Essays on explaining child health outcomes in Nigeria

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Doctor of Philosophy

University of York

Economics and Related Studies

September 2020

Abstract

This thesis contributes, through four essays, to the understanding of why Nigeria, an emerging economy with the strongest GDP in Africa, is a major global contributor to child mortality. Chapter 1 uses a quasi-experimental design—the interrupted time series (ITS) analysis—to investigate the effect of the Millennium Development Goals (MDGs) on child mortality outcomes. The results indicate the existence of a pre-MDG declining trend, and a dwindling gain in child survival post-MDG. The pattern of mortality change is consistent in the adjusted model with controls and suggests that the MDGs have an unclear causal effect on child mortality outcomes. Chapter 2 investigates the relationship between economic growth and child mortality and asks whether there is a structural break in the effect of growth on child mortality following the introduction of pro-poor growth policy. Results from the Arrelano and Bond system GMM indicate a growth elasticity of -0.42. Also, the study findings suggest that child mortality is still prevalent amongst the poor despite the pro-poor growth policy adopted. Chapter 3 addresses the question of whether public health spending in Nigeria, a source country with porous borders, has spill-over effects on neighbouring countries. The results from fixed effects regressions suggest that public health spending in Nigeria is associated with reduction in childhood mortality across West African countries. This implies a loss of efficiency gain in government health spending, which has consequences for child health outcomes. Chapter 4 examines the role of the domestic economy in explaining child health outcomes in Nigeria, using the demographic and health survey datasets. The findings from a propensity score matching technique indicate a lower child Anthropometric failure rate in households within which women have decision-making authority, compared to households within which men make decisions autonomously.

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Preface

Understanding child health outcomes in Nigeria—a country that ranks second only to India in its contribution to global under-five deaths—remains a challenge for stakeholders in global health. This thesis explores and explains levels and rates of change of child mortality using Nigeria as the focus for a country case study approach. As an emerging economy, Nigeria presents an interesting case. Possessing one-fifth of the entire African population, and accounting for about 60% of West Africa's GDP, stakes appear to be high in ensuring that poverty and child mortality levels are significantly reduced in Nigeria if development goals are to be attained for the Sub-Saharan region of Africa. Accordingly, this thesis presents empirical evidence on a range of questions investigating changes in levels and rates of child health within the context of SSA countries and Nigeria in particular.

This thesis consists of four chapters. The first chapter investigates the effect of MDGs on child mortality in Nigeria; the second chapter explores the impact of economic growth on child mortality, and whether changes in economic growth patterns have a structural break effect; the third chapter investigates the impact of Nigerian public health spending on child mortality across borders; the final chapter assesses the role of the domestic economy in influencing child nutritional outcomes in Nigeria.

Globally, the under-five mortality rate has declined since 1990. It has declined by about two-thirds in World Health Organization (WHO) sub-regions including Northern Africa, Latin America, and Eastern and Western Asia, to meet the Millennium Development Goals (MDG) target.[1] However, the Oceania, Southern Asia, and Sub-Saharan Africa (SSA) WHO sub-regions were unable to achieve the target at the end of 2015. Indeed, the SSA sub-region has continue to record the highest under-five mortality rates amongst the WHO sub-regions. In 2015, one in every twelve children (84 per 1,000 live births) died before their fifth birthday. This is about two-folds higher than the world average (42 per 1,000 live birth) but lower than the estimate for Nigeria (125 per 1,000 live births) (World Bank, 2018).

[1] The MDGs are reiterated sets of concerns over global poverty and hunger, health, education, gender inequality, and environmental degradation with measurable and time-bound targets. A detailed description of the goals, targets, and indicators has been provided in Appendix 1.

Nigeria ranks second only to India in its contribution to global under-five deaths, and contributes about 10% to global under-five mortality (IGME, 2010). Of the approximately 5.9 million babies born every year in Nigeria, over one million died before attaining the age of five (FMoH, 2011). These deaths are likely to be higher because births and deaths of neonates occurring at home are less likely to be counted due to the near absence of birth and death registration. The major causes of child mortality in Nigeria are preventable, and include malaria, pneumonia, measles, and diarrhoeal, with malnutrition as an underlying factor (Black, et al., 2008; FMoH, 2011). Other preventable causes of under-five deaths include HIV/AIDS, meningitis, pertussis, and intrapartum.[2]

By the end of the MDG deadline in 2015, Nigeria was unable to achieve the target of reducing the under-five mortality rate by at least 50% and may likely not achieve the SDG target on child mortality reduction. Though the under-five rate has been declining, the rate of decline appears not only to be slowing down but occurring at high levels of mortality.[3] Nigeria's failure to attain the MDG target on child mortality may have an impact on the SSA sub-region's relative ability to achieve the goals since Nigeria represents a substantial share, about 20%, of the continent's total population.[4] This may explain, in part, why the country's progress in development indicators can be inextricably linked to the sub-region, and the need to accelerate current progress on child mortality reduction actions for the country. However, the reasons why child health outcomes are poor in Nigeria, the largest economy in Africa, remain understudied.

Theoretically, there are two broad strands of explanation for the levels of mortality and mortality change in a country—socio-economic and medical influences—as pointed out by Caldwell (1979). These explanations often interact, but spur debate in the determination of cost-effective interventions to address child mortality concerns in developing countries. Essentially, it is an argument about the relative contributions of

[2] Available data from the World Bank suggests an unclear pattern in the progress towards reducing the number of deaths from these causes over the MDG era. To be precise, between 2000 and 2015, deaths from these causes have varied as: pneumonia (126,690 to 16,050); intrapartum (6, 220 to 7,549); meningitis (21,417 to 18,669); diarrhoea (128, 456 to 75,087); measles (143,877 to 9412); malaria (196,205 to 102,368); AIDS (24,299 to 25,732); pertussis (6,911 to 8,288) (World Bank, 2018).

[3] According to the World Bank data, the absolute number of under-five deaths in Nigeria appear to have increased from 853, 117 in 1990 to 866, 084 in 2018 (World Bank, 2018).

[4] According to the World Bank poverty data, the Nigerian population was estimated to be 200 million in 2019 (World Bank, 2018) but it is likely to double (401 million) by 2050 (United Nations, 2019) given the country's high population growth rate of 2.6% (World Bank, 2018).

medical and socio-economic interventions in explaining child mortality rates and levels. The evidence of a causal relationship between income per capita and health outcomes in the literature (see for example, Pritchett and Summers, 1996) supports the later proposition that interventions which increase household incomes may provide the necessary resources to improve health outcomes. Income supplementation policies designed to improve child health outcomes for poor families through conditional cash transfer programmes, as seen in Latin America—PROGRESA (Oportunidades) and other developing countries, tend to allude to the above. Indeed, it is argued that the major causes of child mortality, including preterm birth complications, acute respiratory infections, intrapartum-related complications, congenital anomalies, and diarrhoea, are preventable through socio-economic interventions affecting education, nutrition, hygiene, housing, and gender equality (Schell, et al., 2007 pp. 288-289). Importantly, Bowden, et al, (2014) contributed to the debate by providing a novel insight that emphasized standard of living over the public health system in the control of infectious disease, as seen in post-war Europe. However, they suggested an alternative consideration, arguing that standard of living should be assessed in terms of the human development approach that emphasizes the outcomes rather than monetary value as commonly defined by GDP per capita, absolute and relative poverty lines, income inequality, and real income. This appears to echo the Sen capability approach in addressing poverty and perhaps might hold great potential in developing capabilities in the poor to become less exposed to mortality risk factors.[5]

On the other hand, a further argument considers medical intervention as a relatively greater influence in explaining mortality level and mortality change. It has been argued that the global decline in mortality witnessed in the 20th century would have occurred regardless of socio-economic circumstances and development strategies. In developing countries where substantial decline occurred after the end of the Second World War, "steady progress in reducing child mortality over the last five decades has continued throughout the 1990s, despite the advent of HIV/AIDS, continued civil strife in some countries and a lack of economic growth in others" (Ahmad, Lopez, and Inoue, 2000 p. 14). Also, this argument can be substantiated with recent data from the World Bank in

[5] The Sen Capability approach is a theoretical framework that consists of two normative claims: functioning (various states of human beings and activities that a person can undertake) and capabilities (real freedoms or opportunities to achieve functionings).

the case of Nigeria, where negative growth was recorded between 2015 and 2018, with a corresponding decline in under-five mortality rate (World Bank, 2018).[6] This raises questions about the role of income in influencing child mortality outcomes. In fact, there is evidence that 68% of new-born deaths could have been prevented if appropriate medical interventions were in place to correct missed opportunities in universal coverage of medical intervention (FMoH, 2011), which supports the above argument. The majority of under-five deaths in Nigeria are attributed to malaria (20%), pneumonia (15%) and diarrhoeal (18%) (FMoH, 2011), and these may be prevented using cost-effective medical interventions.[7]

In explaining the levels and rates of child mortality fluctuation in Nigeria, questions over the role of medical and socio-economic intervention will need to be addressed. The policy focus around reducing child mortality in developing countries appears to be mixed. Actions to substantially reduce child mortality and attain development goals will require evidence of the effect of previous interventions. Surprisingly, for example, little is known about the existence of any empirical estimate of the effect of the MDGs on child mortality in Nigeria, or the role of pro-poor growth in explaining child mortality outcomes. Thus, while Chapter One focuses on the effect of the MDGs on child mortality change in Nigeria and across the SSA countries, Chapter Two explores whether changes in economic growth patterns introduced with the MDGs have had a structural break effect on child mortality over time. This thesis also addresses the question of whether there is a cross-border spill-over effect of public health spending from Nigeria and how this might explain changes in child mortality. Finally, the thesis investigates the effect of intrahousehold decision-making on child nutritional outcomes in Nigeria. The Nigerian Government has expressed increasing interest in using social spending to improve household outcomes, and the dynamics of intrafamilial relations could determine the effectiveness of such socio-economic interventions. This thesis

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[6] Data from the World Bank indicates that the Nigerian economy experienced negative annual growth in per capita GDP in 2015 (-0.029%), 2016(-4.17%), 2017(-1.78%), and 2018(-0.67%). However, the under-five mortality rate declined from 125 per 1,000 live births in 2015 to 119 per 1,000 live births in 2018 (World Bank, 2018)

[7] A recent achievement in public health due to universal coverage of preventative vaccines was recorded with wild polio. The World Health Organization declared Africa free from wild polio, an infection that mainly affects under-five children and results in irreversible paralysis or death when breathing muscles become immobilized, on the 25th August 2020.

contributes to the understanding of child health outcomes in developing countries by providing unique insights into the problem, using Nigeria as a case study.

The MDG advocated medical interventions with important characteristics that are associated with child mortality reduction, which Chapter One assesses.[8] Essentially, the effects of the MDG on child mortality in Nigeria, and across SSA countries are estimated in Chapter One. A retrospective assessment of the effect of the MDG on child mortality is imperative in setting an agenda for the attainment of the on-going SDG child health target. A novel quasi-experimental design, the interrupted time series (ITS), is used in estimating the MDG effect on mortality outcomes. The ITS is considered suitable for the evaluation of population-based interventions that are implemented either without randomization or without any control, a model to which the MDGs conform.

The results indicate that the MDG effect in reducing child mortality in Nigeria, as well as countries in the SSA sub-region, is largely unclear. For Nigeria, I find a statistically significant annual declining trend of 2 under-five deaths per 1,000 live births. At the introduction of the MDGs, a gain of 13 under-five survivors per 1,000 live births is reported. However, the post-intervention slope suggests a reduction, 3 under-five deaths per 1,000 live births, in the annual rate of mortality change. From these findings, though child mortality declined with the introduction of the MDGs, the existence of a significant underlying decreasing trend, and the absence of a further decline in mortality rate when the pre-MDG and post-MDG slopes are compared, are inconsistent with the ITS causal effects identification assumptions. Indeed, the evidence of an MDG effect is less conclusive when adjustment is made for confounding factors in the model. This conclusion is similar for the majority of the SSA countries investigated. In fact, in some countries, I find rising mortality trends following the introduction of the MDGs, which suggests the immediate need for rethinking actions in addressing child health concerns.

[8] The MDGs targets on child health are expected to be achieved through interventions that influence indicators such as: Contraceptive prevalence rate; Adolescent birth rate; Antenatal care coverage (at least one visit and at least four visits); Unmet need for family planning; Proportion of population with advanced HIV infection with access to antiretroviral drugs; Proportion of children under 5 sleeping under insecticide-treated bed-nets; Proportion of children under 5 with fever who are treated with appropriate antimalarial drugs. Other progress monitoring indicators include Proportion of tuberculosis cases detected and cured under directly observed treatment short course; Proportion of births attended by skilled health personnel; Proportion of 1-year-old children immunized against measles.

The chapter contributes to the literature analysing the influences on under-five mortality and mortality change by documenting the role of the MDGs in mortality reduction for the SSA sub-region and Nigeria in particular. These findings indicate that it is unlikely that the MDG intervention has started a health/epidemiological transition in the region. Hence, fast-tracking progress in child survival efforts is imperative in the on-going SDGs in Nigeria as well as in the majority of countries across the SSA sub-region, in order to halt possible reversal of “gains” recorded in child mortality decline at the introduction of the MDG intervention.

Chapter 2 investigates the relationship between economic growth and child mortality, and whether there was a structural break in the effect of growth on child mortality after the introduction of the MDGs. The economic growth advocated in the MDGs is pro-poor growth which is expected to be facilitated by pro-poor economic policies, hence regarded as pro-MDG economic growth (Sarkar, 2007; p.2). This pattern of growth is considered to be inclusive, in that all persons in the society are expected to be allowed access to basic nourishment and to enjoy long and satisfying lives, with no child allowed to die prematurely if avoidable (Kakwani and Pernia, 2000). This change is expected to occur through output expansion in pro-poor sectors, which will increase resources on a national and individual level in different ways to traditional growth. Hence, this study investigates whether changes in the economic growth pattern influences child mortality outcomes differently over time, and across countries in the SSA sub-region. I employ the modelling approach of a related paper by Bhalotra (2008) to investigate this research question. The Bhalotra paper investigates to what extent economic growth is likely to reduce mortality rates across Indian states over the period 1970-1998. This study uses a constructed panel data of 48 SSA countries, over a more recent period (1990-2018), and with specific reference to the MDG growth reforms. The panel structure of the data was exploited using the Arrelano and Bond system GMM to estimate the growth elasticity of mortality. The estimator’s ability to generate GMM-style instruments to correct for endogeneity concerns in the model is the main motivation. Further, in contrast to Bhalotra, the study controls for a different set of time-varying confounding factors including institution, ethnic fractionalization, climate, and conflict.

The result indicates that under-five mortality falls with income per capita with an elasticity of -0.42. This is smaller than expected from previous work but may be due to my removal of some confounding effects from the estimate. However, the study findings on whether there is a structural break in the effect of growth on child mortality across countries in the SSA sub-region, and over time following the introduction of the pro-poor growth strategy, resonates with the Bhalotra paper, which found that growth in a post-reform era is less effective in reducing child mortality. This implies that child mortality is still prevalent amongst the poor despite the pro-poor growth policy adopted.

Though there are studies that estimate the impact of economic growth on population health determination (see for example, Pritchett and Summers, 1996; Wang, Jamison, Bos, Preker, and Peabody, 1999; Stuckler, Basu, and McKee, 2010; O'Hare, Bar-Zeev, and Chiwaula, 2012; Nishiyama, 2011), this study contributes to the literature by investigating the relationship between the pro-poor economic growth advocated in the international development strategy and child mortality in SSA countries, and particularly Nigeria. To the best of my knowledge, no studies exist that have directly estimated the impact of pro-poor growth on child mortality in an African context. Importantly, nor have any studies documented evidence of a pro-poor growth structural break effect on under-five mortality for the region. Teasing out the effect of pro-poor growth on child mortality could provide further insights into the debate over whether more attention should be focussed on enhancing growth in on-going child health actions.

In addressing child mortality concerns in developing countries, aside from the emphasis on economic growth, there is renewed interest in social spending as a policy tool to influence the provision of public goods in health care. However, for a *source* country like Nigeria with porous borders, spill-over effects could produce a loss of efficiency gains in government health spending, with consequences for child health outcomes. Whether such spill-overs exist could be an important consideration in the design of public health spending for a source country in its effort to achieve child mortality targets. Chapter 3 addresses the question of whether Nigeria's public spending on health may have spill-over effects on neighbouring countries.

The results from fixed effect regressions suggest that an expansionary Nigeria's public health spending is associated with a reduction in childhood mortality across West

African countries. Specifically, the results show that increasing the size of Nigeria's public health spending by 1% would reduce, on average, under-five mortality rates by 1.14% across any West African country. This finding is interpreted as evidence of a spill-over effect. The existence of a public health spending spill-over effect may imply additional strain on the health care/social security system of the source country, and a possible diversion of the source country's public resources to meeting health care needs of non-citizens. This study makes two contributions to the literature. First, it integrates two lines of theoretical and empirical work—the literature that links public spending and child health outcomes, and a contiguous literature that shows the existence of spill-over effects of policies from a source country across borders—to provide new evidence of the existence of public spending spill-over across borders. It also contributes to the literature on cross-border utilization of health services by providing pioneering spatial evidence of potential geographical access to health facilities by countries within geographical proximity to Nigeria. Whether such externalities are internalized in the public health spending budget could be vital in explaining the contribution of Nigeria to global under-five mortality and will be relevant for policy interventions surrounding the on-going SDGs.

