on the link between education and maternal mortality, income and maternal mortality. The chapter would also consider other causes of maternal mortality.

2.1 Review of the Theoretical Literature

Modernization theory explains the association between income or education and maternal mortality. First of all, modernization refers to the level of urbanization, industrialization, standards of living, education and well-being (Kelly & Cutright, 1980). Furthermore, according to Tipps (1973) modernization can be conceptualized as industrialization, economic growth, structural variation, political development and social mobilization. Modernization can be envisaged as secularization with each procedure of it been seen as representing a source of change at the national level despite the fact that it may be studied at a variety of stages also.

In addition, modernization is broadly viewed as extensive in its scope, as a multifaceted procedure which not only touches at one time or another virtually every institution of the

society but does so in a way such that transformations of one institutional sphere tend to produce the corresponding transformation in others (Tipps, 1973).

Modernization theory integrates the full range of progress and extraordinary changes that a traditional society needs to experience modernity (Hussain & Tribe, 1981). According to modernity, strategies intended to raise the way of life of the poor often entails distribution of knowledge and information about more proficient methods of production (Matunhu, 2011). Alternatively, the theory views economic development as bridging of the gap between developed and underdeveloped countries through an imitative process.

According to Shen & Williamson (1999), the demographic transition theory is derived from modernization theory, under which the link between fertility and mortality is directly proportional. In times of progressive development, the pressure is created to reduce fertility because it reduced mortality, consequently declines in child mortality reduce the number of births necessary to achieve a given number of surviving children (Kelly & Cutright, 1980).

More so, the significant measurements of modernization that influences fertility are urbanization, health, education and economic principles. Indicators of these measurements of modernization are utilized to develop an index of modernization. The hypothesis additionally manages a link between modernization and decrease in fertility. Hence the need to establish if indeed the data available confirms the presence of a permanent or long-run relationship between the various dimensions of modernization and maternal health outcomes. Furthermore, the theory emphasises the transitional effect of income or education on decreasing fertility over time and consequently maternal mortality in the long run. Therefore the study would use the available data to unravel the link between maternal mortality and income or education as stipulated by the modernization theory.

In addition, modernization breaks down traditional kinship control of nuclear family decision-making and procreative goals; it additionally changes customary sex roles and produces alternatives to early marriage and large families for women. Furthermore, if the role of women was reduced and now shifted to a more identical status with their male counterparts, if couples set new goals for themselves and their wards which would be very difficult to achieve with a larger family size, then the incentive for a smaller family size is inevitable even at lower income levels. As family sizes reduce, fertility rate reduces, hence reducing the risk of a woman dying at birth.

Modernization invigorated aspirations of adults for themselves and their children to take part in the new, accomplishment situated, socioeconomic establishments. The accomplishment of these new objectives is less demanding with small families. In societies with higher fertility rate, maternal mortality turns to be higher and on the other hand, maternal mortality turns to be lower when fertility rates are lower. Hence this explains one of the important reasons why maternal mortality is higher in the developing countries. In a nutshell, countries that had tread the path of modernization have moved from a higher to a lower fertility rate.

Furthermore, economic development according to this theoretical perspective leads to improved welfare and progressive medical expertise which in turn contributes to both lower mortality and fertility (Shen & Williamson, 1999). As the economy develops, progressive medical expertise leads to an improvement in maternal health care services and this is expected to reduce complications encountered during pregnancy and at birth. Subsequently, maternal health outcomes improves. Modernization is also found to be closely linked to improved usage of family planning efforts (Kelly & Cutright, 1980). Hence, higher levels of modernization increase the motivation to control births and this decreases the risk of exposing women to

maternal deaths. Consequently, maternal mortality as a vital indicator of the health status of the populace should decline when there is an improvement in economic development.

The transition requires a greater level of industrialization, education and urbanization. Indicators of the transition process of economic growth commonly used by researchers are gross national (or domestic) products, economic growth rate, urbanization, education and health care service (Shen & Williamson, 1999). The theory underscores the relevance of capital inflows to the development process and that, a lack of it inhibited the process of rapid economic and social progress in lesser developed countries (LDCs). The theory believes that the movement of capital from industrialized and world trade will facilitate development in LDCs by making available external capital, new technology and management experience which are essential to rapid economic and social development. In addition, the hypothesis additionally stipulates that, a country's industrialization and modernization will upgrade women status as a rule by giving more work cooperation openings, increase women access to and control over land and any assets including health services and these were supposed to translate into a drastic decline in maternal mortality.

On the other hand, the gender stratification theory stipulates that, societies with women of higher status and self-sufficiency are expected to have lower maternal mortality. These women with higher income status have a say in the number of children they have and have access to improved nutrition during pregnancy and this is expected to improve maternal health and consequently decrease maternal mortality. Women with higher socioeconomic status are better positioned to afford improved maternal health services and this is expected to translate into an improvement in maternal health outcome and subsequently a decline in maternal mortality. Women with lower status in society often give birth to too many children. These women

happen to give birth early and stop at a very later date. These women are exposed to higher risk of maternal mortality (Shen & Williamson, 1999). Coupled with poor socioeconomic conditions, women are vulnerable to health risk posed by childbirth. Fertility is expected to decline with an increase in the status of the woman. A decline in fertility reduces the risk of maternal mortality. According to this theory, women with access to contraceptives are those with higher status in society. This is because these women with access to contraceptives have some control over childbearing and hence the fertility rate. Furthermore, women with higher status have greater access to education which in turn improves the returns to health. These educated women are able to practice safer maternity lifestyles and this is expected to reduce the risk of maternal deaths during childbirth.

The economic dependency theory articulates that, the spillover effect of economic growth has an impact on maternal mortality. Proponents of this theory stipulate capitalist structures distorts the local economy due to the division of labour. Consequently, it deepens income inequality and reduces the well-being of a nation due to unequal exchange between developed and developing countries of raw materials for finished products. The theory proposes that, LDCs export mainly raw materials. In the long term, declines in raw material prices lead to a decline in revenue to the domestic economy which tends to affect the state's many health and social interventions. Hence maternal health care services are affected, consequently maternal mortality increases (Kelly & Cutright, 1984; Miller 1992).

Economic dependency impedes improvement in health care and consequently good maternal health. As a nation grows, investment from the Multinational Corporations (MNCs) increases, and this increase is expected to affect all sectors of the local economy. Investment from MNCs makes a lot of capital available to the domestic economy. When these MNCs repatriate their

profit at the end of the year, the local institutions and businesses are affected, hence retarding the growth of these nations. Subsequently, there are cuts from the spending to the health sector and this affects health care delivery and maternal health care delivery is affected. Hence maternal mortality is affected. Repatriation of profit by MNCs weakens the state's ability to provide the needed social interventions which include health care services amongst others.

The concept of risk hinges on some thematic areas namely risks society and reflexive modernity, social and cultural construction of risk, governmentality of risk and self-surveillance. Risk society and reflexive modernity were the basis for the availability of information on rapid and effective ways of treating medical issues. This helped reduce the risk associated with certain diseases. Moreover, the social and cultural construction perceived risk to be a part of the life cycle of an individual and the society hence might be influenced by the peculiar society. Finally, governmentality of risk and self-surveillance perceived a society to be made up of people who must be managed, led and protected to maximize productivity, wealth and health (Foucault, 1997). Childbirth is viewed as a biological process that comprises a lot of risks consequently leading to the ideology and culture of managing pregnancy and childbirth.

The transition from a social to a medical perspective started with the production stage which facilitated a more risky society via the provision of sophisticated facilities and reforms namely the midwifery and pro-natal agenda tailored towards protection and a healthier citizenry. Facilities included welfare clinic and maternity hospitals and development of antenatal services amongst others. The productionist phase perceived health services to workers to mean reducing the time lost to the industry and this contributed immensely towards the reduction of maternal, neonatal mortality and morbidity. Consequently, this reduces individual risk and the collective

risk at large. Furthermore, the communitarian phase of risk perceived risk as a shared responsibility than an individual one. Here the relevance of medical professionals was on the ascendancy because they were perceived to be all knowing. Consequently, medical consultation was on the rise. Finally, the consumerist era envisaged a dispensation where people took good health practices for granted and suffered many diseases as a result. Hence the introduction of medicine as a commodity to remedy the situation. These phases of medical services were put together to revise a new focus in the dispensation and review of reforms and services towards better maternal health outcomes. In a nutshell, the social context views childbirth as a part of the physiological makeup of the woman and is expected to be a normal one. On the contrary, the medical perspective envisages that childbirth requires strict monitoring to guarantee safety. The medical process is a way of letting medicine dictate the pace rather than leaving everything to nature with its concomitant risks involved.

2.3 Empirical Review

2.3.1 Education and Maternal Mortality

Education plays a vital role in improving maternal health of a nation. Several studies have supported a theoretical link between education and maternal mortality, some of these studies include (Alvarez, et al., 2009; Bhalotra & Clarke, 2014; McTavish et al., 2010; Gonzalez & Ren, 2017). Bhalotra & Clarke (2014) in a study of the causality between educational attainment and maternal mortality in 108 developing countries for 20 years, found that, increments in maternal education causally decrease the probability of death in labour. Additionally, a nation moving from 0 to 1 year of education, diminished maternal mortality by

174 deaths for every 100,000 live births, while moving from 7 to 8 years brought about a little, yet at the same time significant, 15 for every 100,000 live births. The study controlled for income, public health provision and fertility. Also, the study found that the percentage of births attended by a skilled professional was related to lower maternal mortality conditional upon vaccination. However, the study failed to ascertain, if there is any long-run relationship between education and maternal mortality.

Alvarez et al., (2009) in an environmental study of factors that influence maternal mortality in Sub-Saharan Africa, using data for the period 1997 to 2006, employed a correlation technique to identify the level of association between the dependent variables thus using a bivariate analysis technique. The study found that prenatal coverage, birth attended to by skilled health personnel, primary female enrollment rate and income per capita were inversely related to maternal mortality ratio. However, a cause-effect relationship cannot be realistically inferred from an environmental study, hence inappropriate to be inferred to individual subjects. In addition, the study failed to look at whether the association between income per capita or education and maternal mortality occurs over long-run.

Gonzalez & Ren (2017) in a study to unravel the differences and determinants of maternal mortality ratio in forty-five Sub-Saharan African countries, adopted a correlation analysis along with a descriptive statistics approach. Data for the study were solicited from WHO, UNICEF, World Bank, UNDP and health departments. The study found a statistically significant negative correlation between maternal mortality and Human Development Index (HDI), literacy rate, hospital beds, skilled birth attendants, contraceptive prevalence, improved sanitation and the number of midwives and nurses. Fertility rate showed a statistically significant positive relationship with maternal mortality. The findings re-echo the relevance of

education to reducing maternal mortality in SSA. However, the study failed to ascertain if these determinants of maternal mortality especially education had any effect in the long run.

Eghieye (2014) in a study evaluating the progress made by Sub-Saharan African countries, employed a linear regression model, a descriptive and a univariate technique. Data from several sources like the World Health Organization Millennium Indicators Databank, the United Nations Millennium Development Indicator Databank and World Bank database were used. Time periods used for the study were grouped into three namely 1990 to 1999, 2000 to 2004 and 2005 to 2010. The study found that education, GDP per capita, skilled birth attendance, antenatal care and economic freedom significantly led to a decline in maternal mortality. However, the study failed to consider if any long-run relationship existed between the education or GDP per capita and maternal mortality.

In addition, closely related to maternal health is maternal health care utilization. The country's literacy rate turns to affect its use of maternal health services. McTavish et al. (2010) in a study of national female literacy, individual socioeconomic status and maternal health service use in Sub-Saharan Africa utilized information from 2002-2003 World Health Surveys of 14 Sub-Saharan African nations. The examination received a multilevel logistic regression to look at the relationship between national female literacy and person's non-utilization of maternal medicinal services while adjusting for individual-level factors and national economic development. The examination found that inside nations, person's age, education, urban residence and household income were related to non-utilization of maternal health services. In addition, they found that the quality of the relationship amongst income and non-utilization of maternal health services was weaker in nations with higher female education and this suggests higher national levels of female education may lessen income-related disparities being used

through a scope of conceivable instruments, including female expanded work investment and higher status in society. They likewise found that there exist more forms of interventions accessible to women in nations with a higher female education contrasted with those found in nations with lower female education. Besides, mothers with higher levels of income and education had a lower likelihood of lacking maternal health services. Furthermore, mothers with more elevated amounts of income and education had a lower likelihood of lacking maternal health services.

Ahmed et al. (2010) in analyzing the connection between a woman's economic, educational and empowerment status presented as 3Es and maternal health service utilization in developing nations utilized information gathered from 31 nations. The study fitted separate logistic models for present-day contraceptive utilization, antenatal care and skilled birth attendance in connection to three indispensable covariates of interest specifically, education, economic and empowerment status. Moreover the study controlled for women's age and habitation. The investigation utilized the meta-data procedure to join and abridge results from different nations. The chances of having a skilled birth attendant at delivery for women in the poorest wealth quintile are 94% lower than that for women in the highest wealth quintile and very nearly 5 times higher for women with complete primary education in respect to those less educated. The probability of utilizing present day contraception and attending at least four antenatal care visits are 2.01 and 2.89 times respectively and higher for women with complete education than for those with less. Women with the highest empowerment score are in the vicinity of 1.31 and 1.82 times more probable than those with no empowerment score to utilize present day contraception, go to at least four antenatal care visits and have a skilled attendant during childbirth. These findings imply that significant investment in poverty eradication, universal primary education and women's empowerment must be coupled with all efforts to improve

maternal health service utilization. The findings underscores the crucial role education plays in improving the returns to maternal health and subsequently maternal mortality. The current study would move a step further to examine the link between education and maternal mortality over time, since any returns to education in maternal health is expected to take some time to manifest.

Bhandari et al., (2011) studying the reduction of maternal mortality in Nepal found that, the increase in caesarean section rate in rural areas was a contributing factor, reduction in total fertility from 4.6 percent in 1996 to 3.1 in 2006 driven by an increase in the use of contraceptive from 26% to 44% between the same time period. Furthermore, an increase in the use of antenatal care had also paid it dues in the decline. Moreover, the study found that women's level of education reduced fertility rate and this played a crucial role in improving maternal health. At last, a cross-region regression of human development index records scores against maternal mortality proportions demonstrated a meaningful association which recommends that enhanced education, wealth and general health over some time would have affected maternal well-being. However, the study failed to ascertain if education or income per capita affected maternal mortality over time.