Chapter 4 focuses on the role of the domestic economy in influencing child health outcomes in Nigeria. Gender relations among household decision makers could be a vital factor in determining the outcome of social health spending on child health. This chapter addresses the question of whether, and if so to what extent, gender matters in intrahousehold resource allocation in regard to child health outcomes. The decision to allocate resources or use health care services could be influenced by the dynamics of intra-household relations. That is, the asymmetric control over household resources when preferences are heterogeneous could be an important influence on child health outcomes. The relative decision-making right is used as an indicator of bargaining power and its effect on child nutrition is examined in the chapter. Importantly, the study identifies a household model that best describes the Nigerian data. Also, the study empirically identifies the predictors of the bargaining power indicator, decision-making right, within Nigerian households.

Using the Nigerian Demography and Health Survey (NDHS) dataset of 2018, the results suggest that the probability that a child will be stunted, wasted, or underweight, is reduced if a woman is part of the household decision-making process in regard to her health, visits to relatives, and household expenditure. Specifically, compared to women with no decision-making rights, the average marginal effects that a child will be stunted, underweight, or wasted are 3%, 6.6%, and 4% lower when women are involved in at least one of these decision-making spheres. Also, using the propensity score matching technique, the study identifies the collective model as the best fit in describing household decision-making processes in Nigeria. More precisely, our findings indicate that children's anthropometric failure rate in households wherein women have decision making rights is lower, -0.071 ($p<0.01$), compared to children in households in which men make decisions autonomously, and this result is robust to different estimators used. These findings underscore the need for a gendered social spending policy to be incorporated in the evolution of a welfare regime for Nigeria, if the objectives include enhancement of child health outcomes. Additionally, the study uncovers media exposure, education, land ownership, and absence of poverty as significant predictors of female participation in decision-making in Nigerian households.

The study contributes to the literature on intrahousehold resource allocation in several ways: First, it contributes to the empirical evidence of the impact of gender asymmetry in household decision-making on child health outcomes for Nigeria, as a microcosm of SSA countries. Also, in measuring bargaining power, the study innovates by using decision-making rights as an indicator and considering this as a direct consequence of power that can better capture how preferences are asserted to yield household outcomes. The existing empirical studies on intrahousehold resource allocation have measured bargaining power using indicators such as assignable income (e.g., Folbre, 1984 and Hoddinott and Haddad, 1995), unearned income, and aggregate sex ratios on the labour market (Chiappori, Fortin, and Lacroix, 2002); consumption or expenditure pattern (Lundberg, Pollak, and Wales, 1997; Ward-Batts, 2001). The use of decision-making rights could be important in understanding how power is translated into welfare outcomes in the context of the study area. Similarly, the study uses a comprehensive measure of child anthropometrics, the Composite Index of Anthropometric Failure (CIAF). This is a measure of child nutritional outcome that provides a more disaggregated classification of malnutrition and is likely to have greater predictive power relative to the use of a single nutritional indicator such as stunting or underweight, as used in related studies.

Finally, the thesis contributes to the unresolved debate on the nature of the internal processes of household economy, consistent with a specified theoretical framework for SSA countries. For instance, while Burkina Faso households have been considered inefficient in the allocation of farm resources (Udry, 1996), Pareto efficient outcomes were reached amongst pastoralists in Northern Kenya (McPeak and Doss, 2006). Similarly, mixed findings exist concerning the efficiency of households' expenditure patterns in Ethiopia and South Africa (Quisumbing and Maluccio, 2003).[9] There appears to be a paucity of studies that have empirically established the existence of a model to describe Nigerian households. This is vital, since the success or otherwise of any welfare policy could depend on accurate predictions derived from the operational household model in any given country.

[9] The impact of female bargaining power, proxy by resources brought to marriage, on household outcomes (measured as household level expenditure shares on food, education, health, child clothing, and alcohol and/or tobacco) was mixed in (Quisumbing & Maluccio, 2003). For instance, while women's assets increase expenditure shares on education in South Africa and Bangladesh, it is men's assets that have this effect in Ethiopia. Similarly, while men's assets increase expenditure shares in Bangladesh, it is the opposite in Ethiopia. For other expenditure shares such as child clothing, health, and alcohol/tobacco, gender appears not to matter (p. 310).

Acknowledgements

First, I am grateful to my supervisor, Professor Peter N. Smith, whose expertise, comments, and insightful suggestions provided immeasurable contributions to this thesis. I would also like to specially thank other members of the supervisory team, Prof Sue Bowden, Mr John Bone, and Dr Thilo Huning. I would like to thank Professor Giacomo De Luca for his interest in my research. Dr Michael Shallcross, I will eternally be grateful to you. Your standard of humanity is exemplary. I am grateful to the Head of Department, Prof J. K. Swaffield and members of staff for the opportunities I was given to conduct my research in the department.

To my late mother, Mrs Rifkatu Amos, your memory will live on. To my father, Amos Atsiya, thank you Sir for the discipline instil in me and your firm believe in education. My siblings: Hyacinth, Albert, Christopher, Adu, Aveh, Happiness (late) and Victory (late), thank you all for the moral support. To Dr Godiya Atsiya Pius, my darling wife, you braved it! Thank you for believing in me and for all the sacrifices, sai Godiya. To my daughters, Shalom and Olivia, I love you!

To God most high, who made it possible, I will remain eternally grateful.

Declaration

I declare that this thesis is a presentation of original work and I am the sole author of all the chapters. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References. Chapter 1 has been published by the Nigerian Journal of Economic and Social Studies (NES). Also, Chapter 2 is published in the book of abstract of the MIRDEC-16th, International Academic Conference on Multidisciplinary Issues and Contemporary Discussions in Social Science, Rome, Italy.

Chapter 1

Impact of the MDGs on child mortality outcome in Nigeria

1.1 Introduction

Child mortality reduction has consistently been prioritised in the national development plans of developing countries as well in the international development agendas by international institutions.[10] Following series of global summits, the United Nations in its Millennium Assembly in 2000 launched the MDGs. The MDGs are reiterated sets of concerns over global poverty and hunger, health, education, gender inequality, and environmental degradation with measurable and time bound targets. Broadly, the MDGs are a set of eight goals incorporated into national policy planning of signatories' countries, actions of NGOs and civil societies to address the issue of global poverty. The goal on child health, MDG4, had a target to reduce by two third under-five mortality rate over a 25-year period (1990-2015). [11]

In this chapter, I investigate the effect of the MDG campaign on child mortality reduction in the SSA region but with particular reference to Nigeria. Specially, I address the question of what is the effect of the MDG on child mortality change? Given the role ascribed to the MDGs in explaining the global reduction in under-five mortality, it will be imperative to empirically investigate its effects in influencing under-five mortality rates and levels among the SSA countries and particularly Nigeria. Although data suggest that progress has been made in child mortality reduction globally, it is however unclear if empirical evidence exist linking the MDGs to the changes in mortality rates and levels in the SSA region.

There are several reasons for the prominence given to the goal of reducing child mortality. One motivation is the evidence of an association between mortality reduction and the demographic transition (Belli, Bustreo, and Preker, 2005; Bloom and

[10] International institutions including the World Health Organization (WHO), the World Bank, and the United Nations Children's Fund (UNICEF) in partnership with other international Nongovernmental Organizations, undertake international health actions to promote global public health goods. These actions include direct investment in population health, advocacy for health, and surveillance of diseases and risk (Yach and Ruger 2009).

[11] A detailed description of the MDGs is provided in Appendix 1A.

Williamson, 1998).[12] Belli, Bustreo, and Preker argued that significant reductions in child mortality can reduce fertility rate, the dependency ratio in the long run, and consequently enhance economic growth in the second phase of the transition. As an indicator of economic growth (Erdogan, Ener, Arica, 2013), child mortality can be a more equitable index of resource allocation compared to Gross National Income (GNI) per capita. The distributional concerns associated with GNI per capita are likely to be lower in the case of child mortality. The rate of child mortality in a society can provide a better insight into the extent of accessibility to critical infrastructure. It is considered as an outcome measure of the development process of a country's health system (Reidpath and Allotey, 2003). In addition, from the normative paradigm, the number of preventable under-five deaths in developing countries is considered high relative to developed countries. With over 90% of childhood deaths occurring in less developed countries (Black, Morris and Bryce, 2003, p.2226), there appears to be concerns to preserve lives based on the ethics of universalism of life claims.[13]

To address the research question, I use a quasi-experimental design, the interrupted time series (ITS) analysis, to evaluate the impact of the MDG on child mortality outcome. The ITS is considered suitable for the evaluation of population-based interventions that are implemented either without randomization or without any control group (Bernal, Cummins and Gasparrini, 2017), a model to which the MDGs conform. The MDGs advocated public health interventions that are implemented on populations without randomization or control groups. This makes it unsuitable for the application of the gold standard evaluation technique, the Randomised Controlled Trial (RCT).

Using data from several sources but mainly from the World Bank poverty data catalogue, I find that the effect of the MDG on child mortality is mixed across countries.

[12] Bloom and Williamson argued that significant reduction in child mortality will set in motion the so-called demographic transition. They identified three phases in the transition. In the first phase, the demographic burden phase, mortality declines without a corresponding decline in fertility rate. Hence, a glut of unproductive youth will ensue, which in turn increases the dependency ratio, and consequently decline in economic growth rate. In the second phase, birth rates will decline due to increased likelihood children survival. This is likely to reduce the dependency ratio and increase the progressive entry into the labour force. The increase in the share of the working population will result in higher economic growth. In the last phase, dependency ratio rises as the share of working population declines due to the lag effect of the decline in birth rates in the second phase. As a consequence, economic growth starts declining.

[13] The universalism of life claims states that no new-born child should be doomed to a short or miserable life merely because the child is born in the wrong class, or in the wrong country, or is of the wrong sex (UNDP, 1994).

In the case of Nigeria, though mortality declined with the introduction of the MDGs, the existence of a significant declining underlying trend, and the absence of a further decline in the mortality rate post-intervention, run against the ITS causal effects' identification assumptions. Evidence of an MDG effect on mortality is less conclusive when I adjust for time-varying confounding factors. This is the case for majority of countries in the SSA. Indeed, under-five mortality rates appear to be rising with the introduction of the intervention for countries such as Eritrea, South Africa, the Seychelles, Lesotho, Ethiopia, and Somalia. However, I find that countries such as Capo Verde, Sao Tome & Principe, Congo Republic, Mauritius, Rwanda, Zimbabwe, and Botswana had fluctuations in trends that can be associated with the MDGs campaign. Further, I investigate heterogeneity effects across countries by geographical characteristics, institutions, and culture. I examine whether there is variation in countries' performances in achieving the child mortality goal by the above factors. I find that whether countries are landlocked appears to matter with regards to their performance in reducing child mortality. With respect to institution, I did not find any evidence of the impact of a stronger control over corruption in explaining the MDG effect. However, the extent of ethnic fragmentation appears to matter in determining countries' performances in the context of the MDGs.

Following the introduction, section 1.2 discusses the background of the study. Section 1.3 reviews related literature on the causes of mortality change. Section 1.4 discusses the estimation strategy, data sources and description of variables. Section 1.5 presents the regression results of the effect of the MDGs on child mortality rate for Nigeria and countries in the SSA sub-region. In section 1.6, I assess the role of geography, institutions, and culture in determining the performance of countries in reducing child mortality. In section 1.7, I turn to Nigeria and explain the possible pathways through which health interventions may influence child mortality outcomes in the MDGs era. The chapter concludes in section 1.8.

1.2 Background

The global reduction in under-five mortality rate from 89 deaths per 1,000 live births in 1990 to 60 deaths per 1,000 in 2009 has been attributed to the efforts made by the WHO sub-regions including Northern Africa, Latin America, Eastern and Western Asia in meeting the MDG4 target of reducing child mortality (IGME, 2010). Indeed, following the global success of the MDGs, the Sustainable Development Goals (SDGs) was launched.[14] However, the Oceania, Southern Asia, and Sub-Saharan Africa (SSA) sub regions were unable to achieve at least 50% reduction by the end of 2015. In fact, the SSA sub-region has continue to record the highest under-five mortality rates. In 2009, one in every eight children (129 per 1,000 live births) died before their fifth birthday in the SSA sub-region. This is about twenty-folds higher than the average for developed regions (6 per 1,000) (IGME, 2010).

After several years of actions and advocacy, Nigeria ranks second only to India in its contribution to global under-five deaths. It contributes about 10% to global under-five mortality (IGME, 2010), and has the highest number of under-five deaths of any country in Africa. Of the about 5.9 million babies born every year in Nigeria, over one million of these children die before attaining the age of five (FMoH, 2011). These deaths are likely to be higher because births and deaths of neonates occurring at home are less likely to be counted due to near absence of birth and death registrations (McCarthy, et al., 1980; Lawn et al., 2011). Nigeria has achieved only an average of 1.2% reduction in under-five mortality per year since 1990 which is short of the expected annual reduction rate of 10% required to deliver on the child mortality target of the Millennium Development Goals (MDGs) (FMoH, 2011, p.15). By 2015, Nigeria was unable to achieve at least 50% reduction in its under-five mortality rate despite being the largest economy in Africa.[15]

In explaining child mortality outcomes in developing countries, there is the argument about the role of international institutions in influencing child health outcomes either through medical interventions or socio-economic interventions. In using socio-economic interventions, the focus is on improving the quality of life of the socio-economically disadvantaged households. The basic intuition is that enhancing living standard could prevent the onset of diseases and may influence the decisions to use health care services and live heathy life. What constitute standard of living and its measurement has been debated in Bowden et al, (2014) and it points to the human

[14] The SDG target for child mortality by 2030 is to reduce neonatal mortality to as low as 12 deaths per 1,000 live births and under-five mortality to as low as 25 deaths per 1,000 live births: this is the SDG3 target.

[15] Nigeria became Africa’s largest economy in 2014 after the rebase of her GDP in 2013 estimated at US$ 510 billion. Nigerian GDP currently includes previously uncounted industries like information, technology, music, film production, online sales, airlines, and telecom.

development approach in the conceptualization of living standard. I examine this in greater details in the subsequent chapter.

The argument about medical interventions is advocated since the direct causes of under-five deaths—diarrhoea, pneumonia, measles, malaria, HIV/AIDS—can be preventable with appropriate cost-effective health interventions (Jones, et al., 2003).[16] The first day of birth appears to be the riskiest time for babies in developing countries. In Nigeria, up to one-half of all new-born deaths are known to occur on the first day of life (NPC, 2008; Lawn, Cousens, and Zupan, 2005). It is estimated that about 68% of these new-born deaths are likely to be preventable with the right medical interventions and coverages (FMoH, 2011). For instance, about 23,000 babies are estimated to be lost annually due to the inability of mothers to receive two or more doses of tetanus toxoid (TT2+) during pregnancy (FMoH, 2009). The administration of tetanus toxoid (TT2+) during pregnancy reduces the exposure of women to tetanus and consequently the burden of new-born tetanus deaths (WHO, 2006). Similarly, the distribution of insecticide treated nets may prevent malaria in pregnancy and this reduces the rate of miscarriages, stillbirths, preterm labour, and low birth weight (Sule-Odu, Ogunledun, Olatunji, 2002). Additionally, encouraging uptake of family planning interventions may reduce child mortality significantly (Palloni and Rafalimanana, 1999; Tekelab, Chojenta, Smith, and Loxton, 2019; Boerma, and Bicego, 1992).

Nigeria is an important case for this study for several reasons. First, it is possible that Nigeria's failure to attain the MDG4 target might have influenced the Sub-Saharan Africa's achievement of these goals given that its population is the largest in Africa.[17] Hence, sustainable reduction in child mortality could have implications on the sub-regional performance of development goals. Second, in line with Bloom and William's (1998) demographic transition theory, achieving significant reduction in child mortality, will in the long run reduce fertility rate, dependency ratio, result in progressive entry into the labour market, and as a consequence, economic growth will

[16] With reference to Nigeria, majority of under-five deaths can be attributed to malaria (20%), pneumonia (15%) and diarrhoeal (18%) however with malnutrition being an underlying cause for one-third of these deaths (Black, et al., 2008; FMoH, 2011). These estimates are based on methods developed by World Health Organization (WHO) and United Nations Children's Fund (UNICEF) with the Child Health Epidemiology Reference Group (CHERG).

[17] The World Bank estimated the population of Nigeria to be 200,963,599 in 2019 with an annual growth rate of 2.6% and fertility rate of 5.4 (World Bank, 2018).

ensue. Nigeria appears to be in the demographic burden phase with youth glut and will need cost-effective interventions to reduce the number of under-five deaths significantly as a long-term measure to enhance economic growth. Third, Nigeria appears to be a microcosm of SSA countries. Hence, findings from this research could have far reaching implications on countries in the SSA sub-region.

Finally, Nigeria endorsed the eight MDGs in 2000 and have constituted the basis of development and offer the framework for instituting intervention measures (Sarwar, 2015, p.15). The MDGs constituted the framework for the implementation of the National Economic Empowerment and Development Strategy (NEEDS), a policy strategy that was replicated in all the federating states as State Economic Empowerment and Development Strategy (SEEDS). Health intervention programmes were implemented in line with the NEEDS strategy. For example, the National Policy of Food and Nutrition (NPFN) was launched in 2002 in line with NEEDS policy thrust of improving the nutritional status of all Nigerians but with specific emphasis on the most vulnerable groups. After signing the United Nations treaty on MDGs, Nigeria committed to achieving the goal of reducing child mortality by taking a number of steps, including the release of central government funds. Also, funding was made available by international institutions such as the UNICEF in partnership with the WHO and United Nations Population Fund (UNFPA) to carry out interventions instituted to achieve the child and maternal health targets. In addition to donor funding received, Nigeria benefited from a Paris Club Debt relief. The MDG 8 advocated for debt relief for Heavily Indebted Poor Countries (HIPC) to enable governments to free up budgets formerly used in paying debts for essential services provision. In fast tracking the achievement of MDGs 4 and 5, an integrated strategic document, the Maternal, New-born and Child Health (MNCH), was launched. It was developed within the framework of the national health sector reform and in the context of the NEEDS. A notable package of the MNCH implemented is the Partnership for Reviving Routine Immunization in Northern Nigeria (PRRINN-IMNCH). It is a comprehensive programme that encompasses multiple aspects of the health system such as health governance, human resources, health information, strengthening of clinical services, and community engagement in order to reduce maternal and child mortality. In the 2010 MDGs summit, Nigeria reaffirmed its commitment by endorsing the Global Strategy for Women’s and Children’s Health and certified that the initiative was in alignment to its National Health

Plan and strategies (United Nations, 2010). Essentially, the MDGs campaign was a new thinking on fast tracking actions to improve child and maternal health in Nigeria as well as other signatory countries.

1.3 Review of related literature

Aside actions by development organizations, there might be country-specific factors such as institution, geography, culture, ethnic fractionalization, and conflict that could explain child mortality changes across countries. In explaining economic outcomes in societies, Acemoglu, Johnson, and Robinson (2005) considered institutions as fundamental. Institutions, "rules of the game in a society or humanly devised constraints that shape human interactions", can influence incentives in human exchange, whether political, social, or economic (North, 1990, p.3). A *good* economic institution is expected to provide security of property rights and relatively equal access to economic resources for a broad cross-section of the society (Acemoglu, Johnson, and Robinson, 2005). It could provide incentive for investment in physical and human capital and technology needed to spur economic growth. Invariably, weak institutions with poor development of property rights may be a disincentive for investment and this may constrain the prosperity of a society.

Precisely, the control of corruption, a measure of economic institution, may structure incentive for human capital investment through the supply of public services such as education and health care in societies (Reinikka and Svensson, 2004). Essentially, a strong control over corruption will provide incentives for the creation of public goods with positive health externalities. It can influence the provision of quality health care (Vian, 2008). Indeed, in a study by Gupta, Davoodi and Tionson (2000) corruption was found to be strongly associated with poor child health outcomes. Using a simple regression of child mortality on the index of corruption and the quality of health care provision, Gupta, et al. shows that higher corruption is associated with higher child mortality in a sample of 62 countries. In general, the quality of economic institution will determine how humans organize themselves in an innovative way that encourages risk taking, and in a manner that they develop capacities to solve collective action problems that may arise in the provision of public goods, and this can explain differences in economic outcomes between societies. Countries with strong economic institutions are likely to attract investment, participate in trade, and efficiently use physical and human capital (Robinson, Acemoglu and Johnson, 2005).

Although economic institutions are fundamental in shaping economic outcomes, they are themselves endogenous—outcome of collective choices of the society—and are determined by political institutions. Political institutions determine the constraints on and the incentives of the key political groups in societies. The political power, de jure or de facto, of groups in the political sphere of a society, mainly, determines the choice of economic institution and this is usually informed by the expected outcome from the economic institution. That is, political institution directly determines economic institutions and economic performance (Acemoglu, Johnson, and Robinson, 2005). Hence, it is important that any choice political institution, form of government, should have checks on political powers—constraints on politicians—to guarantee the protection of property rights of a broad cross-section of the society for the emergence of a good economic institution. In effect, political institution with independent judiciary and regulatory bodies are more likely to restrict the ability of governments to engage in rent seeking but will promote accountability to taxpayers (North, 1990). There are empirical studies that demonstrate political institutions could matter in population health and child mortality outcomes (for example see, Ruger, 2005; Safaei, 2006; and Bollyky et al, 2019).

The role of nature—geography, climate, and ecology—in explaining cross-country differences in economic outcomes is vital, the geography hypothesis. Geographic, climatic, and ecological characteristics of societies could have profound effect on economic outcomes. More precisely, geographic measures—whether a country is landlocked, distant from the equator, and have difficult terrains—could explain differences in economic performance and health outcomes (Bloom, Sachs, Collier and Udry, 1998; Acemoglu, Johnson and Robinson, 2001). In effect, countries with geographical advantages in terms of having less prone disease environment (infectious disease burden could differ between tropics and temperate zones), lower transport cost, access to natural resources, and access to the coastline and sea might have better economic performances and improved child health outcomes relatively. A relevant version of the geography hypothesis to this study, links economic outcomes directly to disease burden. The hypothesis suggests that infectious disease burden which is higher in the tropics relative to temperate zones, is detrimental to the economic prosperity of a society (Sachs, 2000).[18] It is also argued in the literature that temperate climates create incentives, encourages economic specialization and development of trade (Lehne, Mo, and Plekhanov, 2014).

Other measures of geography, whether a country is landlocked or have difficult terrain—problems of geographical remoteness—are known to determine growth and development outcomes due to transportation costs and productivity in agriculture (Gallup, Sachs, Mellinger, 1999). Globally, there are 31 landlock countries distributed across Africa (15), Asia (12), Latin America (2) and Central and Eastern Europe (2). These countries are classified as developing with most of them poor. Their remoteness from coasts is likely to increase transport cost in international trade. It can be a disincentive for foreign capital inflow and may be responsible for their current level of economic prosperity. This might have constrained their attainment of the MDGs targets related to education, access to safe water, poverty eradication, and infant mortality as suggested in the literature (UNCTAD, 2006).

A more direct effect of climate on health outcomes could be express through variations in temperature and rainfall. High temperature may result in water scarcity, poor sanitation outcomes, changes in disease environment (increase in the prevalence of vector borne and diarrheal diseases) and consequently, elevated mortality risk in children (Kudamatsu, Persson, and Stromberg, 2012; Baker and Anttila-Hughes, 2020). Another route through which high temperature may influence mortality especially in agrarian societies, is food security. Similarly, deficit in rainfall is more likely to have a significant influence on child mortality through malnutrition in agricultural subsistence societies. However, the relationship between climate variables and mortality may vary with latitude—spatial heterogeneity effects. For instance, while infant mortality reduces with high temperature but increases with low temperature in rural Bangladesh (Lindeboom, Alam, Begum, Streatfield, 2012; Hashizume, Wagatsuma, Hayashi, Saha, Streatfield, Yunusy, 2009), there is evidence of heat-related mortality in Europe

[18] One strand of the geography hypothesis as stated by Marshall (1890) suggests that vigour is largely determine by climate. Thus, people in temperate climates are likely to be more vigorous compared to their peers in tropical areas due to lower heat intensity of the sun. In other words, climate has direct effect on income through its influence on work. Another variant of the hypothesis states that geography may determine the technology available to a society as seen in the differences of the technologies available to the temperate and tropical zones at the start of modern economic growth (Sachs, 2001).

(Kovats and Kristie, 2006). In the same vein, the relationship between rainfall variation and child mortality seems to be ambiguous. Excess rainfall was associated more with mortality in a study in Burkina Faso (Dos Santos and Henry, 2008).

While I do not intend to debate the primacy of institution over geography or vice versa, the argument that geography is the main driver of differences in economic outcomes between countries becomes appealing when the distribution of developed versus developing countries is considered on the world map. It can be seen that all developed countries, except Hong Kong and Singapore, are in the temperate region. This introduces the argument that differences in economic prosperity across countries may persist because of the time-invariant nature of geographical factors. Hence, developed countries could have been richer centuries ago and may likely be in the future (Diamond, 1997). In contrast, though the income hypothesis predicts persistence in economic outcomes given the persistence of institutions and the way societies are organised, a change in institution will however result in a change in economic outcomes across countries as pointed out by Acemoglu, Johnson, and Robinson (2001). This is evident in the case of North and South Korea after their separation in 1950. At the time of separation, North and South Korea had approximately the same income per capita (Maddison, 2001) but organizing themselves in different ways and adopting different sets of institutions after separation, income varied considerably between the two countries afterwards. In fact, by 2000 while the per capita income in South Korea was US$16,100, it was US$1,000 in North Korea (Acemoglu, Johnson and Robinson, 2005). Given all other geographical factors remaining unchanged, the separation could be considered as a natural experiment, making it plausible to attribute the differences in prosperity to a change in institution.

Another fundamental explanation for differences in economic outcomes across countries is culture—the values, preferences and beliefs of individuals and societies —transmitted from generation to generation (Acemoglu, Johnson, and Robinson, 2005). Aspects of culture including ethnicity and religion, may act through the pathways of beliefs and preferences to influence economic outcomes. For instance, preference for thriftiness/savings, a major determinant of investment, has been shown to be associated with culture (Guiso, Sapienza and Zingales, 2006). Similarly, it is also argued that political preferences of individuals with regards to the extent of state intervention in an economy, operation of welfare programmes, income redistribution and market regulations can be affected by culture (Guiso, Sapienza and Zingales, 2006). Effectively, countries with a more fractionalized ethnic structure, as a measure of culture, may be less able or willing to provide its citizens with public goods such as education, physical infrastructure, and health (Wimmer, 2015). This is because, different ethnic groups may have divergent preferences, values, and beliefs and this might increase collective action and coordination problems with lower levels of public goods provision consequently (Alesina, Baqir, and Easterly, 1999). Different ethnic groups are likely to have different preferences over which type of public goods to produce with public resources. Even over public goods like health facilities, ethnic groups may have polarised preferences over their locations in developing countries.

Precisely, different cultures could result in varied set of belief systems about how people behave, and this may influence the set of equilibria for a given specification of institutions (Acemoglu, Johnson and Robinson, 2004). Differences in culture may suggest that individuals are coordinating on different equilibria under the same set of institutions. In the empirical literature, ethnicity and religion have been used to measure culture. Indeed, there is rising evidence of a robust association between ethnic fractionalization and infant mortality (see for example, La Porta, et al., 1999).

Finally, the occurrence of armed conflict, though a global phenomenon, appears to have disproportionate intensity among SSA countries and this may explain variation in the performances of countries with regards to child health outcomes. It is established in the literature that armed conflict has persistent adverse effect on children over their life course, and to subsequent generations given birth to after it has ended. For instance, Wagner et al. (2018) found evidence of increased infant mortality risk from armed conflict, and for 8 years after conflicts, with cumulative increase in mortality about four folds greater than the contemporaneous increase. Conflict can result in direct casualties and deaths with survivor children especially below the age of five known to suffer impairment in their cognitive development (McLeod, 2018). Specifically, the civil wars in the Democratic Republic of Congo were reported to result in the deaths of millions of individuals (Coghlan et al., 2007) including infants with a gender imbalance against the male which has been attributed to their vulnerability in the uterus (Dagnelie, De Luca and Maystadt, 2014). Using data from UNICEF State of the World’s Children

(SOWC) report in 42 SSA countries, O'Hare, and Southall (2007) demonstrates that median under-five mortality rate in countries with recent conflict is significantly higher (197/1,000 live births) than countries without recent conflict (137/1,000 live births). Armed conflicts often result in displacement with associated mortality effects. Some empirical studies have documented the increased mortality among children whose families were displaced due to war in Angola (Avogo and Agadjanian, 2010), Guinea-Bissau (Aaby et al, 1999), Darfur (Depoortere et al, 2004), and Rwanda (Goma Epidemiology, 1995). However, the effect of armed conflict on childhood mortality through malnutrition is unambiguous in the literature (see for example Cliff, et al., 1997; Grein et al., 2003). Nigeria has witnessed armed conflicts ranging from the civil war to the Boko Haram insurgency that is currently on-going especially in the northern part of the country. Aside the number of direct fatalities, the disruption in health services and displacements caused by the armed conflicts may reduce the probability of child survival for conflict societies.

There are studies on fluctuations of child mortality trends in Nigeria. These studies pool waves of cross-sectional data from the demographic and health surveys to construct pseudo-panels to investigate trends as well as the effects of biosocial and socio-demographic determinants. For instance, Morakinyo and Fagbamigbe (2017) pooled three waves (2003, 2008, and 2013) from the Nigerian demographic health survey to construct trends of child mortality outcomes. They observed notable declines in neonatal, under-five, and infant mortality rates over time which are associated with individual factors such as maternal education and age. From their findings, the probabilities of child mortality outcomes have progressively decline between 2002 and 2013 though with varied magnitudes. However, the effects of the determinants of mortalities trends were mixed over time. For example, in the case of under-five mortality rate, mother's age only became statistically significant in 2008 and 2013. There are other studies with similar designs but different predictors of trend changes (see for example: Ezeh, et al., 2015; Adeyemi, et al., 2008; Mekonnen, et al., 2013; Nannan, et al., 2012). While Nannan, et al. identified the rate of HIV infections as the major driver of the decline in child mortality outcomes over time, Mekonnen, et al decompose trend by locality of residence and find that the role of urban advantages in influencing mortality decline is disappearing. Ezeh, et al. (2015) used the Mosley and Chen framework in identifying individual and household level factors. Their results from the cox proportional hazard regression models show locality of residence and education to be consistently statistically significant across all waves in predicting trends of child mortality outcomes. Adeyemi et al (2008) assesses the impact of public programmes on child mortality in Nigeria and reports counter-intuitive results with regards to access to water and health care. They argued that quality rather than quantity matters in establishing the relationship between access to water and child mortality outcomes.

Also, there are inter-country trend studies which show disparities in under-five mortality trends between countries/regions across low—and middle—income countries and their determinants (see for example: Garenne and Gakusi, 2006; Adetunji and Bos in Jamison, Feachem, Makgoba, et al., 2006; Ahmad, Lopez, and Inoue, 2000). In Garenne and Gakusi, the demographic and health surveys and world fertility surveys from 32 African countries between 1950-2000 were used to construct and analyse changes in mortality trends for under-five children. A logit model was fitted to mortality rates estimated from life table over the 50-year period and used to investigate whether a smooth health transition occurred. The effect of pediatric AIDS on declining trends in mortality was apparent. Adetunji and Bos in Jamison, Feachem, and Makgoba et al investigate the effect of post-colonial (1960-2005) structural changes on child mortality trends among SSA countries. In a recent study, Garenne (2015) reconstructed trends in under-five mortality rate for 35 SSA countries covering 1985 to 2010 using the Demographic and Health Surveys (DHSs). Contributions from HIV/AIDS, malaria, and emergency situations (political, economic, and social crises) were significant in explaining the aggregate mortality levels, and regional trends as well as country-specific trends. Ahmad and Inoue compared under-five morality trends between developed and underdeveloped countries for the period 1950-2000. A marked reduction in global trends in all WHO regions was reported by the early 1970s and continued throughout the 1990s, with Africa as the least effective performer. They found no widespread evidence of rising child mortality rates.

From the above, the literature identifies wider underlying factors which might influence the success or otherwise of health interventions in developing countries. Our question, therefore, is what light these insights can shed on our understanding of why Nigeria, an emerging economy, consistently fail to attain child health goals in the past and may likely not do so with the SDGs target. Also, from the review of empirical studies on causes of childhood mortality trend fluctuations in Nigeria, none of the above studies, however, explicitly estimate the effect of the MDG on child mortality reduction either in Nigeria or elsewhere. Identifying the effect of the MDG on child mortality may shape on-going efforts to meet child mortality reduction target in the SDG. With less than 10 years to the deadline, meeting the SDGs target on child mortality reduction for Nigeria will require fast tracking progress in evidence based cost-effective interventions.

1.4 Method

1.4.1 Data and variables

I use data from several sources. The World Bank Poverty data is, however, the main source for variables including child mortality outcomes, GDP per capita, price inflation and public health programmes (such as the percentages of people with safe water, improved sanitation, and immunization). The World Bank Poverty data is a compilation of datasets from different sources such as the World Bank, UNICEF, WHO, and UN Department of Economics and Social Affairs. It uses the indirect source to obtain aggregate annual series for development indicators. I assemble annual series on child mortality outcomes as well as their predictors covering a period of 25 years for this study (1990-2015). This scope is considered sufficient to identify the existence of a meaningful pre-and-post intervention trends of the MDG. Also, the data on mortality outcomes are comparable because the period of analysis (1990-2015) is within the time when the methods of surveys were harmonized across countries in the region (Wang, 2002).

Data on the level of under-five mortality by cause for the period 2000-2015 were extracted from Liu et al., (2017). They estimated the number of child deaths by cause as the product of the number of age-specific deaths due to all causes and age-specific and cause-specific mortality fractions. Liu et al., applied a framework with three components for the cause-specific mortality functions: (i) component for countries with adequate vital registration data; (ii) component for countries with inadequate vital registration and low under-five mortality rate (<35 per 1,000 livebirths in 2000-15); (iii) component for countries with inadequate vital registration and high under-five mortality rate (≥35 per 1,000 livebirths in 2000-15). The cause-specific mortality functions (CSMFs) are modelled using multinomial logistic regression with empirical input CSMFs computed from number of deaths by cause and their distal (socioeconomic indicators) and proximate (e.g., childhood life-saving intervention coverage values) determinates of child survival. A detailed description of the estimation framework is provided in Liu et al., (2017).