2.3.2 Income and Maternal Mortality

Numerous studies have affirmed the theoretical essence of income to reducing maternal mortality in SSA (Amiri & Gerdtham, 2013; Buor & Bream, 2004; Sede & Irekpitan, 2014). Amiri & Gerdtham (2013) studied the relationship between maternal mortality and child health on GDP with a special focus on the magnitude and direction of these relationships. The study used longitudinal data and applied the Granger causality analysis to identify the relationship

between GDP, child and maternal mortality. The investigation found that, the connections amongst maternal and child health results and GDP are bi-directional, with the dominant part moving from maternal and child well-being to GDP. They further discovered that, the causal impacts of GDP on maternal and children's well-being results are more grounded in Lower Income Countries (LICs) and Lower Middle-Income Countries (LMICs) with respect to Higher Income Countries (HICs) and Upper-Middle-Income Countries (UMICs). However, the investigation utilized just two factors in their examination of the Granger causality investigation without other control factors like education and without thought for other health factors. Times dimension was too short. The current study uses a much longer duration and includes other control variables together with a robust estimation technique.

Adamba (2013) in an examination of how maternal mortality is affected by socioeconomic conditions in Ghana, used a multilevel design approach with data from the Ghana Demographic Health Survey 2008. The study found that women in deprived areas were more likely to die from maternal mortality than women in less deprived areas. An individual's level of education could not protect an individual against maternal mortality specifically if that individual is in a deprived community. These findings affirm the crucial role of income in reducing maternal mortality. Finally, the study found that educational status of women reduced the level of deprivation status. However, the study failed to examine the role of income in reducing maternal mortality over time.

Moreover, Sede & Irekpitan, (2014) in their study of the impact of economic growth rate on maternal mortality in Nigeria with the Grossman (1972) death model, used data from 1980 to 2011 and found no significant impact of economic growth rate on maternal mortality in Nigeria, but unemployment rate impacted maternal mortality significantly. However, the study

failed to consider if income as a proxy of economic growth influenced maternal mortality over time.

Buor & Bream (2004) examined the causes of maternal mortality in Sub-Saharan Africa. The study considered 28 countries with data from 1990-1998, using data from World Organizations like the World Bank, UNAIDS, the United Nations, Demographic and Health Surveys (DHS), Macro International, and national statistical offices. Their study adopted the bivariate correlation along with the cross-tabulation using Kendall's tau-c and regression lines to ascertain impacts. The study adopted a regional model which found a significant correlation between births attended to by skilled personnel and maternal mortality. Moreover, GNP, life expectancy, health expenditures had a strong relationship with maternal mortality. However, the study failed to ascertain if there exist any long run relationship between income and maternal mortality. The current study will evaluate if there is any permanent relationship relation between maternal mortality and its root determinants like the number of births attended to by skilled medical personnel, income per capita and education.

Shiffman (2000) in a cross nationwide regression of 64 countries indicated that wealth indicators explained only a percentage of the discrepancy in national maternal mortality levels. Other factors such as women educational levels and the proportion of births supervised by trained health professionals are closely related to national mortality rates than wealth. The study employs the Pearson's correlation alongside the OLS estimation technique. However, the study failed to assess if the association between education or income and maternal mortality are only temporal or permanent. The current study employs recent data from many Sub-Saharan African countries as possible to ascertain the significance of education or income in reducing maternal mortality in the long run.

Furthermore, Kirigia et al. (2006) in their study of the effect of maternal mortality on GDP in World Health Organizations (WHO) countries, adopted the double-logged econometric model. The study found that, maternal mortality has a statistically significant negative effect on the GDP of countries. The examination depended on cross-sectional data from 45 of the 46 states in the WHO African countries with information from UNDP and the World Bank productions. However, the study failed to consider the impact of GDP on maternal mortality. The current study will ascertain if the impact of GDP per capita on maternal mortality is just temporal or permanent.

Furthermore, Ensor et al., (2010) in an investigation of the effect of economic recession on maternal mortality and newborn child mortality, using twentieth-century information from 14 high and middle-income nations to examine the relationship between past economic recession and successful periods on maternal and infant outcomes covering the period 1936 to 2005. Their findings were that economic recessions had an inverse relationship with maternal and child mortality at the early faces of a nation's development but differed for countries based on their structure. A first difference logarithmic model is utilized to explore the relationship between short-run fluctuations in GDP per capita (household incomes) and changes in health outcome. Isolated models were assessed for four separate eras. The examination observed that a small yet significant relationship amongst maternal and child mortality and economic development for early periods (1936 to 1965) however not later periods. Individual nation information showed notably unique examples of reaction to economic changes. Japan and Canada were vulnerable to economic shocks in the post-war period. Interestingly, death rates in nations, for example, the UK and Italy and especially the US seem minimal influenced by economic shocks. The study infers that, economic disturbances do have a negative relationship with maternal and newborn child mortality results especially in prior phases of a nation's

advancement despite the fact that the impacts change broadly across nations over various frameworks. However, the study failed to examine the impact of income on maternal mortality over time.

Coburn et al., (2014) in a an investigation of the effect of African Development Bank (AFDB) structural adjustment program on maternal mortality in thirty-five Sub-Saharan African nations with up to four time periods, specifically (1990 1995, 2000 and 2005). The study adopted a generalized least square regression, random effect models and a two-stage Hackman model that addresses potential endogeneity regardless of whether or not a Sub-Saharan African nation gets an AFDB adjustment loan. The study found that, SSA countries that receive structural adjustment loans turn to have a higher maternal mortality than those countries that don't receive the loan. This finding remains stable even when endogeneity is controlled for. The finding of the study implies that in times of structural adjustment, spending to all sectors including the health sector was cut. Hence the quality of maternal health care is also affected, leading to poor maternal health outcomes.

2.3.3 Other Causes of Maternal Mortality

Studies abound that reveal high income and educational levels are not enough to reduce maternal mortality and that investment in education must be accompanied by probity, effective monitoring and evaluation of outputs from the investment. Brouwere & Lerberghe (2001) in a study titled reducing maternal mortality in the context of poverty, found that even though the countries studied were of comparable wealth or poverty, maternal mortality ratios differed amongst them. The study further suggests that the differences in ratio have gotten to do with the availability of health services that are client centered. The study used various stepwise

regression of 68 nations with a GNP per capita of less than \$1000. The study affirmed that even though resources and female literacy are necessary it is not a sufficient factor for the decline in maternal mortality and that there must be an investment in health care coupled with an effective system of accountability to measure adequately the results of various medical interventions.

Furthermore, the intensity of care given to an expectant mother tend to improve maternal health outcomes. Campbell & Graham (2006) in a study that focused on strategies for reducing maternal mortality and adopting measures that work, found that, intrapartum-care has proven to be effective and recorded maternal mortality proportions of under 200 deaths for every 100,000 live births with some even lower. Skilled attendants at home is also another strategy which can be implemented with caution. They likewise found that emergency care is a basic necessity for reducing the significant proportion of maternal mortality. The study affirms the relevance of effective monitoring as an essential part of the maternal health delivery process.

Mensah et al., (2009) in a case study of causes of maternal mortality in Koforidua regional hospital in the Eastern region in Ghana used hospital records of the death of women pregnancy related. The study found that haemorrhage was the leading cause of maternal mortality, followed by eclampsia and abortion. The study also revealed that barriers to emergency obstetric care like blood transfusion services, transportation and ante-natal care also contributed to an increase in maternal mortality.

Similarly, another study by Ganyaglo et al., (2012) in Eastern region of Ghana specifically Koforidua regional hospital found that, postpartum haemorrhage, abortion, hypertensive disorders in pregnancy puerperal sepsis were the major causes of maternal mortality. The study used a variety of data from the hospital departments namely obstetrics and gynaecology wards,

labour ward admission and discharge book, Theatre book and compared with midwifery returns. Supplementary data were extracted from patient folders using 36 structured questionnaires in 2009. However, these studies were unable to consider other factors like income or education on maternal mortality.

Ronsmans & Wendy (2006) in a study of who, where, why and when maternal mortality occurs found that most of the deaths occurred in hospitals with root causes that are direct such as haemorrhage, induced abortion, hypertensive diseases, infectious diseases, obstructed labour. And indirect causes such as HIV infections, accidents, suicides and murders. Availability of skilled and timely medical care was also a possible cause. However, the study failed to examine the contribution of skilled medical personnel to the reduction in maternal mortality over time.

In addition, Gerein et al., (2006) in a study of the implication of the shortage of medical health professionals for maternal mortality in Sub-Saharan Africa, found that deficiencies of health professionals reduce the number of facilities prepared to offer emergency obstetric care 24 hours a day, and are significantly related to quality of care and maternal mortality rates. Furthermore, the accessibility of skilled birth attendants and emergency obstetric care might be diminished because of understaffing, especially in rural, deprived areas. The findings of the study re-echo the effect of the inadequately resourced health sector on maternal health outcomes.

Brouwere & Lerberghe (2001) in a study titled of blind alleys and things that have worked, used historical lessons on reducing maternal mortality. The study analysed the conditions necessary for a substantial reduction in maternal mortality. Preconditions seem to have been early attention to the size of the issue, an acknowledgment that most maternal deaths are avoidable and organisation both of experts and of the community. This, the study believes will

go a long way to help policymakers appreciate the enormity of the problem to facilitate more pragmatic intervention to remedy the situation. The study observed that maternal mortality ratios also differed for industrialized countries just as was the case for countries with similar income status. These differences could be attributed to the way professionalization of delivery care was determined, firstly, the higher level of political will, secondly, adoption of modern strategies for making obstetric care available and thirdly the extent to which professionals were held accountable for addressing maternal health in an effective manner.

Various studies have outlined some macro, micro causes and risk of maternal mortality. Garenne et al., (2013) in an investigation that concentrates on scrutinizing the legitimacy of some indirect causes of maternal deaths in provincial South-Africa, utilizing information on all deaths of women between the ages of 15-49 in the Agincourt sub-area within the period 1992 to 2010. Some causes of death in the study was assessed using a validated verbal autopsy instrument. Investigation contains deaths of which 137 happened amid the maternal hazard time frame. The investigation assembled that, women had altogether lower mortality amid the risk time frame than outside it. This was observed to be valid in the greater part of the age groups with the exception of young people aged 15-19 years where the danger of death was higher. In addition mortality from most causes like for malaria, cardiovascular diseases and violence were higher than obstetric causes in risk periods. These findings were interpreted to mean that pregnancy was to a greater extent safeguarded against the danger of death.

In addition, Christian et al., (2008) in a digest of the hazard factors of pregnancy, in a forthcoming report in Nepal, utilized information on socioeconomic status, mid-upper arm circumference (MUAC), diet, ailment, work, substance utilization and past pregnancy history gathered amid early to mid-gestation. The study observed these women after for a year of post-

delivery. Likewise, All-cause death rates per 100,000 pregnancies were figured for amid pregnancy or up to 42 days after birth and 43–364 days after birth. Hazardous factors like biological, morbidity, dietary, a way of life and socio-economic conditions were embraced to evaluate the probability of mortality. Critical factors inside each gathering were incorporated into a solitary hazard display for each day and age. Important factors within each group were included in a single risk model for each time period. The study found that initial and late pregnancy-related mortality rates were 469 and 254, respectively. Maternal age more than or equivalent to 35 years was related with a three to four unit increment in mortality, though expanding equality presented expanding insurance. In the last model, a bigger MUAC and utilization of dim green leaves were related to the diminished danger of death in the early period. A bigger MUAC was linked with a lower risk of death in the late period. Moreover, diarrhoea/dysentery and pre-eclampsia were related to the expanded danger of death in the early period. Factors feebly connected with mortality in the two-time frames included night visual deficiency, strenuous work movement and cigarette smoking. No socioeconomic variables were important in the models. These results implied that maternal age, equality, MUAC, diet and ailment in initial to mid-gestation were associated with the danger of death during pregnancy and the first year post-delivery in rural Nepal.

Furthermore, Khan et. al., (2006) in a systematic evaluation of WHO investigation of joint determinants of maternal deaths from 34 datasets (35197 maternal deaths) reporting individual causes of maternal deaths with four main causes namely haemorrhage, hypertensive disorders, sepsis, abortion, obstructed labour, ectopic pregnancy, embolism. Haemorrhage was the most pervasive reason for death in Africa and in Asia. In Latin America and the Caribbean, the hypertensive issue was in charge of the dominant part of deaths. Premature birth deaths were most noticeable in Latin America and the Caribbean, which can be as high as 30% of all deaths

in a few nations in this setting. Deaths because of sepsis were higher in Africa, Asia, and Latin America and the Caribbean than in developed nations. These discoveries suggested that haemorrhage and hypertensive issues are real determinants of maternal deaths in developing nations and in effect Sub-Saharan Africa.

In addition, Magoma et al., (2015) in a survey of data with maternal deaths in Bugando hospital north-west Tanzania covered the period 2008-2012. The examination embraced a review investigation utilizing maternal deaths survey information and extraction of missing data from patients documents. The findings were that there were 80 deaths with the normal average age of the deceased 27.1 ± 6.2 years and a median hospital stay of 11 days. Direct obstetric causes accounted for the majority of the deaths forming about ninety percent, 60% from eclampsia, extreme pre-eclampsia, sepsis, fetus removal and sedative complexities. Data on Antenatal Care (ANC) participation was recorded in 36.2 % of the structures and gestation age of the pregnancy coming about into the demise of 23.8 %. Sixty-one deaths (76.3 %) happened after delivery. The method of delivery, place of delivery and birth attendants were recorded in 44 (72.1%), 38 (62.3%) and 23 (37.7 %) respectively.

Nair et al., (2015) in a study that employed a multivariable regression analysis to identify the factors that were associated with maternal deaths and to estimate the additive odds associated with the presence of one or more of these factors in an examination of components related to maternal deaths from direct pregnancy-related complexities in a UK national control study. The study utilized information on 135 women who died during the period of 2009 and 2012 from eclampsia, pneumonic embolism, sepsis, amniotic liquid embolism, and peripartum haemorrhage. The investigation additionally utilized information from the Confidential Enquiry into Maternal Death, and another 1661 women who survived serious intricacies caused

by these conditions (2005–2013), utilizing information from the UK Obstetric Surveillance System. The after-effects of the investigation were that six components were freely connected with maternal death namely, insufficient utilization of antenatal care, substance abuse, restorative comorbidities, past pregnancy issues, hypertensive disorders of pregnancy. Of the expanded hazard related to maternal passing, 70% was credited to the elements said above. These discoveries propose that, medical comorbidities were vitally connected with direct (obstetric) deaths.

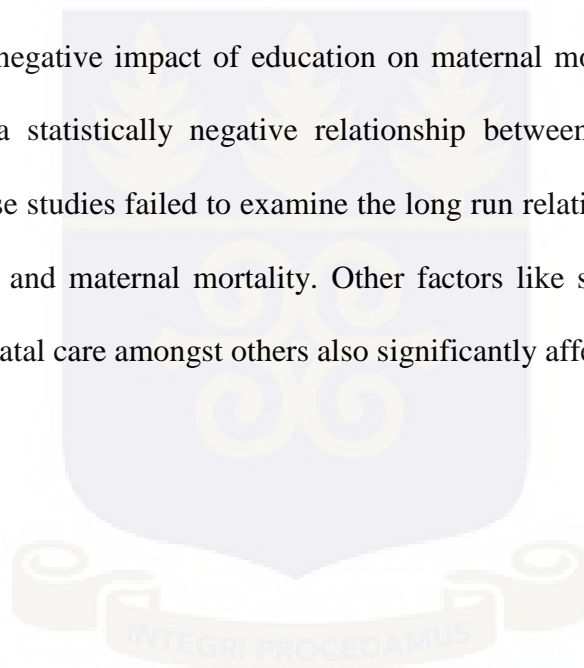
To remedy some of these causes some studies have delved into the role played by institutional factors. Jowett (2000) in a study of various investigation of different safe parenthood interventions in low-income nations with particular concentration on economic validation and evidence of cost viability, found that 26% of maternal deaths are avoidable through antenatal/group based strategies costing around 30% of the WHO Mother-Baby bundle. Moreover, access to quality basic obstetric care can prevent a further 48% of maternal deaths, consuming 24% of aggregate Mother-Baby Package.

Other interventions are also paramount. Herrick et al., (2014) in the survey, organized the different interventions to shield women from the main sources of maternal deaths. The investigation evaluated forty advancements for their capability to decrease maternal mortality from postpartum haemorrhage, preeclampsia and eclampsia in low-asset settings. The investigation received an Excel-based prioritization apparatus covering 22 criteria, the Maternal and Neonatal Directed Assessment of Technology (MANDATE) model, and consultation with specialists. The study observed that these five innovations had a higher potential of improving maternal health, advancements to enhance utilization of oxytocin,

uterine inflatable tamponade, rearranged dosing of magnesium sulphate, an enhanced proteinuria test and better circulatory strain estimation gadgets.

2.4 Summary of Chapter

The chapter reviewed theories that link maternal mortality with education or income. These theories include modernization theory, economic dependency theory, risk theory and gender stratification theory. Empirical reviews of the available studies show that there exists a statistically significant negative impact of education on maternal mortality in SSA. Studies have also established a statistically negative relationship between income and maternal mortality. However, these studies failed to examine the long run relationship between income per capita or education and maternal mortality. Other factors like skilled birth attendance, antenatal care and postnatal care amongst others also significantly affect maternal mortality.



CHAPTER THREE

EDUCATION, INCOME AND MATERNAL MORTALITY TRENDS IN SUB-SAHARAN AFRICA

3.0 INTRODUCTION

The study reviews the trend of education, income and maternal mortality in Sub-Saharan Africa (SSA). The chapter aims to throw more light on the trends in income per capita, education and maternal mortality over the period 1980 to 2010. It specifically gives an overview of educational reforms and how they have impacted enrollment rates. A summary of average income per capita and maternal mortality in certain countries in SSA were analyzed. This was to help appreciate how the average incomes and maternal mortality compared across SSA.

3.1 Education In Sub-Saharan Africa

Education, as measured by the primary and secondary school enrolment rate (PER and SER), has recorded some appreciable improvement over the years in SSA. Considerations would be given to various income status of the countries involved. Table 3.1 below gives an overview of the average enrollment of females in secondary and primary schools in Lower Middle-Income Countries (LMICs).

Table 3.1 Average PER and SER of Females in Lower Middle-Income Countries

Countries	Average PER	Average SER
Angola	84.86	14.15
Cape Verde	113.79	59.51
Cameroon	86.54	21.16
Congo Rep	112.35	48.93
Cote d'Ivoire	60.88	12.80
Ghana	77.61	36.38
Kenya	102.11	38.49
Nigeria	27.20	23.99
Sao Tome and Principe	127.66	45.71
Swaziland	75.21	47.10
Zambia	90.32	12.56
Lesotho	118.03	36.14

Source: Author's Computation from WDI

Primary and Secondary school enrollment rates have been high on the average in SSA especially, in Lower Middle-Income Countries (LMICs). Table 3.1 gives an overview of the average rate of primary and secondary school enrollments in LMICs in SSA between 1980 to 2010. Primary School Enrollment Rate (PER) within this sub region is quite high recording the lowest rate of 27 and a high of 128. These values indicate that primary enrolment of females in LMICs is quite high. Closely related to primary school enrolment is the secondary school enrolment (SER). SER rates have been very poor recording a lower average over the period of 13 and a higher value of 60. These lower values tell a gloomy picture of secondary education in LMICs in SSA.

On the contrary, Upper-Middle-Income Countries (UMICs) have on average a much higher primary school enrolment rate. One might be tempted to attribute this higher rate to the income status of these countries. Therefore, the higher the income status of a nation, the higher the investment that will go to the educational sector to enhance enrollment. However, the rate for these countries has not seen any appreciable rise over the period for females. From table 3.2,

Equatorial Guinea recorded the lowest rate of female enrollment of 22, with South Africa recording a high of 89 in secondary schools.

Table 3. 2 **Average PER and SER for Upper Middle Income Countries**

Countries	Average PER	Average SER
Botswana	105	54
Equatorial Guinea	102	22
Gabon	143	33
Namibia	117	61
South Africa	103	89
Mauritius	105	67

Source: Author's computation from WDI

On the other hand, Lower Income Countries (LICs) have recorded some appreciable rates of enrolment in primary school. Table 3.3 indicates that Madagascar recorded the highest rate of primary school enrolment over the period with 111. Niger recorded the lowest rate with 27.

Table 3. 3 **Average PER and SER for Lower Income Countries**

Countries	Average PER	Average SER
Benin	58.63	1332
Burkina Faso	34.82	8.25
Burundi	58.56	6.25
Central African Republic	55.79	7.16
Chad	42.79	6.11
Comoros	93.16	30.65
Congo Democratic Republic	72.25	17.83
Eritrea	44.68	19.39
Ethiopia	42.62	16.04
Gambia The	65.73	18.61

Guinea	41.33	10.50
Guinea-Bissau	42.76	4.03
Liberia	77.61	22.31
Madagascar	110.77	22.72
Malawi	96.82	18.32
Mali	38.97	11.13
Mozambique	71.06	7.70
Niger	27.20	5.05
Rwanda	98.79	14.86
Senegal	56.34	12.88
Sierra-Leone	49.61	14.16
Tanzania	81.34	5.17
Togo	88.60	16.50
Uganda	94.27	15
Zimbabwe	106.54	34.88

Source: Author's computation from WDI

In a comparison across the various income status, UMICs have the highest rate of female enrollment for the primary school and secondary schools. LMICs have the second highest rate of primary and secondary school enrolment rates. LICs have the lowest rate of both primary and secondary school enrolment rates.

3.1.1 Educational Reforms in Sub-Saharan Africa

An improvement in education in almost all SSA countries was a pre-requisite to accessing structural adjustment loans. SSA countries in need of these loans had no other choice than to reform their educational sector and make it more accessible (Chisholm & Leyendecker, 2008). The reforms in the educational sector meant an improvement in the curriculum used. Educational reforms were a key component of poverty reduction strategy and were made up of interventions to improve access and quality of education (Chisholm & Leyendecker, 2008).

Furthermore, as part of the educational component of the structural adjustment loan, countries like Uganda, Tanzania and Mozambique among others had reformed their educational system. For instance Uganda implemented the Universal Primary Education as a way to improve access to education (IMF, 1998); Tanzania implemented the Basic and Secondary Education Master Plan (IMF, 1999a,b); Mozambique initiated a 5-year Education Sector Strategic Plan (ESSP) for primary and secondary school education between 1999-2003 (IMF 1999a,b). In addition, South Africa and Namibia lead the trail for various reforms in the curriculum, these reforms were learners centered from a life science in Namibia in 1990 (Chisholm & Leyendecker, 2008).

Eger (2016) reviewed certain reforms in the educational structure of certain Sub-Saharan African Countries to ascertain how these reforms contributed to enhancing access and quality of teaching and learning. The countries to be considered include Rwanda, South Africa, Ghana and Botswana. These countries were selected each from the LICs and LMICs and two from the UMICs. These countries were selected due to the peculiarity of their educational system and its impact on the other countries in SSA (Chisholm & Leyendecker, 2008).

First of all, ethnicity and tribal conflicts in Rwanda affected the smooth operation of the educational system before 1994, where some tribes were favoured over the others and this worsened the gap between the enrolled and unenrolled. Discriminations were also done based on an ethnic group with more possession like cattle and proximity to the office of governance. In the midst of growing challenges such as inadequate classroom, the educational curriculum had undergone some reforms to incorporate current technological trends. Due to the crucial role of education in nation building, access to primary education was made free and compulsory after the genocide (Eger, 2016).

Enrollment had increased due to the intervention of fee-free access to education introduced by the government. An increase in accessibility to education threatened the quality of education as more of the private schools were no longer competitive since their cost was much higher. Primary school enrolment of both males and females outweighed secondary school enrollment due to the institution of the fee-free education. The evidence showed that primary school enrolment for males increased to 97% and that of girls 98% (UNESCO, 2003). In order to address the slow rate of enrollment in the secondary schools, the Rwandan government instituted the Nine Year Basic Education Program to offer fee-free tuition to induce patronage. Subsequently, there was a surge in the rate of enrollment in public schools (Eger, 2016). The Rwandan educational systems still suffer from the scars of ethnic fragmentation.

In South Africa, the apartheid deepened racial discrimination in schools and this was evident in cost and the quality of education. Apartheid was a system of racial fragmentation which favoured the white supremacy (Eger, 2016). Apartheid was also prevalent in the educational system which was tailored based on the skin colour of the individual. Some of these segregation included departments of education that were responsible for black South Africans, Indian South

Africans, “Coloured” South African and that responsible for White South Africans. Apartheid was initiated to prevent non-whites from participating in high remunerative roles (Eger, 2016). Democratic governance brought an end to apartheid, and the educational system removed all forms of departmental segregations. The educational curriculum was changed into the Outcome Based Education which sort to free the curriculum from racial segregation. The new curriculum was not too effective as it ended up mimicking the apartheid regime where fee-free schools were characterized by lower quality as compared to fee-paying schools. Enrolment rates were affected by the HIV/AIDS endemic.

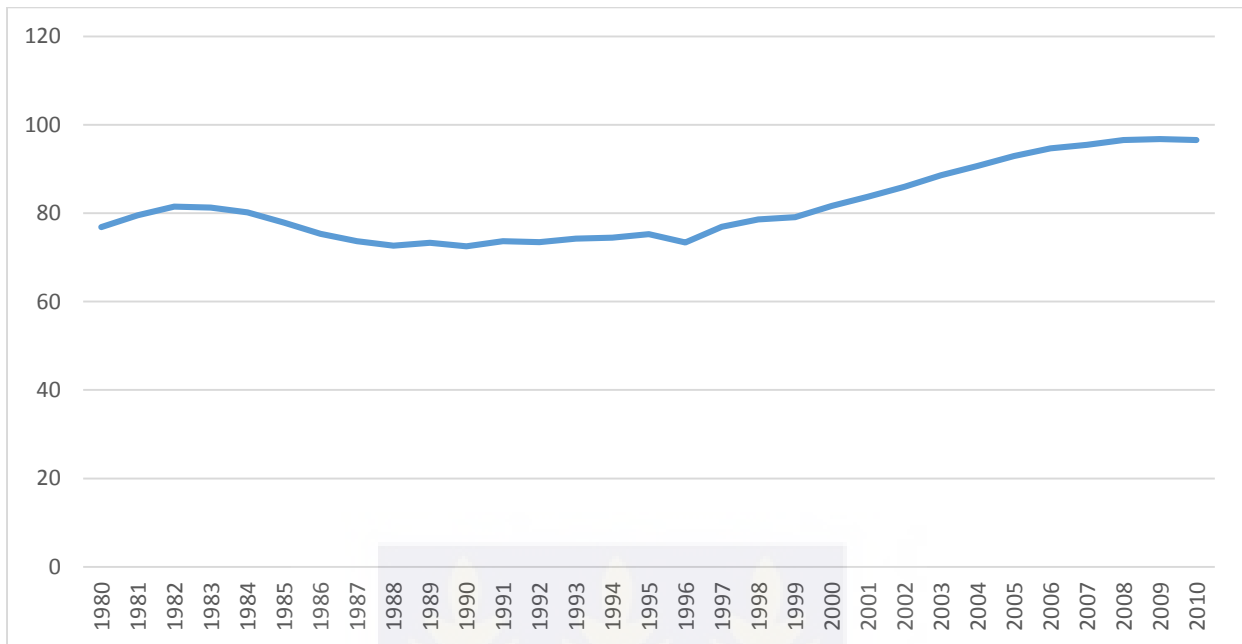
After her independence in 1957, Ghana initiated the Education Act in 1961 to facilitate the building of human capital. This Act made basic education free and compulsory. Following the enactment of the Act, educational enrollment rose astronomically with quality deficiency. Investment moved towards establishing more schools at the expense of the quality. After the military takeover in 1966, the then military government abandoned the free education system hence crippling the educational system since the funding to schools were cut, coupled with improper management of schools (Akyeampong, 2010). In 1987, a joint effort led by government and the World Bank restructured the system to virtually reduce the number of years spent in school and reduce the common entrance fee to make schooling more attractive to the rural folks. The new system was bedeviled by insufficient teaching staff. The Educational structure was restructured to make it more decentralized and improve enrollment through fee-free, compulsory schooling in 1992. Since the quality of fee-free schools was compromised, people preferred the private schools. Ghana’s educational system was seen as successful due to the longer duration children spent in schools.

Botswana, on the other hand, had just two schools before its independence. After independence, improvement in education became a number one priority. After independence, the rate of enrollment experienced a surge and hence was touted as one of the success stories in SSA (Lewin, 2009). The rate of enrollment increased from 2% to about 87.3%. The three major educational reforms that shaped education in the country includes 1994 Revised National Policy on Education (RNPE); 1977 Education for Social Harmony and the Vision 2020 (Eger, 2016). These policies were overlapping in nature to ensure efficiency and effectiveness in the educational system. The educational curriculum comprises of ten years of free and compulsory schooling and hence enhanced enrollment drastically. The educational system was challenged by absenteeism and lower employment opportunities.

On the average, countries over the years have invested more in social intervention to improve enrolment rate, however, these interventions are no guarantee of educational success. It was estimated that SSA countries spend almost 18.3% of their budget on improving the educational sector (UNESCO, 2011). These interventions have enhanced significant improvement in enrollment in SSA from 59% to 79% between 1999 and 2012. Returns on education can be widespread in diverse parts of the economy. It was estimated that nearly two-thirds of the world's 781 million illiterates are women and almost all of them resided in developing economies (UNESCO, 2014).

Growth in PER and SER over the period 1980 to 2010 was unstable. Figure 1 indicates that there has been a decline in PER for females in the early 1980's to late 1990's. Following the period 1997, there has been a steady rise in PER rate for females in SSA.