Key independent variables

Economic institution (Corruption)

In line with the literature, I use control of corruption as a proxy for economic institution (see for example, Mauro, 1995). It is supposed to capture the incentive for human capital investment through the supply of public services such as education and health care in societies (Reinikka and Svensson, 2004). It is likely to influence the provision of health care through the construction and rehabilitation of quality health facilities and equipment (Vian, 2008). Indeed, Gupta, Davoodi and Tionson (2000) found evidence of a strong association between corruption and child mortality. I use the corruption index constructed by the World Bank worldwide governance indicators (WGIs). It captures the perceptions by experts, households, and businesses of the extent to which public power is used for private gain. It has a value of -2.5 to 2.5: the higher value signifying stronger institution. The WGIs are available annually (with some missing annual observations) from 1996 to 2019 for many countries.

There are alternative indices of corruption constructed from the Political Risk Services/International Country Risk Guide (PRS/ICRG) database and Transparency International (TI). These indices do not only have insufficient series covering the pre-MDG and MDG eras but are unlikely to have clearly capture corruption in the health care sector across countries in the SSA sub-region. For instance, while the PRS/ICRG reflects the perception of foreign investors about the extent of corruption in an economy with regards to service provision in the issuance of import and export licenses, tax assessment, exchange controls or police protection, the corruption perception index of the TI captures perceptions of business-people and country experts on the extent of corruption in the public sector.

Political Institution (Regime type)

I measure the effect of political institution using the regime type index source from the Centre for Systemic Peace/Integrated Network for Societal Conflict Research data. It is an index of constructed annual measures for both institutionalized democracy and autocracy with a regime score that ranges from +10 (full democracy) to -10 (full autocracy). It is available annually from 1946 to 2018 for all independent countries with total population greater than 500,000. There is evidence in the literature that regime type could be associated with mortality (see for example, Ruger, 2005; Safaei, 2006; Bollyky, et al, 2019).

Geography

To capture the impact of weather on child mortality, I use annual temperature and rainfall anomalies in line with the literature (see for example Marchiori, Maystadt, and Schumacher, 2012; Henry and Dos Santos, 2013; Maystadt and Ecker, 2014). The anomalies indicators show the intensity of abnormal weather, and the extent to which the differ from their 'normal' long-run conditions. They (anomalies) are computed as the deviations from a country's long-term mean, divided by its long-run standard deviation. I take the mean for a period of 25years (1990-2018) as long run due to data unavailability for some countries in the sample.[19] As in Maystadt and Ecker (2014), I describe years with positive and negative temperature anomalies as drought and non-drought years respectively. Similarly, years with positive and negative anomalies are consider as drier than normal and wetter than normal. In largely agrarian subsistence societies, I expect deficit in rainfall and high temperature to increase the risk of childhood mortality through the malnutrition and changes in diseases environment routes in line with the literature (see for example Kudamatsu, Persson, and Stromberg, 2012; Baker and Anttila-Hughes, 2020). The annual series on rainfall and temperature were obtained from the University of East Anglia Climatic Research Unit (UEA-CRU, Harris, Jones, and Osborn, 2020). The Climatic Research Unit (CRU) produces data that are interpolated from a network of stations at a spatial resolution of 0.5 degrees latitude and longitude. The CRU data are available, both monthly and annually, from

[19] In line with Marchiori, Maystadt, and Schumacher (2012), I measure weather anomality as:

$$WA_{i,t} = \frac{WA_{level,i,t} - LRmean(WA_{level,i,t})}{LRstd(WA_{level,i,t})}$$

Where WA represents weather anomaly for either rainfall or temperature, $WA_{level,i,t}$ is the level of either rainfall or temperature of country *i* in year *t*, $LRmean(WA_{level,i,t})$ and $LRstd(WA_{level,i,t})$ are the country i's mean value and standard deviation, respectively, in rainfall or temperature over the long-run reference period.

1960 to 2020. I use annual weather anomalies measure at country level given the data structure of the study. It is likely that a different climate-mortality effect may be identified with less aggregated data that exploits spatial heterogeneity using daily/monthly anomalies.

Ethnic Fractionalization

It is likely that countries with a more fractionalized ethnic structure may be less able or willing to provide its citizens with public goods such as education, physical infrastructure, and health as pointed out by Wimmer (2015). This is because, the existence of many ethnic groups with divergent preferences, values, and beliefs might increase collective action and coordination problems and in consequence, lower levels of public goods provision (Alesina, Baqir and Easterly, 1999). Data on ethnic fractionalization was sourced from the historical index of ethnic fractionalization (HIEF) dataset (Lenka, 2019). It is the probability that two persons drawn at random from a country's population will belong to the same ethnolinguistic group (0, where all individuals are member of the same ethnic group to 1, where everyone belongs to an ethnic group). The HIEF dataset contains an ethnic fractionalization index for 165 countries annually from 1945 to 2013. It is from the Composition of Religious and Ethnic Groups (CREG) project initiated by the Cline Centre for Democracy, University of Illinois. The inclusion of the variable in the model has support in the literature (La Porta, et al., 1999). La Porta, et al. found a strong and robust association between ethnic fractionalization and infant mortality.

Conflict

In the model, I control for conflict due its persistent adverse effect on children over their life course and to subsequent generations given birth to even after the conflict has ended (see for example, Wagner et al., 2018). A study of 46 SSA countries shows that countries with recent conflicts are likely to have higher under-five mortality rates compared to countries without recent conflicts (O'Hare and Southall, 2007). Millions of deaths have been associated with armed conflict in the Democratic Republic of Congo (Coghlan et al., 2007). Also, conflict can influence child mortality indirectly through displacement and malnutrition (Avogo and Agadjanian, 2010; Aaby et al, 1999; Depoortere et al, 2004; Cliff, et al., 1997; and Grein et al., 2003). In measuring conflict, I use an indicator of a conflict year and the intensity of conflict from the

Conflict Data Programme/Peace Research Institute Oslo dataset version 20.1. The dataset provides yearly series for conflict occurrence and its intensity. Armed conflict, defined as contested incompatibility that concerns government and/or territory where the use of armed force between two parties of which at least one is the government of a state, is categorized as minor if battle-related deaths is between 25 and 999 and coded 1 in the dataset. It is considered a war and coded 2 if at least 1,000 battle-related deaths occurred each year. With an alternative source of conflict dataset, the Armed Conflict Location and Event Dataset (ACLED), it will be possible to construct a broader measure of conflict comprising of the total number of *violent conflict events* including riots, battles, explosions, and violence against civilians at the country level. However, for countries in the study, violent conflict events are only available from 1997. All the variables used are described in Table 1A.1 (Appendix 1).

1.4.2 Empirical strategy

This study uses the Interrupted Time-Series (ITS) single design to test the hypothesis whether the introduction of the MDGs interrupts the under-five mortality trend. In the ITS framework, an intervention is expected to "interrupt" the trend of the outcome variable after its introduction (Linden, 2017). The basic idea is to determine whether the data pattern observed pre-intervention is different from that observed post-intervention (Hudson, Fielding and Ramsay, 2019). In describing the impact of the intervention, it is important to check whether a change in slope between the pre-intervention and post intervention correspond to the difference in the time point of interest (Ramsey, et al, 2003). The ITS is considered suitable for the evaluation of population-based interventions that are implemented either without randomization or without any control (Bernal, Cummins and Gasparrini, 2017), a model to which the MDGs conform. Also, with a defined start year, the MDG effect can be analysed as discrete since under-five mortality rates can be ordered as a time series with observations in both the pre-MDG and post-MDG periods.

Following Linden and Arbor (2015), I specify the ITS regression model of single design-without a comparable group as:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \varepsilon_t$$

where Y_t is the aggregated outcome variable (child mortality rate) measured at each equally spaced time t, T_t is the time since the start of the intervention, X_t is a dummy (indicator) variable representing the intervention (pre-MDG period=0, otherwise=1), $X_t T_t$ is an interaction term, β_0 represents the intercept or starting level of under-five mortality in a country i, β_1 is the slope of under-five mortality until the introduction of the MDG, β_2 represents the change in under-five mortality rate following the introduction of the MDG in comparison with the counterfactual, and β_3 represents the difference between the pre-and-post MDG slopes of under-five mortality rate. While a significant p−value in β_2 indicates an immediate treatment effect (short run effect), a treatment effect over time from the MDG is be identified by a significant p−value of β_3.

In identifying the ITS model without a comparison group (single-group ITS), the pre-MDG trend is projected into the MDG era and serves as the counterfactual. Effectively, it is assumed that the rate of change of any time-varying unobserved confounder is relatively slower and can be identified from the sharp fall of the intervention indicator. Causality can be implied to the intervention effect estimate if the change in slope is significant following the introduction of the intervention. That is, a flat pre-intervention trend is expected to precede a significant change in slope after the intervention to indicate an effect. However, if a trend already exists in the series prior to the intervention, attributing any change in trend slope to the intervention will need clear evidence of a significant break in trend at the intervention. In the ITS framework, it is possible to control for potential sources of bias from time-varying confounding factors. Hence, I control for factors including institutions, geography, conflict, income, food prices, and ethnic fractionalization. In addition, I investigate autocorrelation, a concern common with time series data. I estimate the model using Newey-West standard errors allowing for a two-period lag. To establish robustness, I use an alternative estimator, the Prais estimator that returns with a Durbin-Watson (DW) statistics and compare the results.

The ITS may be considered as a reasonable replacement for the RCT, especially where the study designs are without controlled populations nor any form of randomization in their implementation. In a multiple design, the ITS attempts to emulate the randomization process of an RCT by finding (or creating) a control group that is approximately equivalent to the treatment group on known pre-intervention characteristics, assuming that the remaining unknown characteristics are strongly unlikely to bias the results. The ITS has been used to evaluate the impact of preventive and treatment interventions (Lau, Murray, and El-Turki, et al, 2015; Hawton, Bergen, and Simkin, et al., 2013), effect of ban/legislation introduction (Dennis, Ramsay et al 2013; Grundy, Steinbach, et al., 2009) and random financial shocks (Lopez, Gasparrini, Artundo, and Mckee, 2013). Also, the use of ITS as a study design in the evaluation of population-level health interventions has historical support in the literature (Campbell and Stanley 1966; Glass, Willson, and Gottman 1975; Shadish, Cook, and Campbell 2002; Linden, 2015).

1.5 Results

1.5.1 Descriptive statistics

In Table 1A.2 (Appendix 1A), I provide summary statistics to show the pattern of mortality change before and after the introduction of the MDGs. I note first declining trends in child mortality outcomes over the period of analysis. However, the rate of decline appears to be the same before and after the introduction of the intervention. More specifically, an annual gain of 3 under-five survivors per 1,000 live births, on average, was achieved in both the pre-MDGs and post-MDGs eras. In fact, the annual gain in neonatal survival was below 2 deaths per 1,000 live births both before and after the introduction of the intervention and in some cases, no gain was recorded over time. Second, I assess the extent of progress in reducing levels of under-five mortality across SSA countries over the MDG era in Table 1A.3 (Appendix 1A). I find that some countries recorded increases in the absolute number of under-five deaths between 1990 and 2015. More specifically, the number of under-five deaths in Nigeria increased from 853,177 in 1990 to 867, 269 in 2015. In addition, I note that at the end of the MDGs campaign, majority of SSA countries were unable to meet the target of 60 under-five deaths per 1,000 live births as reported in Table 1A.4 (Appendix 1A).

Finally, I identify countries that have made progress from high mortality status to attain the MDG4 target by the end of 2015 (the achiever countries) in Table 1A.5. I note that the rates of under-five mortality decline amongst the achiever countries were much slower compared with the non-achievers. While majority of the achiever countries experienced steady progress in child survival between 1990 and 2015 to attain the child mortality goal (though with no clear evidence of a sharp decline in mortality rate following the introduction of the MDGs campaign), countries such as the Seychelles, Mauritius, Cabo Verde, South Africa, and Botswana had under-five mortality rate below the MDG4 target since 1990. The above descriptive evidence motivates the research question of what is the effect of the MDGs on child mortality outcomes? To what extent are health interventions in the MDGs associated with child mortality reduction? I investigate these research questions in greater detail below.

1.5.2 ITS results

I use the ITS single-group design to investigate the effect of the MDG on child mortality. I perform the ITS using the Newey OLS, an estimator that adjust for standard errors which are robust to autocorrelation and heteroscedasticity. The MDG effect is identify by observing whether there is a statistically significant 'jump' in the mortality trend following the introduction of the intervention. The basic intuition is that, where there is a repeated measure of the process of interest, the annual under-five mortality series, the MDG treatment effect can be measured in terms of its impact on the mean or the trend slope.

I present the results in two phases. In the first phase, I present results for Nigeria as reported in Table 1.1, while results for all countries in the SSA region as reported in Table 1A.6 (Appendix 1A) are analysed in the second phase. In general, I found evidence that childhood mortality reduces with the introduction of the MDGs in some countries, but it is unclear whether such evidence can be interpreted as causal. Effort to interpret the evidence runs into identification problems. Precisely, when I control for confounding factors in the model, I found less conclusive evidence of an MDG effect on child mortality in the region. In Nigeria, though child mortality declined with the introduction of the MDGs, the existence of a significant underlying declining trend, and the absence of a further change in annual decline in mortality rate when I compared the pre-and-post MDG trends in the adjusted model makes it unclear whether the mortality change can be causally associated with the MDG campaign. For some countries, it appears that some national policies and programmes may have affected the mortality trend before and after the campaign.

In Table 1.1 (column 1), I estimate the MDG treatment effect without controlling for confounders but adjusting for a single lag period for Nigeria. The result indicates a mean mortality rate of 213 under-five deaths per 1,000 live births with a pre-MDG trend slope of -2.24 (p<0.0000, 95% CI=[-2.98, -1.51]). The pre-intervention slope suggests the existence of a statistically significant underlying trend of an annual decline in under-five mortality of about 2 deaths per 1000 live births before the introduction of the MDG. At the introduction of the MDG, a gain of 13 under-five survivors per 1,000 live births (-12.97; p<0.000, 95% CI=[-22.23, -3.81]) is observed. However, when I invoke the post-trend option to produce the post-intervention slope, I note a reduction in the rate of change of under-five mortality post-MDGs (-3.803; p<0.0000, 95% CI= [-4.4711, -3.1365]). In other words, the gain recorded at the introduction of the intervention appear to wither as only 4 additional under-five survivors per 1,000 live births occur annually at post-intervention. While the reason for the reduction in the MDG effect size is unclear, it suggests a possible reversal of gains achieved at the introduction of the intervention. This finding is corroborated in the visual display of Fig 1.1 (a). In column 2, I control for potential time-varying confounding factors. I note a reduction in the magnitude of the MDG effect estimate. To be precise, the MDG effect reduced by about six folds (-2.77; p<0.000, 95% CI = [-5.2955, 0.1096]) compared with the 13 under-five survivors gained in columns 1 at the start of the campaign. Also, I note a declining annual trend of 3 under-five deaths per 1,000 live births prior to the introduction of the MDGs. The existence of an underlying decreasing trend violates an assumption of the ITS for causal effect identification.

In addition, the result suggests that, in reducing child mortality, the form of political regime and price inflation may matter. To be precise, under-five mortality reduces by about 6 deaths per 1,000 live birth with a unit increase in the political regime score (-5.75; p=0.008 95% CI=[-9.744, -1.758]). Similarly, increase in food prices (CPI) reduces under-five survival chances (0.309; p=0.028 95% CI=[-9.744, -1.758]). The income and conflict variables, though with the expected signs, appear not to matter in reducing child mortality. Results for the climate variables were unexpected and insignificant. A tentative explanation could be the smoothed nature of the series which may have masked the spatial heterogeneity effect of the variables. Perhaps, a different weather-mortality relationship may be identified with less aggregated data. Finally, the result indicates that in reducing child mortality, it appears not to matter whether the country is ethnically fragmented. This may be because of the low variability in the ethnic fractionalization index over time. The ethnic fractionalization index in Nigeria has varied between 0.868 and 0.85 over 5 decades (1960-2013). This implies that

Nigeria is highly ethnically heterogeneous but with relative fractionalization stability. In theory, an ethnically fragmented country is likely to contribute to the choice of bad policies and consequently, poor child health outcomes. This is because with many heterogenous ethnic groups, there is likely to be competing ethnically based interest groups acting in self-interested manner. Such groups often agree less on the kind of public good they want, and this will result in lower provision of public goods.