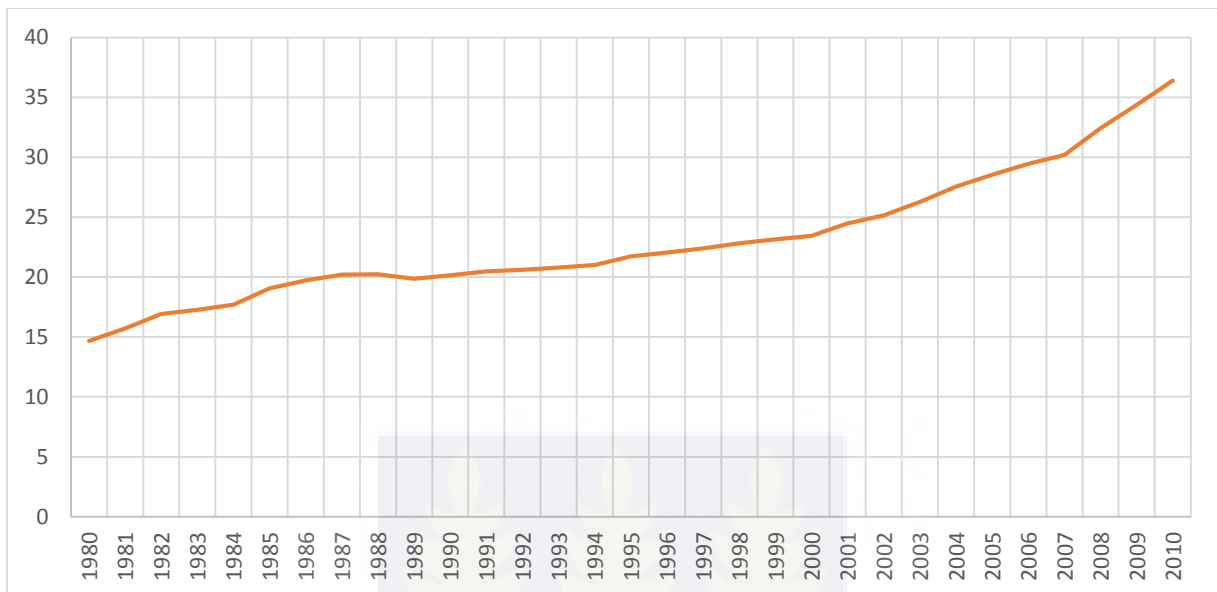
Figure 1 **Trend of PER for females in Sub-Saharan Africa**



Source: Author's computation from WDI

On the other hand, SER for females has also seen a steady rise over the period. Figure 2 indicates that SER increased slowly from 1980 to 1984. It then saw an appreciable rise from 1984 to 1990. After 1990, it increased at a decreasing rate to 1995. After the period 1995 SER increased significantly to 2010. Figure 2 gives indicators that SER has increased on the average in SSA. The increment in both PER and SER both foster important external benefits (UNESCO, 2011).

Figure 2 **Trend of SER of females in Sub-Saharan Africa**



Source: Author's computation from WDI

3.2 Income in Sub-Saharan Africa

Income per capita has evolved drastically amidst some fluctuations in certain time periods. The phases in the evolution can be grouped into post-independence through the 1960s, first half of the 1970s and after independence. It was estimated that, in the 1960s SSA grew at a rate of 2% to 3% annually (Go et al., 2007). In the early 1970s, they further estimated that GDP per capita for SSA grew at a rate of 1.54%. Following the oil shocks in 1974, the economies of SSA went into a recession and was unable to recover on time. Subsequently, the growth rate was highly affected leading to negative growth rates in the 1970s. The rate of growth in GDP per capita witnessed some fluctuations between the period 1980 and 1985. SSA countries

recovered and grew at a rate of 1.5 at the first half of 1990's. Go et al., (2007) found that SSA's income per capita declined by about 26 percent during the periods between 1980 to 2002. Additionally, they further found that 19 countries out of 43 studied had either an average of negative or even zero growth within the same period. Countries like Equatorial Guinea, Botswana and Mauritius experienced high rates of growth.

Inequality in income per capita in Africa varied from one country to another in Sub-Saharan Africa. According to Deininger & Squire (1996), the median value of the Gini coefficient in SSA stood at 49.90% in the 1960s, 48.50 in the 1970s, 39.63% in the 1980s and 42.3% in the 1990s. Even though the estimated income per capita was low, the inequality gap stipulated a wide income disparity even in SSA alone. In the 1990s, the value of the Gini coefficient stood at a record high of 0.75 in Niger, 0.61 in South Africa to a low of 0.29 in Rwanda in the mid-1980s and 0.33 in Burundi, indicating that Africa had a lot of variations in its income patterns (Sahn & Stifel, 2003). Due to lack of time series data on income inequality, it is almost impossible to do any meaningful analysis of inequalities within African countries (Okojie & Shimeles, 2006).

Furthermore, the rate of income inequality slowed the rate of achieving the MDG's of halving poverty for Africa. ECA (1999) ascertained that higher levels of income inequality in a country reduced the redistributive power of economic growth in reducing poverty.

The patterns of income in Sub-Saharan Africa countries with different income status would be explored to explain the magnitudes of income variations within SSA. Attention is given more to average income per capita in SSA. Table 3.4 gives an overview of countries in comparison. The table indicates that Swaziland has the highest form of income per capita on average of \$6300.09 with Kenya recording the lowest amount of \$2264.35 within these countries.

Table 3. 4 **Income Per Capita for Lower Middle Income Countries**

Countries	Average GDP per Capita (\$)
Angola	4334.25
Cape Verde	3568.11
Cameroon	2442.21
Congo Rep	4931.41
Ghana	2348.67
Cote d'voire	2895.72
Kenya	2264.35
Nigeria	3430.67
Sao Tome and Principe	2308.06
Swaziland	6300.09
Zambia	2349.16
Lesotho	1830.44

Source: Author's Computation from WDI

Some UMICs have recorded some desirable levels of income per capita whilst others in that sub-region have recorded some lower levels of income per capita. Table 3.5 also indicates that UMICs have the highest income per capita on average. The country with the highest income per capita was Equatorial Guinea with \$19,970 and Namibia been the lowest with \$6,630. The disparity between the highest and the lowest is quite high. The disparity illustrates that standard of living in some countries of the same income status is quite high and this might affect access to maternity health care services and subsequently maternal mortality. Hence the study would ascertain the quantitative impact of income per capita on maternal mortality over the period 1980 to 2010.

Table 3. 5 **Income Per Capita for Upper Middle Income Countries**

Countries	Average GDP per capital (\$)
Botswana	10431.60
Equatorial Guinea	19970.43
Gabon	18237.41
Namibia	6630.29
South Africa	10235.15
Mauritius	11051.82

Source: Author's Computation from WDI

Income per capita of LICs in SSA might not be expected to be as high as compared with that of LMICs. Table 3.6 indicates the average per capita incomes for LICs. Among these countries, Zimbabwe has the highest income per capita of \$2,131 with Liberia having the least of \$602. The disparity in income per capita is wide. In a comparison across SSA with different income status, Upper-Income countries have the highest income per capita as compared with the LMICs and LICs.

Table 3. 6 **Income Per Capita for Lower Income Countries**

Countries	Average GDP per Capita(\$)
Benin	1317.61
Burkina Faso	1098.30
Burundi	789.86
Central African Republic	852.52
Chad	1308.62
Comoros	1441.72
Congo Democratic Republic	668.82
Eritrea	1521.45
Ethiopia	688.45
Gambia The	1530.33
Guinea	1133.43
Guinea-Bissau	139.78
Liberia	601.87
Madagascar	1432.74
Malawi	860.32

Mali	1548.38
Mozambique	591.32
Niger	803.92
Rwanda	920.51
Senegal	1935.89
Sierra-Leone	1160.27
Tanzania	1620.03
Togo	1242.97
Uganda	1119.75
Zimbabwe	2131.23

Source: Author's Computation from WDI

Growth in income per capita has been unpredictable over the period 1980 to 2010. Negative and positive growth rates were experienced over the period. Figure 3 indicates that income per capita in SSA declined steadily from 1990 to 1994. It stagnated between the periods 1994 to mid-1995 and recovered from 1996 to 2003. After the period 2003, income per capita increased significantly to 2010. The overview of figure 3 shows that, income per capita in SSA had fluctuated over the period thus falling to the lowest and further rising afterward.

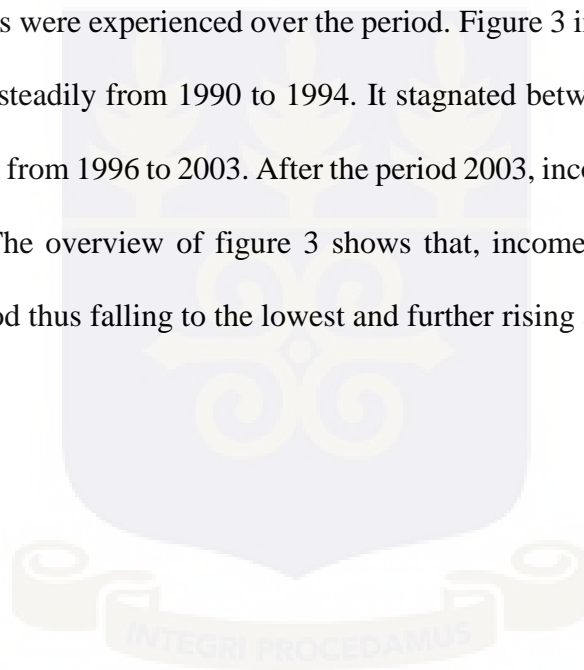
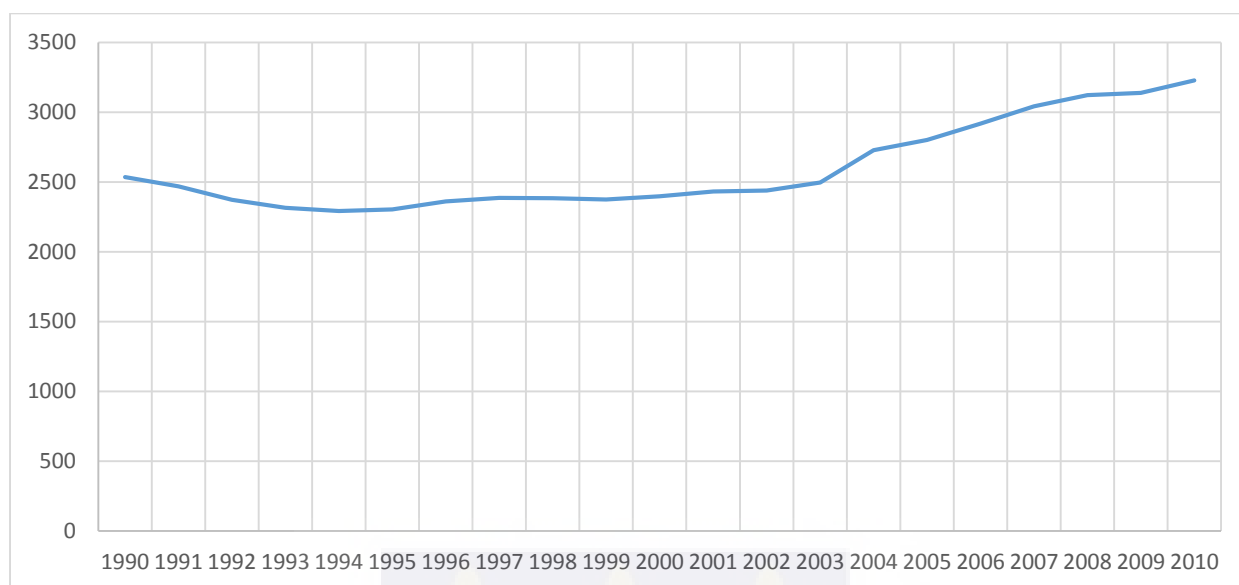


Figure 3 **Trend of GDP_C for Sub-Saharan Africa**



Source: Author’s computation from WDI

3.3 Maternal Mortality in Sub-Saharan Africa

Maternal mortality remains high irrespective of the income status of the nations involved. Table 3.7 gives an indication of expected MMR over the period of study. The table further throws more light on the enormity of the problem of poor maternal health in SSA, especially in LMICs. The table indicates that Nigeria is the worse hit with a record of 1,115 per 100,000 live births with Sao Tome and Principe recording 229 as the lowest.

Table 3. 7 **Maternal Mortality for Lower Middle-Income Countries**

Countries	Average MMR
Angola	912
Cape Verde	112
Cameroon	733
Congo Rep	611

Cote d'Ivoire	716
Ghana	461
Kenya	707
Nigeria	1115
Sao Tome and Principe	229
Swaziland	557
Zambia	485
Lesotho	629

Source: Author's Computation from WDI

Poor maternal health remains a challenge to UMICs in SSA. Table 3.8 indicates that Upper Middle-Income countries also have issues with poor maternal health. The table further indicates high MMR among these countries that must be attended to. The table records the highest value of 776 with Equatorial Guinea and the lowest of 53 with Mauritius. Poor maternal health still remains a problem within SSA irrespective of their income status. The study would ascertain the quantitative impact if any, of income per capita on MMR.

Table 3. 8 **Maternal Mortality Ratios Upper Middle Income Countries**

Countries	Average MMR
Botswana	259
Equatorial Guinea	776
Gabon	383
Namibia	345
South Africa	97
Mauritius	53

Source: Author's Computation from WDI

LICs are the most vulnerable to maternal mortality. Table 3.9 indicates that, MMR remains high among lower income countries. These rates are quite alarming. Sierra-Leone has the highest MMR of 2,417 per 100,000 live births with Senegal recording the lowest rate of 472 per 100,000 live births.

Table 3. 9 **Maternal Mortality Ratio in Lower Income Countries**

Countries	Average MMR
Benin	532
Burkina Faso	557
Burundi	1015
Central African Republic	1173
Chad	1302
Comoros	501
Congo Democratic Republic	853
Eritrea	889
Ethiopia	905
Gambia The	894
Guinea	912
Guinea-Bissau	756
Liberia	1318
Madagascar	575
Malawi	823
Mali	821
Mozambique	958
Niger	777
Rwanda	929
Senegal	472
Sierra-Leone	2417
Tanzania	811
Togo	490
Uganda	592
Zimbabwe	526

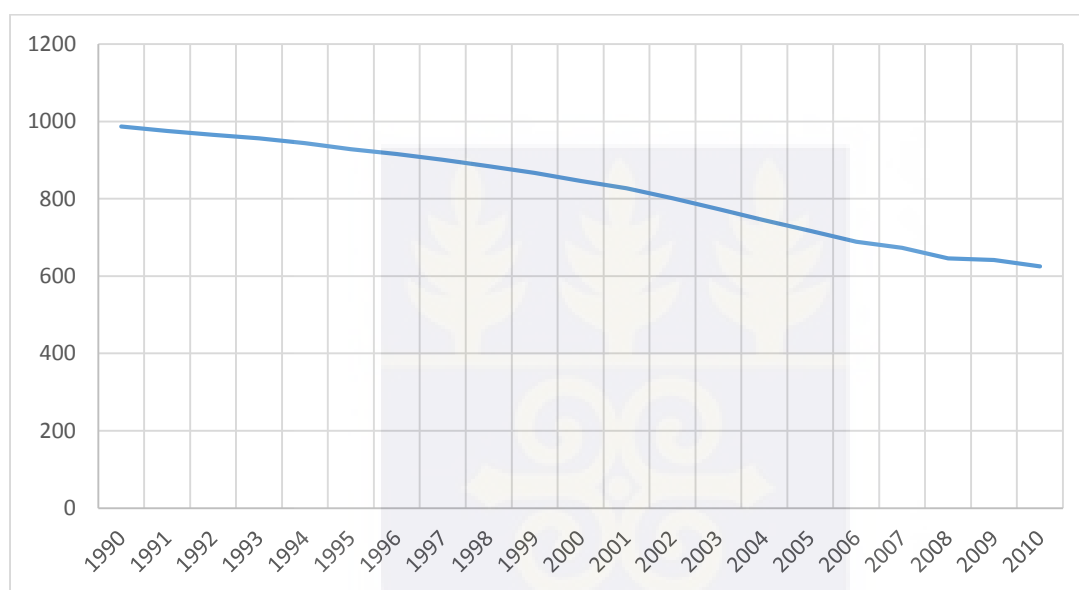
Source: Author's Computation from WDI

In a cross-country comparison of the rates across income status, lower Income countries recorded the highest rate of MMR followed by LMICs and UMICs. This observation gives an indication that income of an economy might affect MMR of that particular economy. The study would ascertain this relationship through a robust estimation technique.

The trend of MMR in SSA shows a constant decline in maternal mortality. Figure 4 represents a diagrammatical representation of the trend in MMR in SSA. The diagram indicates a steady decline in MMR in SSA over the period 1990 to 2010. This decline could be attributed to safe

motherhood interventions over the sub-region. Educational enrollment has been on the rise whilst MMR has been declining. The study would ascertain the impact of income on MMR over time. Since all of the countries in SSA have recorded some increase in educational enrollment along with a rise in income per capita, the study would ascertain if income or education played any role in the reduction of maternal mortality.

Figure 4 **Trend of MMR in Sub-Saharan Africa**



Source: Author's computation from WDI

3.4 Summary of the Chapter

PER in SSA from 1980 to 2010 has experienced some growth. Similarly, enrolment of females at the secondary school level has also experienced tremendous growth over the period in SSA. Returns to education on health could also be greater given the high rates of enrollments. The study would ascertain the quantitative impact of education on maternal health outcome like

maternal mortality. The income per capita has experienced some fluctuations but experienced growth over the period 1980 to 2010 in SSA. This implies that the standard of living of people across SSA has risen significantly. An increase in standards of living implies increased access to maternal health care. MMR has also been on the decline over the period and the study would ascertain if income per capita reduces maternal mortality.



CHAPTER FOUR

METHODOLOGY

4.0 Introduction

This chapter contains the theoretical underpinning for the work and the empirical structure of the model based on theory. This section would also take cognizance of some crucial diagnostic tests to be conducted to improve the credibility of the data alongside the results and findings of the study.

4.1 Theoretical Framework

The modernization theoretical perspective establishes a link between income and maternal mortality. The theory stipulates that modernization comprises a comprehensive transition from a primitive society to a modern one. The transition to modernity is characterized by urbanization, industrialization, improved ways of life, improved access to education and social well-being. The industrialization process of modernity is expected to improve the income of the nation and hence improve health service delivery. The theory stipulates that, the faces of economic development are characterized by improvement in the standards of living of the citizenry. Consequently, the citizens are able to afford good medical services like maternity care which translates to an improvement in the maternal health outcomes and hence a reduction in maternal mortality. Health service sector also benefits from technological advancement which is expected to improve health care delivery. Maternal health care delivery is expected to benefit from technological advancement. Subsequently, an improvement in maternal health care delivery is expected to improve maternal health outcomes and hence reduce maternal

mortality (Shen & Williamson, 1999). Furthermore, the demographic transition theory derived from the modernization theory articulates that, as a society becomes modern fertility rate declines. Consequently, a decline in fertility rate leads to a decline in maternal mortality.

As part of the modernization process, there is an improvement in education which enlightens the citizenry on healthy lifestyles. Education also improves the returns to health in a country. Educated women appreciate and practice good healthy lifestyles during pregnancy. These practices help reduce the risk of expectant mothers being exposed to maternal mortality.

4.2 Empirical Model

The estimable equation for this study is based on a modified version of the model by Shen & Williamson (1999). Under the fundamental mechanism of modernization, education and income have short and long-run effects on maternal mortality.

In general terms,

$$\text{MMR} = f(\text{GDP_C}, \text{PER}, \text{TFR}, \text{BSH}) \quad (1)$$

Where MMR= Maternal Mortality Ratio or a number of women who die during pregnancy and childbirth per 100,000 live births.

GDP_C =Gross Domestic Product per capita at purchasing power parity.

PER= Primary School Enrolment Rate

TFR= Total Fertility Rate

BSH = Births attended to by Skilled Medical Professionals

In a linear form, equation 1 can be expressed as follows:

$$\text{MMR}_{it} = \beta_0 + \beta_1 \text{GDP_C}_{it} + \beta_2 \text{PER}_{it} + \beta_3 \text{TFR}_{it} + \beta_4 \text{BSH}_{it} + \varepsilon_{it} \quad (2)$$

ε_{it} is the error term

Equation 2 would be used to estimate the random, fixed effect model or the generalized least squares for Sub-Saharan Africa.

The coefficient β_1 addresses the hypothesis that economic growth as a proxy for modernity leads to an increase in GDP per capita which eventually improves maternal health and reduces maternal mortality. Hence β_1 is expected to have a negative sign. The coefficient β_2 illustrates that higher level of literacy or educational enrollment associated with modernity improves maternal health outcomes, therefore β_2 is expected to be negative. Furthermore, maternal mortality is expected to be lower if there is an increased access to improved medical services as measured by the increase in the number of births supervised by skilled medical professionals, β_4 addresses this claim. Improved maternity services such as increased number of skilled birth attendance are inversely related to maternal mortality, hence, the coefficient β_4 is expected to be negative. However, a decline in fertility rate would concomitantly lead to a decline in maternal mortality, therefore β_3 is expected to be positive.

Equation 2 would be used to run either the fixed or random effect model or generalized least square for cross-country comparison of MMR and the independent variables within SSA with different income status. The equation would be used to ascertain if there exists any long-run relationship between income or education and maternal mortality in Sub-Saharan Africa.

4.3 Scope of the Study

The study uses data on forty-three Sub-Saharan African Countries ranging from the period 1980 to 2010; thus for a thirty-one year period. The study uses data from the World Development Index (WDI). Countries without data on a particular variable were dropped from the study.

4.4 Description of Variables

4.4.1 Dependent Variable

4.4.2 Maternal Mortality

Maternal mortality is the dependent variable of the study. Maternal mortality is defined as a death that occurs to a woman as a direct consequence of obstetric problems or indirectly as a consequence of pregnancy-stimulated exacerbation of pre-existing medical conditions, but not as an outcome of incidental or accidental causes (Kassebaum et al., 2016). It is measured in the study using Maternal Mortality Ratio (MMR). MMR can be defined as the annual number of deaths of women from pregnancy-related causes per 100,000 live births. A country with poor maternal health outcomes presupposes that, there is a higher level of inequality, poor social development and health outcomes in that country. In addition, MMR is also used to measure the quality of health care services rendered in a particular country (Hibbard & Milner, 1994). Hence countries with higher MMR could be tagged as countries with lower quality of medical services.

4.5 Independent Variables

The main independent variables of focus are income which will be measured by using GDP per capita at purchasing power parity. Education would be measured using PER.

4.5.1 GDP Per Capita

Gerdtham & Johannesson (1999) affirmed that, richer countries thus countries with higher GDP turn to spend more on health care on average than poorer countries. The modernization theory stipulates that modernity can be conceptualized as economic growth. Standards of the living are expected to improve alongside an improvement in medical care services and in effect, improving maternal health outcomes. Modernization also exposes the economy to technological trends and innovations that improve the delivery of services and productivity. In effect, the health care sector of the economy gets its fair share of technological improvement in terms of sophisticated equipment and technology for effective and efficient delivery of health care services. An increase in income of the economy increases the number of resources made available to all sectors including the health sector. Furthermore, as income levels increase households are able to afford better health care services and this also improves maternal health outcomes. Hence Income per capita is expected to have a negative impact on maternal mortality.

4.5.2 Education

Education also forms part of the transition process of the modernization theory. Educational attainment is measured in the study using Secondary School Enrollment (SER) or Primary

School Enrolment (PER). SER and PER are expected to reduce maternal mortality because educated women are able to practice and appreciate healthy lifestyles during pregnancy than uneducated ones, hence secondary or primary school enrolment affects maternal mortality inversely. Bhalotra & Clarke (2014); Majgaard & Mingat (2012) observed that primary education and secondary education each increasing the possibility of receiving professional assistance at delivery. In addition, women who completed primary or secondary schooling are more probable than women with no education to take advantage of certain health care services. This is so because literacy will enable the mothers to know how to apply good medical services. As the process of modernity intensifies, investment in education also improves since this sector is further equipped with the needed expertise and resources to be more efficient. Accessibility to education also improves with modernity.

4.5.3 Control Variables

Control variables used in the study include total fertility rate and the number of births supervised by skilled medical professionals. These variables were selected because they influenced maternal mortality. A decrease in the number of births supervised by medical personnel and an increase in total fertility rate increases the risk of a woman been exposed to maternal death (Bhalotra & Clarke, 2014; Buor & Bream, 2004; Kassebaum et al., 2016; Mccarthy & Maine, 1992).

4.5.4 Fertility Rate

According to the demographic transition theory of the modernity theory, maternal mortality is closely linked to fertility rate, as a result, a decline in total fertility rate results in a concomitant decline in maternal mortality. Hence total fertility rate would be expected to have a positive impact on maternal mortality (Gonzalez & Ren, 2017; McCarthy & Maine, 1992).

4.5.5 Births Supervised by Skilled Medical Professionals

Empirical studies have shown that the number of births supervised by skilled medical attendants tends to reduce maternal mortality (Bhalotra & Clarke, 2014; Buor & Bream, 2004; O. M. R. Campbell & Graham, 2006; Kinney et al., 2010). Access to skilled birth attendants, helps reduce the risk of birth complications, women would have to go through in times of childbirth.

4.6 Diagnostic Tests

Various tests will be conducted to improve the credibility of the results of the analysis. This is also to ensure that the results are not biased. These tests include time effect, stationary tests, test for cointegration and Hausman test.

4.6.1 Test for Time Effect

The data used may have undergone some changes over the period of estimation. If so then pooling the entire data for the analysis would be inappropriate. Hence the need to control for time in the analysis. However, if time is insignificant then the pooled regression results is just appropriate without time for the study.

4.6.2 Serial Correlation and Heteroskedasticity

Since the data used is a combination of time series and cross-sectional data, the data must be cleansed of all such problems that come with these individual data types. Serial or autocorrelation is prevalent with time series data and has to be tackled. Serial correlation occurs when successive values of the random term are not independent. This further implies that a variable at a point in time affects its future value. In addition, heteroscedasticity is also very prevalent in cross-sectional data and has to be addressed to improve the credibility of the results produced. Heteroscedasticity occurs when the error terms differ across observations and is not constant. The study will employ the Fully Modified Ordinary Least Square (FMOLS). Since this technique is able to address the problem of heteroscedasticity, serial correlation and simultaneity bias in a model. The Generalized Least Squares would cater for any form of serial or heteroskedasticity if detected in either the Random or Fixed effect model.

4.6.3 Hausman Test

This test is done to ascertain whether the fixed or random effect model is appropriate. The random effect model would be used if there exists individual heterogeneity among countries

used in the study, that could affect the dependent variable. The Fixed effect model would be adopted if there exists some form of correlation between the individual heterogeneity term and the regressors in the equation.

4.6.4 Endogeneity

Endogeneity occurs when there exists some form of correlation between the regressors in an equation and the error term. The use of the Fully Modified Ordinary Least Square will correct any form of endogeneity.

4.7 Stationarity Test

Since panel data is an amalgamation of Time Series and Cross-Sectional data, the stability of the data used is of great concern. In addition, data used if unsteady could result in spurious regression thus the t-ratio on the slope coefficient would be predictably not significantly different from zero and the value of the R^2 would be expected to be small. Brooks (2014) defined a stationary series as one with a constant mean, constant variance and constant autocovariances for each given lag. In order to induce stationarity, the differencing technique can be employed. If non-stationary series becomes stationary after first difference then the series is said to be integrated of order one, ie $I(1)$, however, if stationarity is induced after the second difference then the series is integrated of order two, thus, $I(2)$ and so on. Furthermore, it can be said that, a series that is $I(1)$ contains a unit root and $I(2)$ contains two unit roots. The study employs Levin, Lin and Chu tests and Im, Pesaran and Shin test to check for stationarity.

4.7.1 Levin, Lin and Chu Test (LLC)

LLC proposed a unit root test for panel data assuming the null hypothesis is that the series comprises a unit root as against the alternative that the series is stationary. Therefore the null hypothesis can be specified as

$$H_0: \delta = 0 \text{ for all } i$$

As against the alternative that

$$H_1: \delta < 0$$

They proposed three model to be used namely, one with no individual effects, another model in which the series has individual-specific effects but no time trend and finally the model in which the series has no individual-specific effect and linear and individual-specific time trend.