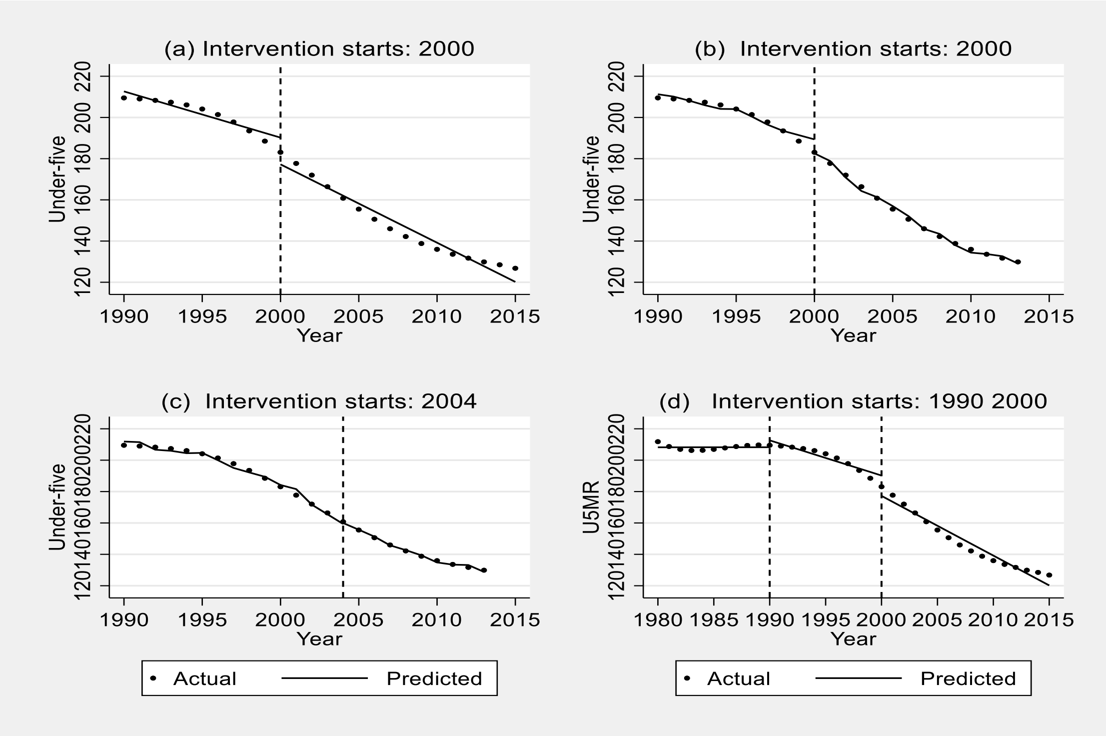

Figure 1.1 - ITS for Nigeria (a) Using year 2000 as start year without controls (b) Using year 2000 as start year with controls (c) Using year 2004 as start year (d) Using multiple start years, 1990 and 2000.

In the second phase, using the same specifications as in Nigeria, I investigate the MDGs effect for all SSA countries and results are presented in Table 1A.6 (Appendix 1). The results reveal countries with possible rising mortality trends and/or dwindling rate of mortality decline post-MDGs. Such countries will require complete overhaul or fast-tracking in child survival actions if the SDG3 target is to be achieved. When I estimate the models with and without controls, I note variations in the magnitudes of the MDG effects. Again, this suggests roles for factors such as institution, geography, ethnic fractionalization, conflict, and income in influencing child mortality in the SSA region. Precisely, the MDG effects sizes appear to be inflated without controls comparatively (see columns 2 and 5) in the cases of Botswana, South Africa, Senegal, Malawi, Madagascar, Rwanda, Zambia, Tanzania, Kenya, and Nigeria.

Table 1.1 - ITS regression results for Nigeria.

VARIABLES	(1) U5MR	(2) U5MR	(3) U5MR	(4) NMRT	(5) U5MR
_t	-2.242***	-3.288***	-3.431***	-0.539**	0.002
	(0.357)	(0.777)	(0.834)	(0.190)	(0.268)
_x2000	-12.97***	-2.775*		-0.922***	-12.97***
	(3.872)	(1.309)		(0.306)	(3.901)
_x_t2000	-1.561***	-2.019		-0.452	-1.561***
	(0.445)	(1.770)		(0.402)	(0.448)
GDPpc		-0.0078	-0.013***	-0.0023	
		(0.006)	(0.002)	(0.002)	
Ethnic Fragmentation		-237.1	-953.7	6.736	
		(1,164)	(1,199)	(319.3)	
conflict		1.590	2.358	0.168	
		(1.203)	(1.586)	(0.315)	
Rainfall		0.009	0.621	-0.187	
		(0.932)	(0.920)	(0.208)	
Temperature		-1.951	-0.772	-0.493	
		(1.287)	(0.730)	(0.337)	
Inflation		0.309**	0.136	0.0922***	
		(0.125)	(0.167)	(0.029)	
Political Regime		-5.751***	-5.961**	-1.107**	
		(1.848)	(2.010)	(0.405)	
_x2004			-3.629***		
			(0.990)		
_x_t2004			0.616		
			(0.739)		
_x1990					4.398*
					(2.349)
_x_t1990					-0.245
					(0.430)
Treated_1990					-2.242***
					(0.359)
Treated_2000	-3.803***	-5.306*		-0.990*	-3.803***
	(0.321)	(1.889)		(0.470)	(0.324)
Treated_2004			-2.815*		
			(1.334)		
Constant	212.7***	440.4	1,072	51.68	208.2***
	(1.738)	(994.2)	(1,025)	(271.5)	(1.656)
Observations	26	24	24	24	36

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Note: _t is time since start of the study; _x is dummy variable representing the intervention period; _x_t is interaction of _x and _t.

There were marginal changes in the MDG effect sizes of countries such as Cabo Verde, Mauritius, Sao Tome and Principe and Cote d'Ivoire. Notably, the MDG effects appear to be counter-intuitive in the Seychelles, Eritrea, South Africa, Lesotho, Ethiopia, and Mauritania (column 5). Indeed, there appear to be rising mortality trends (though not statistically significant) post-MDG in South Africa, Lesotho, Rwanda, and the Seychelles (column 6). This rising trend is visible in the case of the Seychelles as shown from the visual display in Figure 1A.1(a) (Appendix 1).

However, I note MDG effects that appear to be consistent with the ITS assumptions for causal inference in Botswana, Republic of Congo, Mauritius, and Rwanda from the regression results in Table 1A.6 (Appendix 1) and supported by virtual display in Figure 1A.1(a) (Appendix 1). In these countries, a sharp change in slope that can be associated with the timing of the introduction of the MDG campaign is apparent. In South Africa and Lesotho, there were rising underlying mortality trends that the introduction of the MDG failed to interrupt or reverse. In the case of Zimbabwe with rising pre-MDG trend that was reversed at the introduction of the campaign, there was no further change in the rate of annual decline when I compared the pre-and-post MDG trends. In fact, for countries such as the Seychelles, Eritrea, South Africa, and Mauritania, the introduction of the MDG appears to have counter-intuitive effect. In general, for majority of the countries, identifying an MDG effect was unclear as indicated by the results in Table 1A.6 and Figures 1A (b)-(f).

1.5.3 To what extent geography, institution, or culture explain child mortality outcomes?

In this section, I further examine the role of culture, geography, and institutional factors in shaping performances of countries in mortality change. Geography and institutional factors appear to remain at the heart of the historical debate on why developing countries, and in particular, SSA countries have failed to converge towards developed countries. While the institution hypothesis insists that institutions are the fundamental cause of long-run growth (Acemoglu, Johnson, and Robinson, 2005), the geography hypothesis asserts that "the role of geography and resource endowments in development should not be underestimated" (Sachs, 2003, p.38). It is argued that "Africa is poorer than the rest of the world not just because of pure geographical or cultural factors, but because of worse institutions" (Acemoglu, Johnson, and Robinson, 2001, p.1372). In the geography view, tropical diseases and the peculiarities of tropical soils could hinder long term economic development. Also, the geographical characteristics of a country—for instance whether a country is landlocked—could limit its ability to access a large economic market and therefore lowers its production efficiency (Gallup, Sachs, Mellinger, 1999). In effect, countries with geographical advantages in terms of having less prone disease environment (infectious disease burden could differ between tropics and temperate zones), lower transport cost, access to natural resources, and access to the coastline and sea might have better economic performances and improved child health outcomes relatively. On the other hand, Acemoglu et al., (2003) argued that poor macroeconomic performance by developing countries might be reflection of deeper institutional causes. Indeed, it is argued that diseases associated with the tropics can affect development, but only through institution (Easterly and Levine, 2003).[20]

In addition, I have established elsewhere that culture, through the pathways of beliefs and preferences may influence economic outcomes. It is likely that countries with a more fractionalized ethnic structure may be less able or willing to provide its citizens with public goods such as education, physical infrastructure, and health as pointed out by Wimmer (2015). This is because, different ethnic groups may have divergent preferences, values, and beliefs and this increases collective action and coordination problems with lower levels of public goods provision as a consequence (Alesina, Baqir, and Easterly, 1999). Ethnic groups may have polarised preferences over location of interventions such as health facilities in developing countries. From the sample, 7 countries can be classified as least ethnic fractionalised, using an arbitrary threshold of index value below 0.5.[21]

To investigate whether the performance of the MDG is driven by the geographic characteristics of countries, I estimate regressions for a sub-sample of countries identified using a time-invariant measure of geography, whether a country is landlocked. I note that the geographic characteristics of countries appear to matter with regards to their performances in reducing child mortality. From columns 4-6 (Table 1A.7, Appendix 1A), the MDG appears not to have had any significant effect among

[20] There is another opinion in the literature that the geography and institution hypotheses are interrelated (Parent and Zouache, 2012).

[21] Using the index value in 2000 as a marker, I classify Lesotho (0.298), Madagascar (0.093), Zimbabwe (0,402), Rwanda (0.246), Mauritius (0.468), Cabo Verde (0.436), and Botswana (0.427) as least ethnic fractionalized countries.

landlock countries except for Zimbabwe which is a close example of a trend interruption with possible casual inference. It is likely that the absence of geographical advantages such as access to coastline and sea may influence transportation cost and trade. To the extent such inhibiting tendencies for trade affect medical supplies, progress in child mortality action might be undermined.

I present regression results for countries with strong control over corruption in Table 1A.8.[22] I note an unclear pattern in mortality trends amongst countries with stronger control over corruption before and after controlling for confounding factors in the models. For instance, while Cape Verde and Sao Tome and Principe are the closest examples of a visible MDG effect, the impact of the campaign was unclear in majority of the countries with relatively stronger control over corruption (see Figures 1A.1[b]-[c], Appendix 1). This finding underscores the fact that geography, relative to institution may more likely compromise child health outcomes.

Finally, when I investigate the sub-sample of countries with least ethnic fractionalized index, I note MDG effects that appear to be consistent with the ITS assumptions for causal inference in Botswana, Mauritius, and Rwanda from the regression results in Table 1A.9 (Appendix 1A) and supported by virtual display in Figure 1A.1(a) (Appendix 1). In these countries, a sharp change in slope that can be associated with the timing of the introduction of the MDG campaign is apparent. In the case of Zimbabwe, I note a rising pre-MDG trend that was reversed at the introduction of the campaign though there was no further change in the rate of annual decline when I compared the pre-and-post MDG trends. Put together, the evidence suggests a possible role for culture in the performance of interventions in the sub-region. This is in contrast with earlier finding of insignificant effect of the ethnic fractionalization index in the linear regression.

[22] In 2000, only 8 countries had positive index (strong) of corruption control among the SSA countries: Botswana (0.83); Eritrea (0.68); Capo Verde (0.63); South Africa (0.62); Namibia (0.57); Seychelles (0.45); Mauritania (0.38); Sao Tome and Principe (0.19). The results hold when an alternative measure, the corruption graft index (corruption perception index) of the transparency international, was used to classify countries into high and low corruption. A country is classified as high corruption if its corruption score is greater than the median, otherwise, it is considered as low corruption.

Robustness

A brief historical account of the development of the MDGs suggest that it has its roots in the World Summit for children in 1990 (Bradford, 2002).[23] It is likely that this might have introduced some time varying confounders. Hence, I test for an "interruption" away from the true start of the MDG. To investigate if such an effect exists, I use a multiple-baseline design where the intervention is introduced at two different periods, a hypothetical 1990 and a true start year 2000. I extend the mortality outcome series to start from 1980 and re-estimate the models. This is necessary to obtain observations covering a period before the hypothetical intervention 1990 start year. Data unavailability is a limitation to using the multiple design while adjusting for confounding factors. Annual series starting from 1980 to 2015 for majority of the time-varying confounding factors are unavailable. For instance, the series for income in the World Bank dataset is only available from 1990. However, I extend the data for only mortality outcomes from 1980 to 2015 and re-estimate the specifications for all countries adjusting for multiple design. The results as presented in column 2 (Table 1A.10, Appendix 1A) indicate the absence of a structured pattern of declining trend across countries in the region in 1990. Majority of countries had positive slopes in mortality trends in 1990 suggesting the absence of an intervention effect. For countries with declining trend such as Madagascar, Malawi, Niger, Somali, Benin, Chad, Eritrea, and Ghana, it is unclear whether the decline can be attributed to any intervention occurring in 1990 given the rate of decline in mortality post-intervention. It is likely that this evidence will become less conclusive when adjustment is made for confounding factors.

Further, though Nigeria endorsed the eight MDGs in 2000 and it has constituted the basis and framework for development and instituting of health interventions (Sarwar, 2015 p.15), it can be reasonably argued that as a political agreement, time lag will be required between actions and implementations. To this end, I consider 2004, a 3year lag period, for implementation of programmes. The results in Table 1.1 (column 3) and

[23] The World Summit set specific goals on global child and maternal mortality, reduction in malnutrition, completion of primary education, adult literacy, access to safe water and sanitary services. There were follow-up summits within the same periods such as the 'Earth Summit' or 'Rio Summit' by the United Nations Conference on Environment and Development in June 1992, the World Conference on Human Rights in Vienna in 1993 and the Rome International Conference on Food and Nutrition in 1992. These summits motivated discussion on the global need to achieve freedom from hunger, which later became an MDG target of halving the number of malnourished people (Hulme, 2009).

Fig 1.1(c) are robust to the initial choice of 2000 as the start year. Thus, I conclude that for countries with statistically significant MDG treatment effect, it was only present at the true intervention year. Effectively, our choice of 2000 as start year is valid. I had implicitly assumed that the under-five mortality decline would occur with a year lag. I relaxed the assumption and re-estimate the model using a two-year lag period. The results in Table 1.1 (columns 1 and 2) are robust to variation in lag for Nigeria. Also, I investigate whether the MDG effect is robust to alternative definition of child mortality in column 4. I estimate the MDGs effect on neonatal mortality since factors affecting child survival may not be equally important throughout the period of childhood. I note a lower impact of the MDG on neonatal mortality rate which can be attributed to the protective effect of breastfeeding.

A test for autocorrelation was conducted given that a current mortality rate is likely to be correlated with previous observations (a potential case of serial dependence) and this is common when using linear regression models to fit time series data. I follow the procedure in Baum and Schaffer (2013). From the results, autocorrelation was only present at lag (1) but not at any higher lag orders. I argue that the Newey OLS regression-based model specifying lag (1) used in fitting data is sufficient to account for any potential autocorrelation. Further, I use an alternative approach that adjust for residual autocorrelation—the Prais–Winston estimator. It is implemented through the generalized least-squares method.[24] The Prais–Winston estimator transforms the time series by removing possible dependencies before analysing the treatment effects. In addition to using the Prais–Winston estimator, I specify the rhotype (tscorr) option, which bases rho on the autocorrelation of the residuals and adjust for robust standard errors. The results indicate marginal changes in the treatment effect estimates after the above adjustments. This is because the estimates produced by Prais are transformed and are not directly comparable with those of Newey produced using the Newey OLS estimator. However, the results in general confirm a significant decrease in the annual trend of under-five mortality at the start of MDGs for Nigeria. The Durbin-Watson statistics showed no evidence of autocorrelation given it p-value ($p>0.05$).

[24] Using the prais alternative, a Durbin–Watson d statistic is provided as an indicator of how well the model corrects for first-order autocorrelation. Formally, the D-W can take on values between 0 and 4 under the null hypothesis that d is equal to 2. If the Value of d is less than 2, a positive autocorrelation ($p > 0$) is suggested. On the other hand, if the value of d is greater than 2, a negative autocorrelation ($p< 0$) is inferred.

1.6 Explaining the pattern of mortality change in the MDGs era

To explain the pattern of under-five mortality trend in Nigeria during the MDGs era, I consider the role of public health programmes. The MDGs provided a framework for instituting intervention measures (Sarwar, 2015). The intervention programmes were initiated and implemented through public health services delivery. Hence, I assess whether changes in trends in the coverages of public health programmes can be associated with levels of under-five mortality by cause. To be specific, in assessing the role of immunization, I juxtapose trends in levels of mortality caused by measles with the coverage of measles immunization to show whether an association exist. From the trend plots, I note that changes in the rate of coverage of immunization against measles appears to be associated with the number measles related deaths (see Figure 1A.2, Appendix 1A). In particular, in 2009 when the coverage in measles immunization attains its peak with 67%, the annual number of under-five deaths from measles was at its lowest ebb with about 2,200 deaths. Similar relationship appears to exists between changes in the rate of coverage of diphtheria, pertussis, and tetanus (DPT) immunization and pertussis related under-five deaths. Also, from Figure 1A.2, I note that the rising trends in the coverages of populations with provision of safe water provision and sanitation services is associated with declining trends in the number of under-fives from diarrhoeal and malaria. These findings suggest a positive role for preventative actions in influencing child mortality in Nigeria. Notably, from Figure 1A.2, I find that the trend in the number of children dying from AIDS appears unchanged through the MDGs era despite rising trend in the coverage of Prevention of Mother-to-child transmission services (PMCT) and it is unclear why this is the case. This finding shed new light on a possible explanation for the unclear pattern of change in mortality for Nigeria.

The above associations are basically descriptive. A more robust econometric technique that controls for mediating variables and other unobserved heterogeneity will be required to produce an unbiased estimate of the effect of public health programmes on mortality changes. I argue that the interactions among childhood diseases are complex in developing countries. To precisely estimate the effect of an intervention, it will require specific study design that will clearly identify a particular intervention targeted at a population over time. For instance, in estimating the effect of a measles immunization programme on changes in mortality from measles, information on the epidemiology of the disease in the population, the vaccine administration (timeliness of administration), and the socio-economic characteristics of the targeted population among others will be required.