4.7.2 Im, Pesaran and Shin (IPS) Test

Im et al., (2003) suggests unit root test for heterogeneous panels using the mean of individual unit root statistics. This test is conducted by averaging the various individual unit root tests statistics. Furthermore, the IPS test suggests an average of the Augmented Dickey Fuller (ADF) when the error term is correlated with diverse serial correlation properties across cross-sectional units (Baltagi, 2005). The null hypothesis is that each series in the panel contains a unit root, thus

$$H_0: \rho = 0 \text{ for all } i$$

Whilst the alternative will allow for (but not all) of the individual series to have unit root, thus

$$H_1: \rho_i < 0 \text{ for } i = 1, 2, \dots, N_1$$

And

$$H_1 \quad \rho_i = 0 \text{ for } i = N_1 + 1, \dots, N$$

4.8 Tests for Cointegration

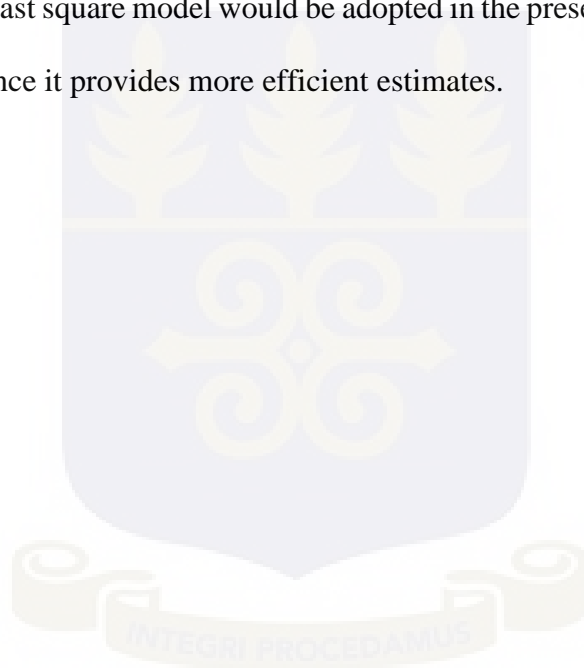
The linear combination of series with unit root $I(1)$ could lead to a series which is stationary ($I(0)$). The test for cointegration includes Residual-Based Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) Tests (Kao Test) and the Pedroni Tests. Kao (1999) proposed DF and ADF-type unit root test for the error term in the model, as a test for the null of no cointegration. The DF type can be computed from the fixed effect residuals (Baltagi, 2005).

$$H_0: \rho = 1 \text{ as against } H_a: \rho < 1$$

In addition, Pedroni (2000, 2004) suggested some test for the null hypothesis of cointegration in a panel data model that allows for considerable heterogeneity. His test is in two categories which involve averaging test statistics for cointegration in the time series across cross-sections (Baltagi, 2005). For the other test, the averaging is done in pieces so that the limiting distributions are based on the limit of the piecewise numerator and denominator terms (Baltagi, 2005). If there exist cointegration between the variables under study, then there is a long run relationship between the variables.

4.9 Estimation Technique

If there exists some form of a long-run equilibrium, the Fully Modified Ordinary Least Square (FMOLS) technique would be employed to analyze the long-run effects. Im et al., (2003) affirmed that fully modified ordinary least square is an optimal single equation method based on the use of Ordinary Least Square (OLS) with semi-parametric corrections for serial correlation and endogeneity. In the absence of serial correlation and heteroskedasticity, the study would use either random or fixed effect model to compare the impact of education or income on maternal mortality across Sub-Saharan Africa with different income status. However, generalized least square model would be adopted in the presence of serial correlation or heteroscedasticity, since it provides more efficient estimates.



CHAPTER FIVE

DATA ANALYSIS AND DISCUSSION

5.0 Introduction

This chapter looks at the overall behaviour of the data employed in the study. This section of the work also considers the end results of various diagnostic tests alongside the empirical results of the various models estimated in the study.

5.1 Descriptive Statistics

Table 5.1 Summary of Statistics

Variable	Obs	Mean	Standard Deviation	Minimum	Maximum
MMR	903	720.3865	426.4643	35	2900
GDP_C	891	3396.672	5194.161	246.6705	50640.18
SER	733	25.59562	22.02793	1.67272	96.67698
PER	1086	77.72356	33.85418	12.997	156.2119
BSH	233	46.21234	25.70638	5	99.2
TFR	1323	24.09134	145.2903	1.57	1398.825

Source: Author's Computation from WDI

Table 5.1 gives an overview of the data employed in the study. First of all, the study used a total of 903 observations of maternal mortality ratios in forty-three Sub-Saharan African countries. MMR based on the modeled estimate on average for SSA countries used in the study was 720.39 deaths per 100,000 live births. High MMR reechoes the fact that SSA is still battling poor maternal health issues. The standard deviation for MMR is 426.46 which shows the rate of dispersion around the mean value. The standard deviation for MMR indicates that

the distribution is widely spread out about the mean. The data on MMR for the countries studied recorded a minimum value of 35 and a maximum of 2900 resulting in a range of 2865 deaths per 100,000 live births. The disparity between the well to do countries are too wide hence the need for rapid actions and transformation in the health sector.

Secondly, GDP_C had 891 observations with an expected value of \$3,396.67 purchasing power parity. This average indicates that most SSA countries have a decent standard of living. The standard deviation of \$5,194.16 indicates a wider dispersion around the mean. The minimum value of GDP_C is \$246.67 and a maximum of \$5,0640.18 with a range of \$5,0393.51 representing a vast disparity between the countries.

Furthermore, the study also analyzed the enrollment rate for females at secondary school and the total number of observations gathered was 733 with an average rate of 25.60. This average stipulates that a number of female enrolled in schools in SSA is still very low. Standard deviation recorded 22.03 which is quite close to the mean. The minimum for Secondary School Enrollment Rate (SER) was 1.67 and a maximum of 96.68 which emphasize the disparity in the rate of enrollment of females in SSA.

Closely related to SER is Primary School Enrollment Rate (PER) for females in SSA. This variable recorded an average of 77.72 out of a total observation of 1,086. It can be inferred that, the rate of female enrolment in primary schools is quite high and this indicates that basic education was at the heart of most of the SSA countries studied. The standard deviation of 33.85 indicates a closer dispersion around the mean. Furthermore, the minimum rate was 12.10 and the maximum observation was 156.21 with a range of 143.21 indicating a wide disparity of enrollment gap in SSA.

Another very crucial variable used in the study is the number of births supervised by skilled professionals (BSH). BSH has an average value of 46.21 out of 233 observations. This average stipulated that the number of births supervised by skilled medical professionals was quite low and this implies that most women give birth without the presence of medical professionals. Absence of medical personnel could spell doom for expectant mothers in times of complications during childbirth. The standard deviation recorded a value of 25.71 which indicated a wide spread from the mean. The minimum number of BSH was 5 and a maximum of 99.2 with a range of 94.2 which gives a wider disparity gap between countries with the least number and highest number.

Finally, there is the total fertility rate (TFR) which had a total of 1,323 observations with an average of 24.09 indicating a much higher rate of fertility in Sub-Saharan Africa (SSA). Based on the demographic transition theory of the modernization theory, maternal mortality goes hand in hand with fertility rate. Hence a higher rate of fertility implies a high MMR and vice versa. The high rate of fertility explains part of the reasons why maternal mortality is quite high in SSA. TFR recorded a standard deviation of 145.29 indicating a closer range of dispersion. The minimum recorded for the study in SSA was 1.57 and a maximum value of 1398.83 with a range of 1,397.26 indicating that most countries in SSA have very astronomical fertility rates.

5.2 Diagnostics Tests

5.2.1 Time Effect

Time was not significant in the models used. Hence the regressions would be done without any consideration for time effect. The test for time effect in the model used in SSA could be found in Appendix IX. Furthermore, the test for time in the models used in LICs, UMICs and LMICs could be found in Appendix XVII, XVIII and XIX respectively.

5.2.2 Hausman Test

This test was conducted to choose between the Random Effect Model (REM) or the Fixed Effect models (FEM). The Hausman test favoured the Fixed Effect Model over the Random Effect Model for SSA. The test can be found in Appendix X. For cross-country comparison within SSA, the test favored the FEM for Lower Income Countries (LICs) and the REM for Lower Middle-Income Countries (LMICs) and Upper-Middle-Income Countries (UMICs).

5.2.3 Test for Stationarity

MMR was stationary at levels as measured by the LLC test. However, the GDP_C was stationary at first difference hence can be said to be integrated of order one. Moreover, SER is also stationary at first difference and integrated of order one. Additionally, PER is stationary at first difference and integrated of order one. BSH is integrated of order two. TFR is stationary at levels hence this variable is integrated of order zero. The results are shown in Appendix IV, V, VI, VII and VIII respectively. A linear combination of these variables could result in a

stationary model at levels, hence indicating the potential of a long-run relationship between the variables. This potential would be ascertained with some recommended tests.

5.2.4 Summary of Results

The significance of Time was tested in all the models estimated in the study. Time was not significant in the estimated equations, hence Time was not included all the estimated equations of the study. In addition, to choose the right model for the study, the study conducted the Hausman test. The Fixed Effect Model was chosen for an examination of all selected countries in SSA. Moreover, the Hausman test chose the FEM for estimation in LICs and the REM for LMICs and UMICs. TFR and MMR were stationary at levels but GDP_C and PER were stationary at first difference. Interestingly BSH was integrated of order two.

5.2.5 Test for Cointegration

Based on the results of the Kao and Pedroni tests. Both tests indicate that there is the presence of cointegration. However, the Pedroni test has some p-values indicating the presence of cointegration whilst others said otherwise. The results of the test for cointegration are shown in Appendix I and II respectively. The presence of cointegration emphasizes the fact that there is a potential long-run relationship between the variables been studied. Furthermore, the existence of a long-run relationship actually confirms the suspicion that, the linear combination of the variables of different orders of integration yields a potential permanent relationship. The study proceeds to estimate the Fully Modified Ordinary Least Square Model (FMOLS) to

analyze the long run relationship between the variables. The FMOLS can be found in Appendix III.

5.3 Empirical Findings

The Hausman test in appendix X selected the Fixed Effect Model (FEM) over the Random Effect Model (REM), however, Table 5.2 contains estimates of the Generalized Least Squares (GLS), due to problems of serial correlation and heteroskedasticity with the FEM. Test for serial correlation and heteroskedasticity are found in appendix XI and XII respectively.

Table 5. 2 **Generalized Least Square for Sub-Saharan Africa**

Variables	Coefficient	Standard Error
GDP_c	-0.03***	0.007
PER	-2.53***	0.5730
BSH	-4.81***	1.0310
TFR	1.35***	0.0891

*means $p < .01$, ** means $p < .05$ ***means $p < .10$ Source: Author's Computation

The results of the Generalized Least Square (GLS) in Table 5.2 for all SSA countries indicate that there is a statistically significant negative relationship between maternal mortality and GDP per capita at 1%. The relationship between GDP_C and MMR is also significant at 5%. Furthermore, this relationship is significant at 10%. Thus a unit increase in GDP_C leads to 0.03 reduction in maternal mortality ratio. This finding is consistent with the modernization theory. Similarly, Hu et al., (2007); Shen & Williamson (1999) also found an inverse relationship between economic variables like income and maternal mortality. Also, Ahmed et al., (2010) observed some form of association between economic growth and maternal

mortality. The modernization theory stipulated that as an economy develops, it turns to witness an increase in income and eventually an improvement in the standards of living of the citizenry. Citizens with improved standards of living are able to afford improved maternal health care services and this goes a long way to reduce maternal mortality. Economic growth turns to expose the country to advanced medical technology which introduces innovative birth controls that reduces fertility rate and subsequently reducing the risk of maternal deaths during pregnancy or delivery.

The primary school enrollment rate of females had a statistically significant inverse relationship with maternal mortality at 1%. This relationship is also significant at 5%. Furthermore, the relationship is also significant at 10%. A unit increase in PER leads to 2.53units reduction in maternal mortality ratio. Bhalotra & Clarke (2014); Caldwell & Caldwellt (1979); Karlsen et al., (2011) have also established an inverse relationship between education and maternal mortality. In these works, lower primary enrollment rate had a greater impact on maternal mortality than relatively higher levels of education. Females with higher level of education are able to appreciate and utilise improved maternal health services and this goes a long way to improve their maternal health outcomes (McTavish et al., 2010),

The number of births supervised by health professionals was found to be inversely related to maternal mortality and statistically significant at 1%. This relationship between BSH and MMR is also significant at 5%. In addition, the relationship is significant at 10%. Similarly, several studies have found it to be statistically significant and inversely related to maternal mortality (Bhalotra & Clarke, 2014; Buor & Bream, 2004; O. M. R. Campbell & Graham, 2006; Kinney et al., 2010). The inverse relationship established between birth supervised by skilled professional and maternal mortality conforms to theory. Hence a unit increase in births

supervised health professionals reduced MMR by 4.81 units. Improved maternal health service like increased number of births supervised by medical professionals often reduces deaths during births since complications are easily identified and readily attended to before they escalate.

The total fertility rate was inversely related to maternal mortality. This relationship was statistically significant at 1% and consistent with the modernization theory. The relationship between TFR and MMR was significant at 5%. Furthermore, the relationship was significant at 10%. The theory stipulated that, as fertility rate increased, it increases the risk of dying during pregnancy or birth and eventually increases the risk of maternal deaths. On the other hand, a decrease in fertility rate would also decrease the risk of maternal deaths. As societies modernize women are exposed to better opportunities and jobs, these women can afford better health care services. Hence these women are able to have some control of the birth and pregnancy processes and hence total fertility rate. McCarthy & Maine (1992) found that higher fertility rate increased the risk of dying during pregnancy. Subsequently, as fertility rate decreases, the risk of dying during pregnancy or birth decreases and hence maternal mortality also decreases. The total fertility rate is statistically significant in the short term because the change from higher fertility rates to lower fertility rate is directly proportional to maternal mortality according to the modernization theory. Gonzalez & Ren (2017) had a similar finding.

The existence of a long run relationship between the variables was estimated using the Fully Modified Ordinary Least square model (FMOLS).

Table 5.3 **Fully Modified Ordinary Least Square for Sub-Saharan Africa**

Variable	Coefficient	Standard Error
GDP_C	-1.72***	12.92291
PER	-1.16***	86.77376
BSH	-3.33***	24.93137
TFR	3.14***	23.5216

*means $p < .01$, ** means $p < .05$ ***means $p < .10$ Source: Author's Computation

The FMOLS in Table 5.3 indicated that most of the variables have a negative relationship with maternal mortality. First of all, there exists a long run relationship between maternal mortality and GDP per capita. This relationship is an inverse one and is statistically significant at 1%. The relationship between GDP_C and MMR is significant at 5%. In addition, the long run relationship between GDP_C and MMR is also significant at 10%. For instance, if the GDP per capita of a country increases by a unit, the MMR reduces by 1.72 units. This relationship conforms to the modernization theory. An increase in income per capita is expected to yield some results over a certain period since it takes time for the increase in income to transform and improve the other sectors of the economy especially the health sector and eventually health outcomes of the citizenry. As income increases, it also takes time to improve the standards of living of the people, which includes better health care services and eventually better maternal health outcomes. As the standards of living improves, women are able to access better medical care and this translates into an improvement in maternal health outcomes and subsequently a reduction in maternal mortality ratio in the long run.

Education had also established a long run relationship with MMR. Here the study observed that there existed a negative and statistically significant relationship between primary school enrollment of females and maternal mortality ratio at 1%. The relationship between PER and MMR is significant at 5%. In addition, the relationship between the variables were significant at 10%. The modernization theory predicted this relation, as a result of an increase in investment in education which yields high literacy rate among women who can better appreciate good medical practices. Observing these medical practices during pregnancy often reduced the risk of mothers dying during childbirth (McTavish et al., 2010). The returns to education on maternal mortality is expected to occur over a certain period of time. From the estimation, if primary enrollment rate increases by a unit then maternal mortality ratio is expected to reduce by 1.16 units over time.