1.7 Discussion

In explaining the change in under-five mortality rate in Nigeria, and across countries in the SSA sub-region, I find unclear evidence of a causal impact of the MDGs. The study findings indicate that countries such as Cape Verde, Sao Tome & Principe, Congo Rep, Mauritius, Rwanda, Zimbabwe, and Botswana had changes in mortality that may be associated with the introduction of the MDGs campaign, but it is unclear whether such effect can be interpreted as causal.[25] There are findings in the literature suggesting that mortality could decline over time though such studies have used different methodologies, study populations and data sources (Garenne, and Gakusi, 2006; Garenne, 2015 and Adetunji and Bos in Jamison, Feachem, and Makgoba, et al, 2006). However, for majority of countries in the sub-region, the MDG effect appears mixed as revealed by the study findings. Results indicate the existence of statistically significant underlying trends without an apparent break in slope at the introduction of the intervention. This runs contrary to the ITS causal effects' identification assumptions. For such countries, isolating the impact of the intervention from time trend effect will be vital in implying an MDG effect. Indeed, under-five mortality rates appear to be rising with the introduction of the intervention for some countries such as Eritrea, South Africa, the Seychelles, Lesotho, Ethiopia, and Somalia.

In Nigeria, though child mortality appears to decline with the introduction of the MDGs, the existence of a significant underlying declining trend, and the absence of a further change in the annual rate of decline when the pre-and-post MDG trends are compared in the adjusted model makes it unclear whether the mortality change can be causally linked to the MDG campaign. Specifically, the result indicates a statistically significant "jump", a gain of 13 under-five survivors per 1,000 live births, at the introduction of the MDG. However, an annual decline of about 3 under-five deaths per 1,000 live births

[25] I note the trend reversal in Botswana which is apparent in Figure 1A.1(a) (Appendix 1). A possible explanation could be the action taken against HIV— The provision of universal free anti-retroviral treatment—and may be responsible for the drop in AIDS-related death from 18,000 in 2002 (a peak) to 4,800 in 2018 (USAIDS, 2019).

existed prior to the introduction of the campaign and has remained about the same after the campaign. Also, when I controlled for time-varying confounding factors, the effect at the introduction of the MDG reduces to about 3 additional under-five survivors.

To further explain the MDG effect, I consider the role of existing public health programmes on child mortality reduction during the era. The MDG constituted the framework for the implementation of the NEEDS and SEEDS. Intervention programmes were initiated and implemented through public health services delivery. Hence, I consider the role of public health programmes implemented during the MDG era in explaining the fluctuations in mortality trends. From the trend analysis, I find that preventative programmes such as immunization, safe water provision, and sanitation, may be associated with child mortality change in Nigeria. I find an unclear pattern when trends in the levels of under-five mortality due to HIV/AIDS and the coverage of women under the Prevention of Mother to Child Transmission (PMTCT) are juxtaposed. In Nigeria, the World Bank data indicates zero coverage of antiretroviral therapy for PMTCT within the first five years of the start of the MDG, 2000-05. In fact, about 50% of pregnant women with HIV had no access to antiretroviral therapy at the end of the MDG (World Bank, 2018). The WHO identify Mother-to-child transmission (MTCT) of HIV as the most significant source of HIV infection in children below 10 years (WHO, 2001). In a resource limited country like Nigeria, it is likely that daily drug regimen for women under PMTCT coverage are missed. It is also unclear whether replacement feeding, which involves the process of feeding children that are not initiated to breast milk with supplements, are available to majority of infants of infected mothers as a way to prevent mother-to-child transmission.

Notably, the finding that access to safe water and improved sanitation may have contributed to reducing under-five deaths is also suggestive of scaling-up actions. The provision of safe water and improved sanitation can interrupt the transmission of water-borne diseases such as malaria and diarrhoea from their sources. However, the World Bank estimates of the proportions of people using safely managed drinking water (15%) and improved sanitation services (26%) at the end of the MDGs campaign in 2015 (World Bank, 2018) show a wide variance from the expected universal coverage target of 90%. It is unclear why this is the case since Nigeria has enormous water resources with surface water potential estimated at 267.3 billion cubic metres and groundwater potential estimated at 51.9 billion cubic metres (Nigeria-PRSP, 2005). These resources can be harnessed to increase coverages of safe water provision and sanitation. Such action can be supported with other interventions like the distributions of low-osmolarity Oral rehydration Salt (ORS) and Insecticide Treated Netting (ITN). The ORS intervention is reported to reduce diarrhoea mortality in children by up to 90 percent (Koletzko and Osterrieder, 2009; Carvajal-Velez, et al, 2016). Similarly, the effect of ITN in preventing malaria is well established in the literature (Alonso, Lindsay, Armstrong, et al., 1991; Lengeler, 2004; Phillips-Howard, Nahlen, Kolczak, et al., 2003; Steinhard, et al., 2016).

The finding on the positive effect of immunization in the reduction of mortality is supported in the literature (Muhammed, 2015). This suggests a role for the Primary Health Care (PHC) in achieving the SDG3 target. In Nigeria, programmes on immunization are implemented through the National Primary Health Care Development Agency (NPHCDA). The inclusion of combination vaccines such as the Pneumococcal conjugate vaccine-10 (PCV-10) and Pentavalent vaccine in the expanded routine immunization schedule can enhance vaccination cost-effectiveness in reducing mortality. At present, there are barriers in the administration of vaccines especially in remote areas. Using combination vaccines may be a way to overcome low coverage problem of vaccines uptake.

The findings on the effects of the MDGs on child mortality should be interpreted within the context of the study limitations. Alongside the MDGs, there were national programmes that could have affected the mortality trend before and after the MDG campaign. For a public intervention like the MDG, isolating its pure effect may require an ITS design that clearly identifies a specific intervention targeted at a population. This will allow for controlling of treatment interference or other intervention interruptions in the case where the population are exposed to more than one competing interventions. This will be needful in the identification of an unbiased effect. Second, the study uses an ITS design for a single group without a control. Future studies should consider the use of more robust ITS designs that create real counterfactual groups to improve on the validity of findings. The inclusion of a control group that is comparable on both the baseline level and trend of the aggregate outcome series, will allow for clear identification of disparity in trend changes between groups such that any changes in the intervention group not found in the control group can be interpreted as casual. In a recent paper, Linden (2017) has suggested the use of a novel matching framework to create a comparative group when estimating treatment effects in ITS—the ITSAMATCH procedure. In addition, it will be a significant value addition to the present study if further research considers statistically testing for non-stationary or secular trend in the outcome series. Identifying whether the mortality series is increasing or decreasing over time irrespective of any intervention or the existence of some seasonal or cyclical trends in the series will be needful.

Further, I have considered the MDG as a blanket intervention. Unbundling its various components such the safe water and sanitation project—the Water Aid project—and examining their effects on mortality, individually, may shed new light of the impact of the intervention. I have attempted in a naïve way to provide evidence of the relationships between public health programmes and mortality by cause, but this will require more advanced econometric techniques to make causal claims. Such evidence will be needful for cost-effectiveness analysis of interventions to embarked upon especially in the face on resource constrain. Finally, taking into consideration the above identified scope for value addition, and extending the analysis to other emerging economies could be a plausible agenda for future research.

1.8 Conclusion

This study provides an analysis of the role of the MDG campaign in influencing child mortality in Nigeria as well as across countries in the SSA sub-region. The empirical analysis demonstrates that the MDG effect in reducing child mortality is largely unclear. Though there is evidence that child mortality reduces with the introduction of the MDGs in some SSA countries, it is unclear whether such evidence can be interpreted as causal. Effort to interpret the evidence runs into identification problems. Precisely, when I control for confounding factors in the model, the evidence is less conclusive of an MDG effect on child mortality. In Nigeria, though child mortality declined with the introduction of the MDGs, the existence of a significant underlying decreasing trend, and the absence of a further decline in mortality rate when the pre-MDG and post-MDG trends are compared contradicts the ITS causal effects' assumptions. Perhaps the existence of other health programmes may explain the underlying mortality trends. The case of Nigeria is similar with majority of the countries in the SSA sub-region. In fact, in some countries there is evidence of rising trends with the introduction of the MDGs. While the reason for the mixed MDG effect is unclear, it is plausible to suggest that the interventions might be compromised by country-specific constraints identified in this study. This makes it vital for policy to consider underlying constraints such as institutions, geography, conflict, and culture as factors that may compromise progress in the formation and implementation of health interventions.

The results have four policy implications. First, from our findings, it is unlikely whether the MDG intervention has started a health/epidemiological transition in the region. A sustainable decline in under-five mortality will be necessary in fertility reduction efforts needed to exit a possible demographic trap. Second, it is also uncertain given the pattern of changes in mortality trends whether the SDG3 target will be achieve by 2030 for most SSA countries. Hence, fast-tracking progress in child survival efforts is imperative in the on-going SDGs in some countries to halt possible reversal of "gains" recorded in child mortality decline which appear to exist at post-MDG intervention. This could be achieved by deliberate promotion of public health programmes facilitated by supply sided policies of international and domestic child health stakeholders. Third, an inference from the findings suggests the scaling of public health programmes to universal coverage but this may require accelerating the efficiency of health system guided by the ideals of transparency and probity in the administration of aid, public health budget and donor funds. Finally, the culture of depending on development organizations to influence health outcomes in developing countries might require a re-evaluation. Paucity of fund by international organizations implementing the MDGs has been implicated in explaining why targets were unattained. In line with the Addis Ababa Agenda on financing for development, mobilization of domestic public resources will be critical to realizing sustainable development and achieving the SDGs.

In chapter 1, I estimated the effect of the MDG on child mortality in Nigeria, and across countries in the SSA sub-region. In explaining child mortality levels and rates in developing countries, there is the argument whether policy focus should be on socio-economic or health interventions. This raises the question about the primacy of economic growth argument in the development strategy for developing countries. Economic growth has consistently been emphasised in the development strategy of the

United Nations for developing countries. Indeed, with the MDGs, a targeted pro-poor growth rate of 7% was suggested as a requirement for attaining the goals. With the conditioning of the attainment of development goals on sustained economic growth, chapter 2 addresses the question of what is the relationship between growth and child mortality? Also, the chapter will investigate the hypothesis whether there is a structural break effect of economic growth on child mortality in line with the growth reform — the pro-poor growth—introduced with the MDGs.

Chapter 2

The role of pro-poor economic growth in child mortality decline in the MDGs era: Implications for Nigeria

2.1 Introduction

Does change in economic growth pattern introduced with the MDGs has a structural break effect on child mortality across SSA countries, and over time? It has been argued that about half a million under-five deaths would have been averted in Africa in 1990 alone if the continent's economic growth were 1.5% higher in the 1980s (Pritchett and Summers, 1996). The Millennium Development Goals (MDGs) advocated a pro-poor growth which is expected to be facilitated by pro-poor economic policies, hence regarded as pro-MDG economic growth (Sarkar, 2007; p.2). Understanding how this form of growth reduces mortality could, therefore, be vital in attaining the on-going child health targets of the Sustainable Development Goals (SDGs).

The pro-poor growth is supposed to occur through output expansion in pro-poor sectors such as manufacturing and agriculture. This is expected to increase national and individual level resources differently from a *traditional growth*. Aside enhancing the incomes of the poor which will increase their access to food, safe water, sanitation, health, and education, the pro-poor growth policy could be a pathway to improve development indicators for the SSA sub-region. Despite the potentials of pro-poor growth in influencing health outcomes in developing countries, it remains understudied. Though there is a vast literature on the effect of growth on mortality, there appear to be paucity of evidence on the relationship between the economic growth advocated in the international development strategy and child mortality in SSA countries and particularly, Nigeria. This chapter fills the existing empirical gap by addressing two research questions: i) What is the relationship between economic growth and child mortality; ii) Whether there is structural break in the effect of growth on child mortality following the introduction of the MDG. Investigating how changes in the economic growth patterns influence child mortality outcomes across countries in the SSA sub-region, and over time, could provide further insight into the debate of whether more attention should be given to socio-economic interventions.

To investigate the effect of growth on child mortality, I construct a panel dataset for 48 SSA countries for the period of 1990 to 2018. The data contain time-varying covariates including under-five mortality rate, GDP per capita, corruption, political regime, ethnic fragmentation, conflict, public service delivery, and anomalies of temperature and rainfall. There are three potential statistical problems in estimating the effect of income on mortality: endogeneity, simultaneity, and unobserved country-specific effects. Though income per capita is likely to reduce mortality, but it is also possible that the reduction in mortality could translate into higher income. Also, there could be the problem of omitted variable bias if there is the presence of country effect. Further, mortality rates tend to produce high persistence within country, and this can bias the estimates. To minimize the extent of these biases, I exploit the panel structure of the data using the Arrelano and Bond system GMM to estimate the growth elasticity on mortality. I employ an estimation strategy that rely on instrumental variables generated by the estimator to correct for endogeneity. To attenuate the potential bias from unobserved country-effects, I control for country-specific effects. Also, I include year dummies to remove time-related shocks from the errors. To deal with the problem of high persistence of mortality rates, I control for its lagged values directly in the empirical specification. The regressions use instruments based on the second lag of the endogenous variables and adjust for robust standard errors.

Result indicates that under-five mortality falls with income per capita with an elasticity of -0.42. That is, a random SSA country at the sample mean would avert 42 under-five deaths per 1,000 live births if income per capita were raised by 1%. When I control for corruption and regime type, as expected, the magnitude of the income elasticity reduced to -0.206. Further, I investigate the hypothesis that the magnitude of growth elasticity of mortality may depend on institutional quality across the SSA countries, and over time. Since the economic institution in a country will determine the creation of incentives for investment in physical and human capital and technology needed to spur growth, I investigate the role of *good* institution on mortality. I did not find evidence that the quality of institution matters in determining the growth elasticity of mortality.

Also, I test the hypothesis whether there is heterogeneity in the effect of growth on mortality between resource-rich and resource-poor countries. In principle, resource revenues should result in greater pro-poor spending—spending on social sectors such as education and health. Nigeria is a resource rich and oil producing country but with volatile economic growth rate. I split the sample into sub-samples of resource-rich and resource-poor countries and estimate growth elasticities for each sub-sample respectively. The result indicates that the impact of growth on mortality is only significant amongst resource-poor countries. This supports the argument in the literature that resource-rich countries tend to under-perform in terms of economic development compared to resource-poor countries (see for example, Sachs, and Warner, 1995). It is likely that natural resource curse may be operational in countries with point natural resources since such resources are more prone to rent seeking and conflicts (see for example, Boschini, Pettersson, and Roine, 2007). Perhaps, this may explain the performance of Nigeria and other resource-rich countries with respect to child health outcomes. Finally, I investigate whether there is structural break in the effect of growth on child mortality across countries in the SSA sub-region, and over time following the introduction of the pro-poor growth strategy. I estimate and compare the magnitude of the growth elasticities before and during the MDG era. I find that growth in the post-MDG era is less effective in reducing child mortality. That is, child mortality is still domicile amongst the poor in spite of the pro-poor growth policy adopted.

Section 2.2 discusses the study background. Section 2.3 reviews related literature on the effect of economic growth on child mortality in developing countries and analyses the evidence on pro-and anti-poor growth patterns. In section 2.4, I discuss the sources of data, variables, and estimation strategy. I use data from several sources and employ the system GMM developed by Arrelano (1995) and Blundell and Bond (1998) to estimate the model. As I shall argue, a dynamic model may better reflect the data generating process since the outcome variable, child mortality, can be persistent. Another motivation for the use of the GMM is the need to treat potential endogeneity concerns with some explanatory variables in the specification. In section 2.5, before the econometric analysis, I provide descriptive evidence of the association between growth in the MDG era and poverty measures for some selected countries in the SSA region. I use data from the World Bank's database of household surveys, the PovcalNet, to construct poverty measures and quintile incomes. Also, the data allow for the construction of Growth Incidence Curves (GICs). A motivation is that the distribution of income could matter in the relationship between health and income. That is, a stronger association between income and health may exist at the lowest quintile of the income distribution. With the GICs, it is possible to show whether economic growth has an equalizing (pro-poor) or disequalizing (pro-rich) effect on the income distribution. In addition, I present results from a system GMM estimation. I exploit variation in economic growth between two sample periods to establish whether a structural break effect exist on child mortality outcomes. Section 2.6 discusses the findings of the study and conclusions are drawn in the last section.

2.1 Background

Nigeria alongside other SSA countries incorporated the MDGs into its national development strategies and policy pronouncements since 2004 (Sarwar, 2015 p.15) and reaffirmed its commitment in 2010 (United Nations, 2010). In the Nigerian Poverty Reduction Strategy Paper, a growth rate of at least 7-8% that empowers the people is projected in line with the "human rights approach to development that places people at the centre of development efforts" (Nigeria-PRSP, 2005 P.9). The growth rate is considered adequate in meeting the MDG target of halving the incidence of poverty and in reducing the percentage of people living below the poverty line to 20%, from the current 70%, by 2015 (Nigeria-PRSP, 2005 p.12).

The pro-poor growth advocated in the poverty reduction strategy paper resonates with the paradigm of sustainable human development in the *Human Development Report* which suggests that development must enable all individuals to enlarge their human capabilities to full potentials and to put those capabilities to optimum use (UNDP, 1994). It is supposed to occur in labour intensive sectors with high concentrations of the poor such as agriculture, education, and health. For instance, leveraging the agricultural system, on and off the farm, can be vital in reducing poverty and raising living standards amongst the poor as pointed out by Beegle and Christiaensen (2019). However, increasing the incomes of the poor and vulnerable on agriculture will require appropriate structural, spatial, and institutional transformation since not all agricultural growth models are equally good for the poor (Christiaensen and kanbur, 2017). Specifically, raising the productivity growth in cash crops is shown to have smaller growth multipliers and greater poverty-to-growth elasticities than equal amount of productivity growth in staple crop (Diao et al., 2012). Growth occurring in pro-poor sectors through output expansion reinforced by strong linkage effects between sectors, can increase resources both at the national level for public investment and at the household level for the poor to purchase well-being.

However, an investigation into the trends of the real GDP growth rates and child mortality for the SSA sub-region and in particular, Nigeria, before and after the MDGs is revealing. Figure 2.1. depicts trends of real GDP growth rates and international crude oil prices. The overall economic performances for the sub-region and Nigeria appear weak and erratic as indicated by the fluctuations in the GDP per capita trends. In the case of Nigeria, an episode of growth acceleration occurring around year 2000 is visible. The Nigeria economy attained a 12.5% growth peak in 2002 but experienced a negative growth of -0.1% at the end of the MDG in 2015. Perhaps, the fluctuation in crude oil prices might explain the volatility of the economic growth as depicted in the trend plot (Figure 2.1). Such volatility in growth may adversely affect the economic prosperity of a country as pointed out by Ogwumike and Ogunleye (2008). This may explain why Nigeria, a country with the biggest economy in Africa, is considered as a resource curse. Despite the abundance of natural resources such as oil and solid minerals, the number of people living in poverty appears to be relatively high. According to the Nigeria Living Standard Measurement Survey (NLSS 2018-19), 40.1% of the total population are classified as poor. This translates to over 82.9 million Nigerians who are considered poor by the national standards (NBS, 2020). Other examples of countries in Africa that are considered to be resource curse include Seirra Leone, DR Congo and Angola. Thus, there is the argument in the literature that resource-rich countries tend to under-perform in terms of economic development compared to resource-poor countries (see for example, Sachs and Warner, 1995). Specifically, it is argued that point-source non-renewal resources such as oil and mineral could adversely affect development. It is further argued that natural resource curse only occurs in countries with low institutional quality (Mehlum, Moene, and Torvik, 2006). It is likely that natural resource curse for countries with point natural resources may exist because such resources are more prone to rent seeking and conflicts (Boschini, Pettersson, and Roine, 2007). On the contrary, there are studies suggesting that point natural resources are potential sources of growth and not curse (Cavalcanti, Mohaddes, and Raissi, 2011; Smith, 2015).

Additionally, Figure 2.2 shows cross-country correlation between under-five mortality and GDP per capita before and after the introduction of the MDGs. The figure suggests that the relationship between GDP per capita and under-five mortality rate is undefined. There are countries with high under-five mortality rates relative to GDP per capita, as well as countries at similar levels of GDP per capita but with different child mortality rates. This raises the question of the exact nature of relationship between economic growth and child mortality in the sub-region.

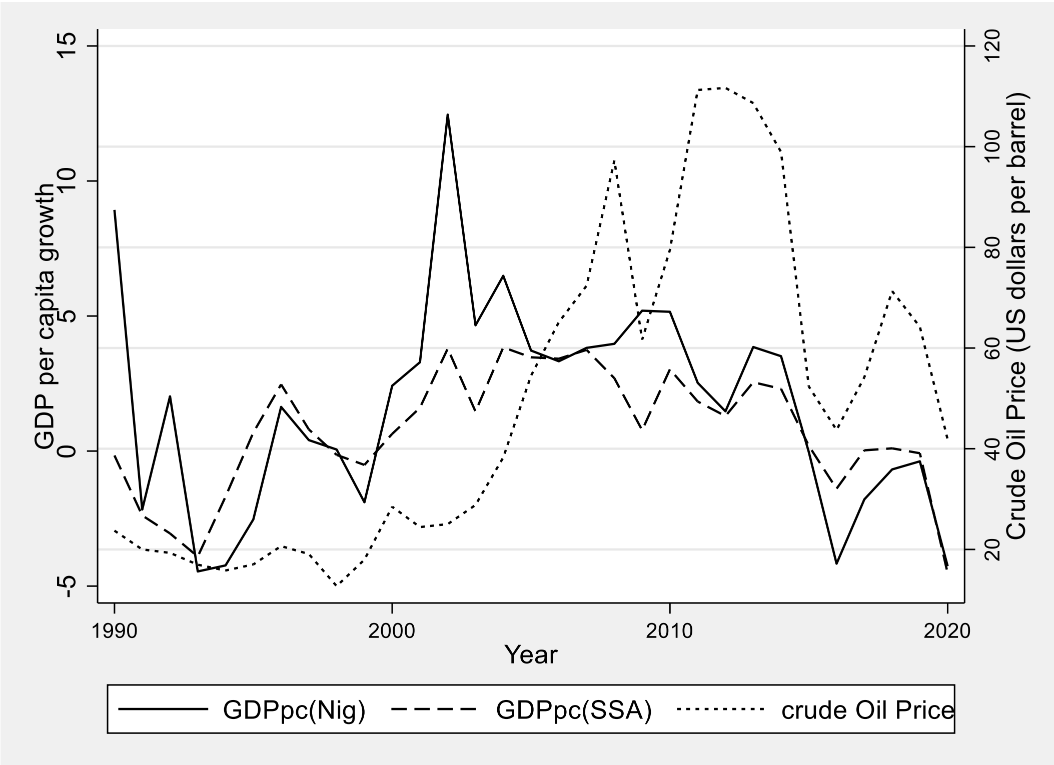

Figure 2.1 - GDP growth for the SSA sub-region and Nigeria, 1990-2018 (annual percentage change).

Data sources: (i) World Bank Poverty data (ii) Statistical review of World Energy.

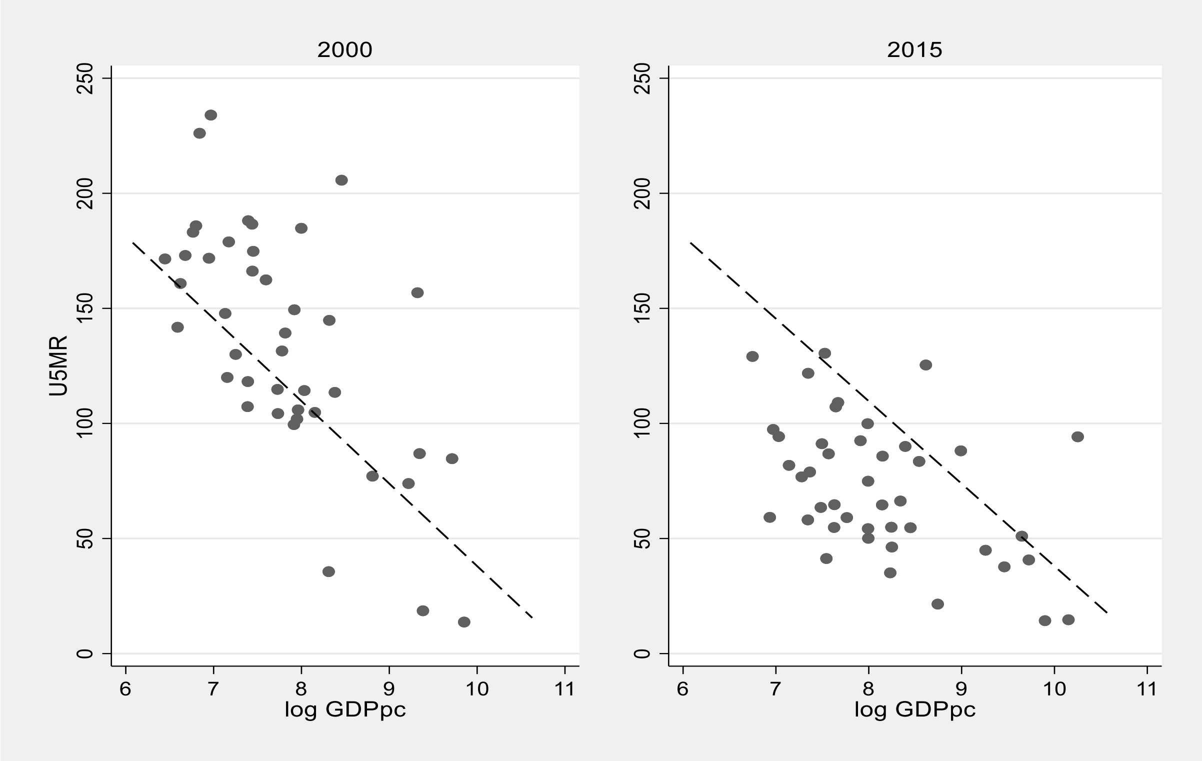

Figure 2.2 - Under-five mortality rate and GDP per capita for SSA countries (2000-2015)

Data source: World Bank Poverty data.

2.3 Related literature

This section reviews related literature on the effect of economic growth on child mortality in developing countries. Also, it analyses the evidence on growth been pro-poor or anti-poor. I highlight the debate in the literature about the extent to which the poor benefit from growth along two extremes: At one end of the spectrum is the view that liberal economic policies resulting in growth can raise the income of the population in an equi-proportionate manner. At the other extreme is the view that sharp increases in inequalities could be inherent in rapid economic growth and may undermine the potential benefits of growth for the poor or even offset it entirely.

In a World Bank report, Wang et, al. (1999) provides quantitative measures of 155 countries performances over the period 1960-90 on six health indicators (under-five mortality rates, total fertility rates, adult mortality rates for males and females, and life expectancy at birth) by gender relative to income and education, and over time. They used random-effects generalized least square regression since it allows for country effect to vary over different time periods, to provide a weighted average of between and within country results. The model allows the estimates to be conditioned by the sample in that the country effect has a distribution, and it is not fixed. The result indicates an income elasticity for the under-five mortality rate as -0.38, holding education constant. Compared with the effect of education, income was reported to predict health outcomes better over time. The results are robust to the use of a hierarchical linear modelling (HLM), a method they argued reduces bias in the standard errors.

Pritchett and Summers (1996) using instrumental variables estimation and data at five-year intervals over the period of 1960 up to 1985, across 58 developing countries find a causal and structural positive relationship between income and health. Their motivation to use five-year instead of annual difference hinges on data quality and the need to reduce measurement error and smoothen short term fluctuations as pointed out by Bhalotra (2008). The results of IV estimation using instruments including terms of trade shocks, investment ratios, price level distortion, and black-market premium indicates a growth elasticity of -0.29. An implication of the result is that if GDP per capita were 1% higher in developing countries, about 50,000 child deaths are likely to be averted annually. They estimated the global health consequences of various growth paths of income which was 2.5 lower, on average, for Africa and Latin America regions compared to other regions of the world. The result suggests that over 400,000 child deaths would have been averted across Africa and Latin America in 1990 alone, had the two regions experienced the same growth in the 1980s as they did in the period from 1960 through 1980.

A closely related paper with significant contribution to the present study is by Bhalotra (2008). The Bhalotra paper investigates to what extent economic growth is likely to reduce mortality rates across Indian 15 states over a period of 1970-1998. She estimates growth elasticities before and after a 1980 economic reform and use the growth elasticity of the post reform period to determine the required growth rate to achieve the MDG target. The results indicate that economic growth reduces child mortality with an unconditional growth elasticity of -0.7, and that growth in post-reform era is less effective in reducing child mortality. This study extends the work of Bhalotra in a number of ways. It uses an assembled panel data of 48 SSA countries, over a more recent period (1990-2018), and with specific reference to the MDG growth reforms. Also, in contrast to the Bhalotra paper where the growth elasticity of mortality was effectively estimated using the least squares dummy variable method, as I will show, this study exploits the panel structure of the data using the Arrelano and Bond system GMM to estimate the relationship. The estimator's ability to generate GMM-style instruments to correct for endogeneity concerns in the model makes it appealing. Also, this study uses a unique set of time-varying confounding factors including institution, ethnic fractionalization, climate, and conflict. It considers these factors to be relevant in estimating the growth elasticity for the study area. Like the Bhalotra paper, this study includes time effect in the model to allow for the identification of the distinct effect of economic growth from other time-related shocks. Due to data unavailability, the study does not investigate income distribution effects on child mortality inequalities. This limits the understanding of the effect of changes in income inequality on equity in child mortality outcomes.

Other studies that have estimated the relationship between economic growth and child health outcomes for developing countries include Stuckler, Basu, and McKee (2010) and Nishiyama (2011). Using data from 164 countries, Stuckler, Basu, and McKee (2010) investigates whether differential progress in attaining the MDGs child health goals is related with GDP per capita. The effect of growth alongside other covariates was estimated on measured distances of countries from achieving child mortality target, unmet MDG progress. The results indicate that a 10% increase in GDP per capita is associated with 1.8% and 1.64% increases in progress towards attaining the infant and under-five mortality targets respectively. Nishiyama (2011), using panel data from 83 developing countries over a period of 40 years, shows that economic growth broadly reduces infant mortality, and the impact could be asymmetrical during periods of booms (weak and mixed effect on mortality reduction) and slumps (strong adverse impact).

Though the above review suggests that increase in GDP per capita will improve child health outcomes, it is also possible that there could be increase in GDP per capita without corresponding child health gains if the increase in income is disproportionately accruing to the top 1% of the income distribution as pointed out by Pritchett and Summers (1996). This introduces the debate in the economic growth literature about the extent to which the poor benefit from growth. There are two extremes to the debate. At one end of the spectrum is the view that liberal economic policies resulting in growth can raise the income of the general population proportionately: the equiproportionate proposition. At the other extreme is the view that sharp increases in inequalities are inherent in rapid economic growth and this tends to undermine the potential benefits of growth for the poor or even offset it entirely: the anti-poor bias proposition. Below, I review the related literature along these two broad extremes.

The equiproportionate proposition implies that growth or growth-enhancing policies are not systematically associated with changes in the share of income accruing to the poor of any given society. This view is supported in the literature. For instance, Dollar and Kraay (2002) examine the relationship between growth in average incomes of the poor and growth in overall incomes for a sample of 80 countries consisting of both developed and developing economies. They define the poor as those in the bottom fifth of the income distribution of a country whose average incomes are proportional to the share of income accruing to the poorest quintile. They use the variation in the income share of the poor due to changes in average income to show the extent of income inequality. Their findings suggest that the income of the poor will rise one-for-one with overall growth (i.e incomes of the poor will rise equiproportionately with average incomes). This implies that irrespective of the nature of growth, growth is good for the poor and has no distributional effects.

Also, Gallup, Radelet, and Warner (1999) estimate the average income level of the poorest quintile and the corresponding income growth rate in 69 countries over time to show that aggregate economic growth is highly correlated with the incomes of the poor, and this relationship is one-for-one. On average and across countries in the sample, 1% higher average income levels correspond to 1% higher income levels of the poor, and 1% higher growth in average income corresponds to 1% higher growth of income of the poor, both in the long term and in the short term. While there are some countries in which the incomes of the poor grow more slowly, there are an equal number in which the incomes of the poor grow even faster than overall growth.

Similar findings were reached by Roemer and Gugerty (1997) who used the Deininger-Squire data set covering 26 developing countries to measure the growth of average income for both the poorest 20% and 40% of the population resulting from the growth of GDP per capita. Their research shows that an increase in GDP growth rate translates into a direct one-for-one increase in the rate of growth of average incomes of the poorest 40%. A related study by Timmer (1997), using the same data and method as Roemer and Gugerty, obtained an economic growth elasticity close to 1. Kraay (2006) in a recent study, confirmed the earlier findings in Dollar and Kraay (2002) using household survey data for a sample of developing and developed countries in the 1980s and 1990s. Unlike the earlier paper where relative measures of inequality were used, Kraay uses changes in absolute poverty measures as dependent variables (such as the headcount, the poverty gap, the squared poverty gap, and the Watts index). A simple correlation between the poverty measures and growth rates of mean income shows negative relationships, implying that poverty on average falls as average income increases. Thus, economic growth is good for the poor. Some studies have estimated a growth elasticity of poverty (using a head count ratio) higher than 2, indicating that when average income increases by 10%, the proportion of poor declines by more than 20% (Ravallion, 2000; Ravallion and Chen 1997; and Bruno et al., 1998).

The anti-poor bias view suggests that economic growth can be anti-poor when inequality increases as a consequence of growth such that the potential benefit of growth is more than offset by the adverse impact of rising inequality. Kakwani (2000) argues that in order to assess the impact of economic growth on poverty, the impact of changes in average income on poverty needs to be identified separately from its distribution effect. Kakwani develops an index of pro-poor growth that is applied to the empirical cases of Lao People's Democratic Republic, the Republic of Korea, and Thailand. Findings show that growth is not necessarily always good for the poor, revealing that economic growth in Lao PDR contributed to an increase in poverty in urban areas. In the case of Thailand, Kakwani observes that the pace of poverty reduction would have been much faster if income distribution had improved or at least not worsened following Thailand's phase of rapid economic growth.