In addition, the number of births supervised by skilled professionals had a statistically significant inverse relationship with maternal mortality at 1%. The long run relationship between BSH and MMR is also significant at 5%. Furthermore, the relationship between the variables are significant at 10%. As predicted by the modernization theory, an expansion and transformation in the health sector lead to an increase in recruitment along the process of economic transformation. Services rendered in the health sector improves and as a result births become more supervised by skilled health professionals. Skilled birth attendants are expected to help identify and treat complications encountered at birth which may increase the chances of maternal deaths over time. It was estimated that as the number of birth attended to by skilled professional increases, it also reduces maternal deaths. These findings are also true in the short run as stipulated in works of Bhalotra & Clarke (2014); Buor & Bream (2004); O. M. R. Campbell & Graham (2006); Kinney et al., (2010). Hence in the long run, if the births attended by skilled professionals increase, the MMR is expected to decline by 3.33 units.

Furthermore, total fertility rate also had a permanent association with maternal mortality ratio at 1%. The relationship was also significant at 5%. Furthermore, the relationship between TFR and MMR was also significant at 10%. According to the demographic transition theory of modernization theory, Shen & Williamson (1999) affirmed that fertility moves along with maternal mortality. This is because as fertility rate increase, the risk of maternal deaths also increases. Moreover, in times of economic development, the pressure is created to reduce fertility, consequently declines in child mortality decreases the number of births required to achieve a given number of surviving children (Kelly & Cutright, 1980). Also, in times of rapid economic growth, family target and personal targets are difficult to achieve with a larger family size, hence the motivation for smaller family sizes and therefore leading to lower fertility rates and subsequently lower risk of maternal deaths. The study found that a unit increase in the fertility rate led to an increase in MMR by 3.14 units over time. These findings also explain why countries with higher fertility rate tend to have higher maternal mortality rates.

In a comparison of the impact of income per capita on maternal mortality across SSA with different income status, the findings were as follows. First of all, in Lower Income Countries (LICs) in SSA, the Hausman test in appendix XIII recommends the use of the Fixed Effect model. However, the presence of heteroskedasticity makes the GLS more efficient. Hence the GLS estimates would be interpreted. The test for heteroskedasticity can be found in appendix XIV.

Table 5. 4 **Generalised Least Square for Lower Income Countries**

Variables	Coefficient	Standard Error
GDP_C	-0.22***	0.0508
PER	-2.18***	0.6508
BSH	-2.52***	1.1976
TFR	1.42***	0.0880

*means $p < .01$, ** means $p < .05$ ***means $p < .10$ Source: Author's Computation

Income per capita as measured by GDP per capita had an inverse relationship with MMR. This relationship was significant at 1%. Income per capita was statistically significant at 5% in reducing maternal mortality. Furthermore, income was statistically significant in reducing maternal mortality at 10%. Therefore a unit increase in GDP per capita leads to a decline in MMR by 0.22units. This finding is consistent with the modernization theory and the findings of Alvarez et al., (2009). An increase in income increases the standards of living of citizens which in turn improves access to maternal health care. Consequently there is a reduction in the rate of maternal deaths.

Furthermore, primary school enrollment of females had an inverse relationship with MMR. This relationship was significant at 1%. Primary education reduces maternal mortality significantly at 5% significance level. Additionally, table 5.4 indicates that primary enrollment is statistically significant in reducing maternal mortality at 10%. Hence a unit increase in the rate of primary school enrollment rate decreases MMR by 2.18units. These finding imply that as primary enrollment rate increases, maternal mortality would eventually decline. These findings further imply that, educated women are likely to live a healthy lifestyle during pregnancy and even after birth, hence reducing their chances of maternal death. Bhalotra & Clarke (2014) found similar results where educational enrollment decreases MMR.

Moreover, the number of births supervised by skilled birth attendants had an inverse relationship with MMR, this relationship was significant at 1% significance level. The number of supervised births was significant at 5%. Furthermore, it was significant at 10% significance level. This finding was similar to that of Bhalotra & Clarke (2014); Buor & Bream (2004); O. M. R. Campbell & Graham (2006); Kinney et al., (2010). As the number of births attended to by medical professionals' increases, complications encountered during childbirths are easily spotted and attended to, hence reducing the risk of maternal deaths.

Moreover, the total fertility rate was also positively related with MMR. This relationship was also statistically significant at 1%. This relationship was also significant at 5%. In addition, fertility rate significantly increases the rate of maternal deaths at 10% significance level. Total fertility was significant because it increased the risk of exposing a mother to complications during childbirth and this increase the chance of losing a mother to maternal death.

For Lower Middle-Income Countries (LMICs), the Hausman test in appendix XV recommends the Random Effect Model. The random effect model in Table 5.5, indicates that income per capita is inversely related to MMR. This relationship is statistically significant at 5%. Income per capita has a statistically significant negative relationship on maternal mortality at 10%. Thus in a lower middle-income country, a unit increase in GDP_C decreases MMR by 0.07units. These findings are consistent with theory. Similarly, Alvarez et al., (2009) also found a statistically inverse relationship between income per capita and maternal mortality. As income per capita increases, citizens are able to afford improved maternal health care services and this goes a long way to improve maternal health outcomes.

Table 5. 5 **Random Effect for Lower Middle-Income Countries**

Variables	Coefficient	Standard Error
GDP_C	-0.07**	0.0293
PER	-6.42**	1.2689
BSH	-2.35	2.1869
TFR	-47.70	39.88

*means $p < .01$, ** means $p < .05$ ***means $p < .10$ Source: Author's Computation

Furthermore, PER had an inverse relationship with MMR. This relationship was statistically significant at 5%. Primary enrollment also turns to be significant at 10%. Hence an increase in primary school enrollment of females reduces MMR by 6.43 units. This finding is also consistent with theory. Bhalotra & Clarke (2014) also established a negative relationship between primary school enrolment and maternal mortality. Women who are better educated are able to efficiently utilise maternal health care services which goes a long way to improve maternal health outcomes. Educated women are able to observe healthy lifestyles during pregnancy which also goes a long way to improve maternal health outcomes. In addition, TFR and BSH had an inverse relationship with MMR. These relationships were not statistically significant. These relationships were not statistically significant in the short term because of the time it takes to have any significant impact on maternal mortality. On the contrary, several studies have also found a statistically significant inverse relationship between BSH and MMR, These studies include Bhalotra & Clarke (2014); Buor & Bream (2004); O. M. R. Campbell & Graham (2006); Kinney et al., (2010).

In Upper-Middle-Income Countries (UMICs) in SSA, the Hausman test in appendix XVI recommends the use of Random Effect Model.

Table 5. 6 **Random Effect Model for Upper Middle Income Countries**

Variable	Coefficient	Standard Error
GDP_C	-0.01	0.0119
PER	-10.44***	3.3876
BSH	-13.09***	2.1578
TFR	45.07	27.7433

*means $p < .01$, ** means $p < .05$ ***means $p < .10$ Source: Author's Computation

There is an inverse relationship between income per capita and MMR. However, this relationship is not statistically significant. Income per capita is not significant in the short term because it takes time to have any significant impact on reducing maternal mortality in UMICs. This finding also implies that, at a certain income status, income per capita no longer plays any role in reducing maternal mortality. This could also be because the increase in income is being channelled to alternative sectors apart from the health sector.

There exists an inverse relationship between PER and MMR, this relationship is statistically significant at 1%. In addition, female primary enrollment is significant at 5%. Furthermore, this relationship was significant at 10%. Bhalotra & Clarke (2014) found that an improvement in primary enrollment rate reduced maternal mortality significantly. Education empowered women to make informed decisions about their spacing of their children and birth control. Educated women tend to appreciate antenatal care during pregnancy, and this goes a long way to improve maternal health outcomes consequently reducing maternal mortality.

More so, BSH is inversely related to MMR and statistically significant at 1%. This relationship was significant at 5%. Furthermore, BSH is significant at 10% in reducing MMR. Bhalotra & Clarke (2014); Buor & Bream (2004); O. M. R. Campbell & Graham (2006); Kinney et al., (2010) also affirmed that skilled birth attendance reduced maternal mortality. Supervised birth

attendants are able to identify and treat possible complications during births so that they don't escalate. Consequently the risk of a mother dying at birth reduces.

TFR is positively related to MMR but not statistically significant. This implies that other factors other than income per capita and total fertility rate determines MMR in UMICs. UMICs have lower fertility rates since these economies have mothers who are more empowered to regulate the birth process with help of advanced medicine. UMICs have more literate populations that are well informed of the health benefits of spacing their children. These women tend to prefer smaller family sizes in order to meet the challenging needs of their careers. Hence leading to lower fertility rates which translates into lower risk of being exposed to maternal death during birth. TFR are so low to the extent that they would have no significant impact on maternal mortality.

Income per capita was influential in determining MMR in the SSA. As income per capita increases across the continent of SSA, it trickles down into higher standards of living. Consequently, the citizenry are able to afford improved services which includes medical care. Access to improved maternal health care improves maternal health outcomes. Income per capita had the greatest impact on MMR in lower-income countries (LICs) in SSA, followed by lower-middle-income countries (LMICs) whilst income was not relevant in determining MMR in UMICs. The results further imply that the returns to income are greatest in LICs and LMICs. The results further indicate that as the income of a nation increases, its impact on MMR starts to diminish. Hence diminishing returns to income explains why LICs and LMICS benefit from an increase in income whilst UMICs don't benefit at all. The results further imply that an increase in income does not guarantee a decrease in maternal mortality.

Furthermore, PER of females was more influential in reducing MMR in all SSA irrespective of their income status. This emphasizes the fact that education enlightens women to make informed decisions about their health. Educated women are also to practise good medical practises during pregnancy and this goes a long way to reduce the risk of maternal deaths and subsequently MMR. The study also found that benefits of education to MMR is greater in UMICs, LMICs than LICs in SSA. The benefits to education was highest in UMICs because these countries had the requisite infrastructure for education to thrive in order to get all the benefits education brings to the health sector and for that matter improving maternal health outcomes.

In addition, BSH was influential in determining MMR across the various Sub-Saharan African Countries. The effect was mostly felt in UMICs than LICs. As the number of skilled birth attendance increases, the quality of maternal health care services improves, and this goes a long way to reduce maternal mortality. Furthermore complications during births are easily spotted and well diagnosed and properly treated to reduce the risk of maternal deaths. The fertility rate was also significant in directly increasing maternal mortality in SSA. However, fertility rate was only significant in determining maternal mortality in LICs. In LICs women barely have opportunities that improve their standards of living. These women are not able to have control over the number of children they give birth to since they are largely dependent on their husbands, hence have a higher fertility rate. Higher fertility rate increases the risk of maternal deaths in LICs. Fertility rate does not affect MMR in UMICs and LMICs because these countries have a more empowered female populace who have some control over their family sizes and are able to reduce their fertility rates and hence the risk of dying during birth. Women in these countries are also challenged with difficult personal targets that would be difficult to

achieve with a bigger family size. Consequently, fertility rate are quite low and insignificant with UMICs and LMICs.



CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter contains the summary, conclusions as well as the recommendations of the study based on the findings of the empirical results conducted. This chapter also contains the limitations of the study as well as recommendations for future research.

6.1 Summary of findings

The study attempted to examine the long run relationship between income per capita and maternal mortality ratio. In addition to that, the study examined the long run relationship between education and maternal mortality. Furthermore, the study attempted to compare the impact of education on maternal mortality in Sub-Saharan African countries with different income status. Finally, the study attempted to compare the impact of income per capita on maternal mortality in Sub-Saharan African countries with different income status.

Most studies have looked at the impact of maternal mortality on GDP, however, just a few have looked at the impact of GDP on maternal mortality. This study, on the contrary, has moved a step further to ascertain if GDP per capita impacts maternal mortality over time.

The study found that there exists a significantly negative long-run relationship between income per capita and maternal mortality in SSA. Additionally, if income per capita increases, maternal mortality is expected to decline in the short term. In addition to that, the study ascertained that education had a statistically significant inverse long-run impact on maternal mortality in SSA.

These findings underscore the crucial role education of females plays in reducing maternal mortality in SSA. The finding stipulates that educated women appreciate and practice safe maternity practices and hence reduce the risk of dying from maternal deaths.

Moreover, the number of births supervised by medical professionals had a statistically significant negative relationship with maternal mortality in SSA over time. As the number of births supervised by skilled birth attendants increases, maternal mortality would eventually decline in the long run. Finally, the total fertility rate had a statistically significant positive long-run effect on maternal mortality. As total fertility rate decreases, the modernization theory predicts that, it would reduce maternal mortality over time and this perspective is consistent with findings of the study.

For the entire SSA. The study found a statistically significant inverse relationship between income per capita, primary school enrolment rates, skilled birth attendance and maternal mortality. However, the total fertility rate was positively related to maternal mortality in SSA.

In the short term, a comparison of the various impacts of income per capita on maternal mortality in SSA with different income status indicates that, income per capita was inversely related to maternal mortality in SSA except for UMICs. Income per capita was more influential in LICs than LMICs in determining MMR. Furthermore, comparing the impact of education on maternal mortality in SSA with different income status, the study also found that, PER of females was inversely related to maternal mortality ratio. Moreover, the effect is much stronger in LMICs than LICs and UMICs.

The number of births supervised by medical professionals had a significant impact on maternal mortality in SSA in the short term. These findings affirm the perception of the modernization

theory that, total fertility rate and births attended to by skilled professionals take time to have any significant impact on maternal mortality.

6.2 Limitations of the Study

The study was unable to capture all SSA countries for lack of data on certain variables used in the study. The study was unable to use data that preceded the era 1980 due to data porosity and unavailability. Availability of data back in the 1970s would have enriched the outcome of the estimation since that would mean more data points available.

6.3 Conclusions

Income is a crucial factor in reducing maternal mortality in SSA over time. Furthermore, income per capita reduces maternal mortality in LICs and LMICs in the short term. These findings imply that the returns to income are greatest in LICs than LMICs. Education also plays an important role in the reduction of maternal mortality over time. Education contributes more to certain economies in SSA in reducing maternal mortality. The study found that, an improvement in primary enrollment rates of females reduces maternal mortality more in UMICs than LMICs and LICs. The current study has established that, there exists a long run relationship between income per capita and maternal mortality. On the contrary, most of the studies examined only the short-term impact of income on maternal mortality. The current study has also established a long run relationship between educational enrollment of females

and maternal mortality, however, most studies had previously examined only the impact of education on maternal mortality in the short term.

The current study also establishes that, births supervised by skilled medical professionals had a long-run and short term impact on maternal mortality as against the findings of some works that examined the relationship only in the short term. In addition, the findings of the current study have shown that, total fertility rate takes time to affect maternal mortality. Moreover, the impact of total fertility rate on maternal mortality can be confirmed in the current study in the short term.

6.4 Policy Recommendations

The study recommends that, governments in SSA should invest more in improving efficiency and productivity in public and private sectors of the economy in order to increase their income levels. The increase in income is expected to have a transformational impact on health services over time and this would reduce maternal mortality since targets set for countries in Sustainable Development Goals (SDGs) would serve as checkmate. Furthermore, countries that want to look good in the global sense, would have to take a keen interest in investing in maternal health services as a key part of health care investment. Maternal health services like antenatal care, post-delivery care, increasing the number of skilled birth attendants amongst others would go a long way to improve maternal health outcomes.

Furthermore, governments in SSA should roll out educational reforms that would help improve the primary school enrollment rate of females since this form of intervention could reduce

maternal mortality in the long run. These educational reforms must inculcate interventions that enhance the accessibility of females to both primary and secondary schools. These reforms could be in the form of fee-free interventions for primary schools and provision of textbooks and other logistics to enhance teaching and learning at the primary and secondary school levels.

In addition, policies that enhance educational enrollment of females would also help delay birth and subsequently reduce the risk of maternal mortality. Moreover, an increase in budgetary allocation to the health service sector would lead to an improvement in health services such as increased number of birth supervised by skilled birth attendants, consequently, maternal mortality would be reduced over time. Finally, any measure by the government that can reduce fertility rate like birth controls could be adapted to help reduce the risk of maternal deaths. Birth control methods like family planning, contraceptive use give women some form of control over the birth process and helps reduce fertility rate. Reduction in fertility rate reduces the risk of maternal deaths.

6.5 Recommendations for Further Research

Future studies can use current data to ascertain if country-specific factors affect maternal mortality in SSA. In addition, more recent data could be used to examine if income beyond a certain threshold affected maternal mortality ratio more. This is to help ascertain if more data points would help provide any significant variations in the cohort of income and maternal mortality in SSA.

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APPENDICES

Appendix I Kao Test for Cointegration

Kao Residual Cointegration Test
 Series: MMR GDP_C PER BSH TFR
 Date: 07/22/17 Time: 20:21
 Sample: 1980 2010
 Included observations: 1333
 Null Hypothesis: No cointegration
 Trend assumption: No deterministic trend
 Automatic lag length selection based on AIC with a max lag of 0
 Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	1.983839	0.0236
Residual variance	187.0952	
HAC variance	382.8487	

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(RESID)
 Method: Least Squares
 Date: 07/22/17 Time: 20:21
 Sample (adjusted): 1991 2010
 Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.192882	0.099376	-1.940936	0.0611
R-squared	0.105018	Mean dependent var		0.528424
Adjusted R-squared	0.105018	S.D. dependent var		28.90774
S.E. of regression	27.34773	Akaike info criterion		9.484979
Sum squared resid	23932.75	Schwarz criterion		9.530327
Log likelihood	-155.5021	Hannan-Quinn criter.		9.500237
Durbin-Watson stat	0.286474			

Appendix II Pedroni Test for Cointegration

Pedroni Residual Cointegration Test
 Series: MMR GDP_C PER BSH TFR
 Date: 07/24/17 Time: 12:43
 Sample: 1980 2010
 Included observations: 1333
 Cross-sections included: 1 (42 dropped)
 Null Hypothesis: No cointegration
 Trend assumption: No deterministic trend
 User-specified lag length: 1
 Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-1.302474	0.9036	-1.302474	0.9036
Panel rho-Statistic	0.281250	0.6107	0.281250	0.6107
Panel PP-Statistic	0.728709	0.7669	0.728709	0.7669
Panel ADF-Statistic	-3.958898	0.0000	-3.958898	0.0000

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	0.716436	0.7631
Group PP-Statistic	1.197416	0.8844
Group ADF-Statistic	-4.553949	0.0000

Appendix III Fully Modified Ordinary Least Square

Dependent Variable: MMR
 Method: Panel Fully Modified Least Squares (FMOLS)
 Date: 07/22/17 Time: 21:22
 Sample (adjusted): 1991 1999
 Periods included: 5
 Cross-sections included: 1
 Total panel (unbalanced) observations: 33
 Panel method: Weighted estimation
 Cointegrating equation deterministics: C
 Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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GDP_C	-1.72E+10	12.92291	-1.33E+09	0.0000
PER	-1.16E+11	86.77376	-1.33E+09	0.0000
BSH	-3.33E+10	24.93137	-1.33E+09	0.0000
TFR	3.14E+10	23.52160	1.33E+09	0.0000

	-		
	1158757263		
	3713180000		
R-squared	0	Mean dependent var	815.8182
	-		
	1765725353		
	7086750000		
Adjusted R-squared	0	S.D. dependent var	567.9731
S.E. of regression	7.55E+12	Sum squared resid	1.20E+27
Long-run variance	7.82E-14		

Appendix IV Unit root test for Maternal Mortality Rate

Panel unit root test: Summary

Series: MMR

Date: 07/24/17 Time: 18:33

Sample: 1980 2010

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.46949	0.0000	43	817
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.90840	0.8182	43	817
ADF - Fisher Chi-square	114.593	0.0214	43	817
PP - Fisher Chi-square	112.808	0.0279	43	860

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix V Unit root test for GDP per capita

Panel unit root test: Summary

Series: D(GDP_C)

Date: 07/24/17 Time: 18:36

Sample: 1980 2010

Exogenous variables: Individual effects
 User-specified lags: 1
 Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.23522	0.0000	43	762
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.77694	0.0000	43	762
ADF - Fisher Chi-square	212.747	0.0000	43	762
PP - Fisher Chi-square	376.986	0.0000	43	805

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Appendix VI Unit root test for PER

Panel unit root test: Summary
 Series: D(PER)
 Date: 07/24/17 Time: 18:38
 Sample: 1980 2010
 Exogenous variables: Individual effects
 User-specified lags: 1
 Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.50627	0.0660	38	791
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.77305	0.0000	38	791
ADF - Fisher Chi-square	165.589	0.0000	38	791
PP - Fisher Chi-square	355.980	0.0000	38	863

Appendix VII Unit root test for BSH

Panel unit root test: Summary
 Series: D(BSH,2)
 Date: 07/24/17 Time: 18:48
 Sample: 1980 2010
 Exogenous variables: Individual effects
 User-specified lags: 1
 Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
--------	-----------	---------	----------------	-----

Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.50762	0.0658	2	53
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.42048	0.0003	2	53
ADF - Fisher Chi-square	19.3648	0.0007	2	53
PP - Fisher Chi-square	36.9384	0.0000	2	55

Appendix VIII Unit root test for TFR

Panel unit root test: Summary

Series: TFR

Date: 07/24/17 Time: 18:43

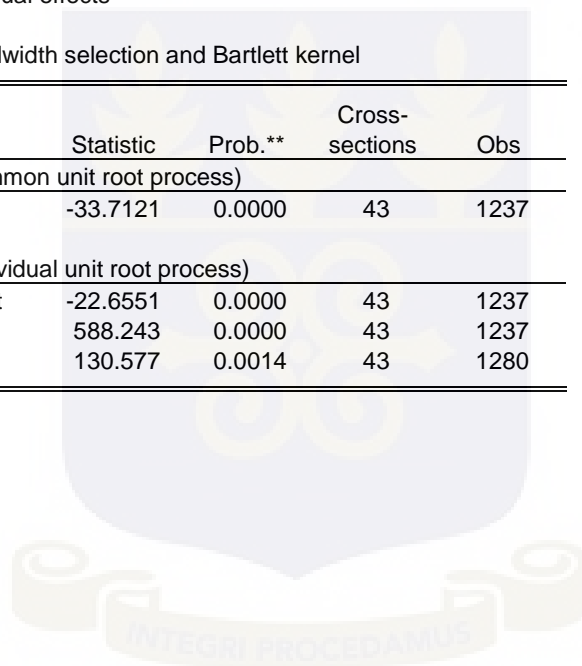
Sample: 1980 2010

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-33.7121	0.0000	43	1237
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-22.6551	0.0000	43	1237
ADF - Fisher Chi-square	588.243	0.0000	43	1237
PP - Fisher Chi-square	130.577	0.0014	43	1280



Appendix IX Test for Time Effect

(1) _Iyear_1990 = 0
(2) _Iyear_1992 = 0
(3) _Iyear_1993 = 0
(4) _Iyear_1994 = 0
(5) _Iyear_1995 = 0
(6) _Iyear_1996 = 0
(7) _Iyear_1997 = 0
(8) _Iyear_1998 = 0
(9) _Iyear_1999 = 0
(10) _Iyear_2000 = 0
(11) _Iyear_2001 = 0
(12) _Iyear_2002 = 0
(13) _Iyear_2003 = 0
(14) _Iyear_2004 = 0
(15) _Iyear_2005 = 0
(16) _Iyear_2006 = 0
(17) _Iyear_2007 = 0
(18) _Iyear_2008 = 0
(19) _Iyear_2009 = 0
(20) _Iyear_2010 = 0

F(20, 82) = 0.92
Prob > F = 0.5647



Appendix X Hausman Test For Sub-Saharan Africa

	Coefficients			
	(b) fe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
gdpc	-.0437114	-.0383031	-.0054083	.004011
per	-4.716384	-3.911117	-.8052669	.0307324
bsh	-.9359269	-2.309864	1.373938	.07113
tfr	-.0285619	.8388035	-.8673653	.1478329

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

```
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 22.13
Prob>chi2 = 0.0002
(V_b-V_B is not positive definite)
```

Appendix XI Test for Heteroskedasticity for Sub-Saharan Africa

Modified Wald test for groupwise heteroskedasticity
 in fixed effect regression model

H0: $\sigma(i)^2 = \sigma^2$ for all i

```
chi2 (21) = 128.45
Prob>chi2 = 0.0000
```

Appendix XII Test for Serial Correlation for Sub-Saharan Africa

Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation

```
F( 1, 3) = 35.692
Prob > F = 0.0094
```

Appendix XIII Hausman Test for Lower Income Countries

	— Coefficients —			
	(b) fe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
gdpc	-.2548449	-.2865636	.0317187	.0433889
per	-3.767408	-2.925447	-.8419606	.2762665
bsh	-.9299708	-1.795065	.8650939	.0897125
tfr	.243201	1.021958	-.7787569	.189079

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 19.11
 Prob>chi2 = 0.0007
 (V_b-V_B is not positive definite)

Appendix XIV Test for Heteroskedasticity for Lower Income Countries

Modified Wald test for groupwise heteroskedasticity
 in fixed effect regression model

H0: $\sigma(i)^2 = \sigma^2$ for all i

chi2 (25) = 1.5e+05
 Prob>chi2 = 0.0000

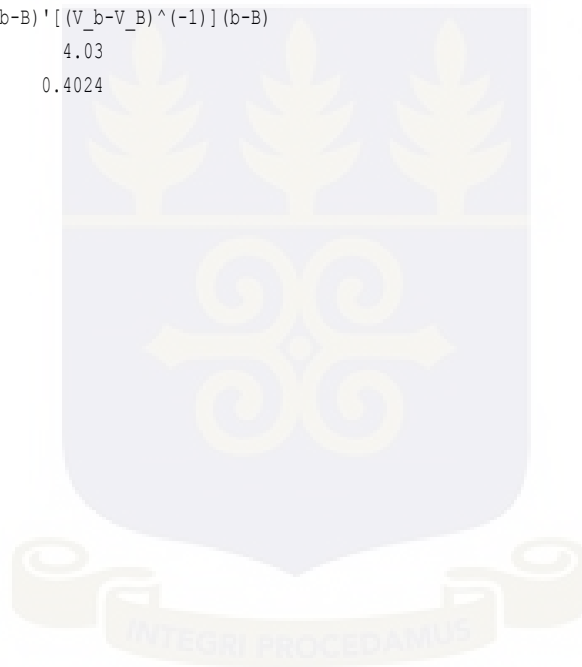
Appendix XV Hausman Test for Lower Middle Income Countries

	— Coefficients —			
	(b) fe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
gdpc	-.1100944	-.0690973	-.0409972	.0270761
per	-5.443348	-6.455961	1.012613	.8587448
bsh	-1.580642	-2.403354	.8227128	1.204195
tfr	-77.73956	-46.68053	-31.05903	23.69614

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 4.03
 Prob>chi2 = 0.4024



Appendix XVI Hausman Test for Upper Middle-Income Countries

	Coefficients			
	(b) fe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
gdpc	-.0161674	-.0057526	-.0104148	.
per	-1.024883	-10.43504	9.410162	.1944262
bsh	-5.374319	-13.09983	7.725516	2.957752
tfr	-95.2445	45.07247	-140.317	23.98862

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

```
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        = 3.51
Prob>chi2 = 0.4768
(V_b-V_B is not positive definite)
```



Appendix XVII

Test for Time Effect in LICs

(1) _Iyear_1990 = 0
(2) _Iyear_1991 = 0
(3) _Iyear_1992 = 0
(4) _Iyear_1993 = 0
(5) _Iyear_1995 = 0
(6) _Iyear_1996 = 0
(7) _Iyear_1997 = 0
(8) _Iyear_1998 = 0
(9) _Iyear_1999 = 0
(10) _Iyear_2000 = 0
(11) _Iyear_2001 = 0
(12) _Iyear_2002 = 0
(13) _Iyear_2003 = 0
(14) _Iyear_2004 = 0
(15) _Iyear_2005 = 0
(16) _Iyear_2006 = 0
(17) _Iyear_2007 = 0
(18) _Iyear_2008 = 0
(19) _Iyear_2009 = 0
(20) _Iyear_2010 = 0

F(20, 78) = 0.69
Prob > F = 0.8261



Appendix XVIII Test for Time Effect in UMICs

(1) _Iyear_1990 = 0
(2) _Iyear_1991 = 0
(3) _Iyear_1992 = 0
(4) _Iyear_1993 = 0
(5) _Iyear_1994 = 0
(6) _Iyear_1995 = 0
(7) _Iyear_1998 = 0
(8) _Iyear_1999 = 0
(9) _Iyear_2000 = 0
(10) _Iyear_2003 = 0
(11) _Iyear_2005 = 0
(12) _Iyear_2007 = 0
(13) _Iyear_2008 = 0

F(13, 3) = 0.82
Prob > F = 0.6593

Appendix XIX Test for Time Effect in LMICs

```
( 1)  _Iyear_1990 = 0
( 2)  _Iyear_1993 = 0
( 3)  _Iyear_1994 = 0
( 4)  _Iyear_1996 = 0
( 5)  _Iyear_1998 = 0
( 6)  _Iyear_1999 = 0
( 7)  _Iyear_2000 = 0
( 8)  _Iyear_2001 = 0
( 9)  _Iyear_2002 = 0
(10)  _Iyear_2003 = 0
(11)  _Iyear_2005 = 0
(12)  _Iyear_2006 = 0
(13)  _Iyear_2007 = 0
(14)  _Iyear_2008 = 0
(15)  _Iyear_2009 = 0
(16)  _Iyear_2010 = 0
```

```
F( 16, 16) = 0.76
Prob > F = 0.7026
```