Foster and Szekely (2000) corroborates Kakwani's finding using a method that is based on comparison of growth rates for two standards of living: the ordinary mean and a bottom-sensitive general mean, to evaluate the effects of growth on poor incomes using data from 144 household surveys from 20 countries between 1976 and 1999. The key indicator in their approach is the growth elasticity of the general mean. If the general mean grows faster than the ordinary mean, this is indicative that growth disproportionately benefits the poor. They discovered that growth is good for the poor, but not necessarily as good as for other segment of the population. McCulloch and Baulch (1999) construct two measures of the Poverty Bias of Growth (PBG) using data from the two Indian states of Andhra Pradesh and Uttar Pradesh between 1973 and 1989. The measures are estimated by deducting the change in poverty produced by the actual pattern of growth from a counterfactual that would have been produced if growth were distribution neutral. In Andhra Pradesh, growth was discovered to be moderately pro-poor but in Uttar Pradesh, growth was biased against the poor over the period of analysis.

The Kuznets's (1955) hypothesis on the relationship between economic growth and the distribution of income is well known in the growth and development literature. Kuznets opined that during the life cycle of an economy, income inequality rises at the early stage of development, recede during the juvenile stage, and declines at later stages of development. Thus, the full relationship between inequality and growth can be described by an inverted U-shape, implying that inequality first rises and later falls as the economy becomes more developed. Barro (2000) highlighted different models that feature a Kuznets curve in describing the relations between growth and inequality. The model by Robinson (1976), focused on the movement of individuals from agriculture to industry. He argued that economic development involves the movement of persons from the agricultural/rural sector which is characterised by low per capita income and relatively little inequality within the sector, to the industrial sector with high per capita income and, perhaps a relatively high inequality within the sector. At the early stages of development, inequality rises with level of per capita income because the persons who move experience a rise in income and this raises the economy's overall degree of inequality. At the later stages of development, the relations between level of per capita income and inequality tend to be negative since more poor agricultural workers are enabled to join the relatively high-income industrial sector. Also, the declining size of the agricultural labour force will tend to increase relative income in the sector. Hence, a reduction in the overall indexes of inequality will occur.

The model by Greenwood and Jovanovic (1990) uses the Kuznets curve to show how a shift from a financially unsophisticated environment to one of inclusion with the modern financial system could describe the inverted U-shaped inequality-growth relation. They argued that the early stages of development, is characterised by non-existent financial markets. As the economy approaches the intermediate stage of the growth cycle, financial superstructure begins to form, saving rates increases, and the distribution of income across the rich and poor widens. In the final stage of development, the distribution of income stabilizes across individuals, the savings rate falls, and the economy's growth rate recede but to a higher level than that at the early stage of development.

Another approach shows how technological progress tend to initially raise inequality in line with the Kuznets's proposition (See for example, Helpman, 1997; Aghion and Howitt, 1997). The basic insight is that technological innovations will require a process of familiarization and re-education, and this may result in few individuals getting to share initially in the relatively high incomes of the technologically advanced sector. As people move into this high-income sector, inequality tends to rise initially along with expanding per capita product, but subsequently falls as more people take advantage of the superior techniques. The income equalization will occur since relatively few people will remain behind eventually and because the newcomers to the more advanced sector tend to catch up to those who started ahead (Barro, 2000). However, the conventional Kuznets curve will only fit well in these theories depending on the history of the technological innovation, and the extent to which capita GDP is related to this technological history.

On an empirical level, Banerjee and Duflo (2003) pointed out why the Kuznets relation is likely not to be established. They argued that the imposition of a linear structure on data when estimating the relationship between inequality and growth might be responsible for the varied conclusions reach in empirical studies. They found that results from OLS regressions of cross-sectional data yields negative relationship between growth and inequality. The fixed effects approach, controlling for country-specific effects, indicates a positive relationship between changes in inequality and changes in the growth rate. In contrast, a three-stage least squares approach implemented by Barro (2000) found no relationship between inequality and growth but when the sample is split into poor and non-poor countries, a negative relationship in the former, and a positive relationship in the later sub-samples emerges. They conclude that it is likely that the data do not support the linear structure imposed, hence, the different conclusions (Banerjee and Duflo, 2003). Using theoretical models, they show that the political economy hypothesis—the view that inequality leads to redistribution and then redistribution hurts growth— predicts an inverted U-shaped relation between changes in the level of inequality and expected growth for the economy. Further, Banerjee and Duflo argue that the statistical agency responsible for measuring inequality may systematically mis-measure the indicator—especially in a crisis situation, and since these are also times when growth rates have high tendency of falling, a U-shaped relation between measured changes in inequality and changes in the growth rate is expected. Put together, the prediction from the above propositions allows for the data to be examine without imposition of a linear structure. Their results from different specifications suggest that changes in inequality (in any direction) are associated with future growth rates in a non-linear relationship. Similar finding was documented by Piketty and Saez (2003) using constructed annual series of shares of total incomes accruing to various upper income groups fractiles within the top decile of the income distribution across the United States covering the 1913 to 1998 period. They show that the top shares series display a U-shape over the century. They pointed out that a pure Kuznets mechanism cannot fully explain the shape of the relationship but factors such as changes in labour market institutions, fiscal policy, or social reforms regarding pay inequality may have contributed to shaping the wage structure.

In determining the predictors of child mortality in developing countries, some studies have identified individual factors such as maternal education (Caldwell, 1979; Kayode, et al. 2012; Adetunji, 1995; Ezeh, et, al. 2015;), religion (Ogunjuyigbe, et al., 2009), Age (Morakinyo and Fagbamigbe, 2017), breast feeding (Kayode, etal., 2012), employment status, mass media exposure, sex of the household head (Gayawana and Turraa, 2015), birth order and gender (Lawoyin, 2000) as predictors of under-five mortality. In addition, there are studies that have identified community/environmental predictors of child mortality to include cultural beliefs (Ogunjuyigbe, 2004), seasons (Lawoyin, 2000), environmental conditions expressed in food sold by vendors, sources of water, toilet facilities, carbon-dioxide emission, total fertility rate, electricity (Adeyemi et al., 2008), and urban advantage (Antai et al. 2010; Mesike and Mojekwu, 2012; Gayawana and Turraa, 2015).[26]

The factors identified above are conceptualized at the individual level. There may be different health implications for children living in poor households as compared with children living in a deprived society and in poor households. Hence, this study focuses on how macroeconomic factors, and in particular, GDP per capita influences child mortality in the most deprived sun-region of the world—the SSA. Also, it documents new evidence of the structural break effect on under-five mortality resulting from economic growth reforms in the region.

2.4 Method

2.4.1 Estimation strategy

In line with Bhalotra (2008), I express the specification for child mortality outcome as a function of GDP per capita and a vector of controls defined at country level. The Bhalotra specification include demographic variables such as gender, religion, ethnicity, age of mother, maternal, and father education. These were measured at the child or family level but aggregated up to the state level. Unlike the Bhalotra paper where the relationship between growth and mortality was effectively estimated using the least squares dummy variables method, I investigate persistence in child mortality using an alternative technique. I argue that child mortality, the outcome variable, GDP per capita and other control variables can be persistent with current levels depending on their past realizations, hence a dynamic model may better reflect the data generating process. I specify a dynamic panel data model as:

$$lnU5m_{i,t} = \Phi\ lnU5m_{i,t-1} + \propto lnGDPpc_{i,t} + \gamma lnGDPpc_{i,t-1} + \boldsymbol{X}_{i,t}\boldsymbol{\beta} + \delta_t + \mu_t + u_{i,t}, ---- (2.1)$$

[26] Urban advantage could be in the form of transportation, infrastructure and access to knowledge and technology, all of which protective to child mortality.

The specification suggests that under-five mortality ($lnU5m_{i,t}$) in a country i, can be explained by its past level ($lnU5m_{i,t-1}$) , by GDP per capita ($lnGDPpc_{i,t}$) as well as its lagged values ($lnGDPpc_{i,t-1}$), and a vector of time-varying factors ($\boldsymbol{X}_{i,t}$) including education (as well as its lagged values), corruption, regime type, conflict, ethnic fractionization, public health programmes, and anomalies of weather variables (temperature and rainfall). As earlier mentioned, while there is some form of persistence in mortality with current under-five mortality correlating with past levels, in the case of income, endogeneity due to reverse causality is possible since health may influence productivity and consequently, socio-economic condition of households which in turn could impact on health outcomes. This introduces the problem of dynamic endogeneity. Therefore, I include lags of under-five mortality and GDP per capita as instruments. Lags as instrumental variables can have the desirable properties of being correlated with the regressors, yet uncorrelated with the error terms. Also, in the model, δ_t denotes a full set of country dummies and μ_t denotes a full set of time effects capturing common shocks to mortality across all countries and $u_{i,t}$ is an error term capturing all other omitted factors, with $E(\mu_t) = 0$ for all i and t.

In identifying the effect of income on under-five mortality, I employ the system GMM developed by Arrelano (1995) and Blundell & Bond (1998). The problem of potential dynamic endogeneity in the model motivates the use of an estimation strategy that controls for lagged values of the variables of interest directly. That is, past realisations are used as valid instrumental variables to correct for potential endogeneity issues. The estimator's ability to generate GMM-style instruments to correct for endogeneity makes it a plausible candidate amongst dynamic panel models especially when it is difficult to find appropriate time-varying geographical or historically variables that could be used to instrument for income. Also, with multiple instruments in the GMM procedure, it is possible to investigate whether the assumption of serial correlation in $u_{i,t}$ can be rejected, and to test for overidentifying restrictions. I only report results from models that pass the specification test (the Hasen J-test) and the serial correlation test. In all specifications, I use robust standard errors, and double lag to instrument for all variables with potential endogeneity concerns.

In the modelling, I include year dummies to remove time-related shocks from the errors. In implementing the estimator there is the likelihood of proliferation of instruments as the number of instruments tends to increase exponentially with the number of time periods. This may result in the overfitting of endogenous variables and increases the likelihood of false positive results (Heid, Langer, and Larch, 2011). I control for such potential bias by estimating the model with a collapsed instrument matrix. More so, with the GMM procedure, it is possible to use instruments outside the baseline specification as excluded instrument for the endogenous independent variable. It was difficult to identify additional valid instruments. The results are sensitive to the addition of excluded instruments.

In addition, I control for a unique set of time-varying confounding factors including corruption, political regime, ethnic fractionalization, conflict, and climate-related variables in order to reduce the problem of omitted/unobserved variable biases. These factors are likely to influence the success of growth polices in the SSA sub-region. I rely on the fixed effects component of the GMM to treat all time-invariant country specific characteristics that are likely to bias the income parameter estimate. However, it is likely that there might still be some unobserved effects that are both country-specific and time-variant. For instance, there might be some country-specific policies on inequality that could determine the effect of income per head on health outcomes. Due to data unavailability, I did not control for inequality or policy on redistribution, but it is unclear whether this will significantly affect our results given the homogeneity of institutional structures across countries in our sample. In any case, the GMM framework is known to overcome estimation problems introduced by unobserved panel heterogeneity, dynamic endogeneity, and simultaneity and produce unbiased and consistent estimates under mild assumptions (Schultz, Tan, and Walsh, 2010).

In identifying the structural break effect of economic growth on child mortality post MDGs, I first estimate the relationship between economic growth and child mortality. I address the question of whether changes in GDP per capita influences under-five mortality outcomes across countries in the SSA sub-region over time. I find a statistically significant relationship, and this allow for the assessment of the impact of growth after the introduction of the MDGs. I argue that as a pattern of growth that is inclusive, the pro-poor growth is likely to allow a greater proportion of children access to basic nourishment and health care. It is supposed to occur in sectors with high concentration of the poor. Hence, policies and programmes that expand output in these sectors will increase resources both at the national level for public investment and at the household level for the poor to purchase well-being. A priori, I expect a stronger relationship between economic growth and child mortality post-MDGs. I use changes in GDP per capita to proxy the impact of changes in growth policy before and after the MDGs. Due to data unavailability, I use GDP per capita series aggregated at country level though this limits our understanding of how changes in income inequality due to the reform has impacted on equity in child health outcomes. I interpret the study findings in the context of this limitation.

Further, I split the data at year 2003, a potential structural break-point, and estimate the growth elasticities in the different sample period. I allow a 3-year lag period after the introduction of the campaign in 2000 for the implementation of policies and agreements by development agencies. As in Bhalotra (2008), I compare the growth elasticities for the two sample periods and test whether the differ statistically. If growth elasticity is stronger after the introduction of the MDGs, I may conclude that a structural break that is pro-poor has occurred with the introduction of the intervention. A problem with using the GMM approach is the inability to statistically test whether the growth elasticities differ between the sample periods. A classical test for structural break is the Chow test (Chow, 1960).[27] In implementing the chow test, I naively re-estimated the model using the Least Square Dummy Variable (LSDV) estimator. Using the above procedure, I conduct series of heterogeneous analysis. For instance, I test the hypothesis whether the structural break effect identified is different for resource-rich countries. This hypothesis is based on the argument that it will matter whether a country is resource rich in assessing the impact of growth on other economic outcomes.

[27] The classical test for structural break as in Chow (1960) was used. In applying the Chow test, the sample is split around the break-point into two sub-periods and the parameters for each sub-period are estimated. The F-test statistics is used to test the equality of the set of parameters.

2.4.2 Data and variable description

The World Bank open data catalogue is the main source for this study. The dataset comes from demographic and health surveys and censuses and is available at annual frequencies. To produce yearly observations, extrapolations and interpolations and sometimes simple estimate comparison with similar countries are used. International agencies such as the UNICEF, the World Bank, and the WHO are involved in the production of the data and will usually cross-check with national government statistics and independent social and demographic surveys for possible errors (Ross, 2006). Also, there is no known evidence of lesser quality of effect estimates produced using the dataset. Other data sources used include the Worldwide Governance Indicators (WGI) project database, Centre for Systemic Peace/Integrated Network for Societal Conflict Research data resources, the University of East Anglia Climatic Research Unit database, the historical index of ethnic fractionalization dataset, and the Uppsala Conflict Data Programme/Peace Research Institute Oslo dataset version 20.1. These datasets have been described in chapter one. In brief, I construct an unbalanced panel data set for 48 countries classified by the World Bank as constituting SSA. The panel data which covers a time span of 25 years (1990-2015), is meant to account for the period prior to, and during, the MDG era. The period of analysis allows for the assessment of the impact of the pro-poor economic growth reforms on child mortality.

I specify child mortality as a function of GDP per capita and a vector of covariates including education, corruption, weather variables, regime type, conflict, and public health programmes (sanitation, safe water provision, and immunization). While the *under-five mortality rate* is defined as the probability per 1,000 that a new-born baby will die before reaching the age of five, *infant mortality rate* is the number of infants dying before reaching one year of age, per 1,000 live births in a given year. For income, I use *GDP per capita* based on Purchasing Power Parity (PPP) in constant 2011 international dollars. The use of GDP per capita PPP makes it possible to compare the effect of growth on mortality on an international scale whilst controlling for inflation. It is expected that the value of a dollar in Ghana should be the same as in South Africa. The basic intuition is that accelerated pro-poor economic growth through output expansion in pro-poor sectors will increase national and individual resources, reduce inequality, and improve on household outcomes. To assess the impact of pro-poor growth on mortality, it is vital that the analysis captures changes in child mortality inequalities by income quintiles. However, disaggregated mortality and income data by quintiles appears sparse or unavailable for countries in the sub-Saharan Africa region. The available data limits our understanding of how changes in income inequality due to the reform has impacted on equity in child health outcomes. With less aggregated income and health outcome data, it would have been possible to estimate the precise effect of an increase in income growth of the bottom 10% on mortality amongst the population in the lowest socioeconomic status.

The effect of maternal *education* is measured using the primary school completion rates for females. In the World Bank dataset, it is measured as the number of new entrants in the last grade of primary education, regardless of age, divided by the population at the entrance age for the last grade of primary education. In line with the literature, I argue that the probability of a mother without schooling losing a child is higher compared to a mother with schooling (Cadwell, 1979; UNESCO, 2010; Summers, 1992; Semba, 2008). The chance of children dying may reduce with increasing maternal education. Cadwell (1979) pointed out several mechanism through which child mortality declines with increasing maternal education to include the likelihood to have later fertility schedule, react better to illness and decision-making during illness, better reception and utilization of health information, ability to change feeding and child-care practices without additional strain on household budget, and the ability to change the traditional balance of familial relationship which is vital for decision-making. Due to the quality of data on adult female literacy rate in the World Bank database, I use primary school completion rates for females as a proxy for maternal education.

In line with the literature, I use the *control of corruption* as a proxy for the quality of economic institution in a country (see for example Mauro, 1995). It is expected to broadly capture the societal incentive to invest in human capital through the supply of public services such as education and health care (Reinikka and Svensson, 2004). A strong control over corruption, especially in developing countries, will influence the provision of health care through the construction and rehabilitation of health facilities, control of quality health products, medical research, purchase and supply of health equipment, and drugs (Vian, 2008). I use a corruption index constructed by the World Bank worldwide governance indicators (WGIs). It captures the perceptions by experts, households, and businesses of the extent to which public power is used for private gain. It has a value of -2.5 to 2.5: the higher value signifying stronger institution. An alternative indicator of corruption can be source from the Political Risk Services/International Country Risk Guide (PRS/ICRG) database. However, the PRS/ICRG only reflects the perception of foreign investors about the extent of corruption in an economy with regards to service provision in the issuance of import and export licenses, tax assessment, exchange controls or police protection.

I control for *regime type* using a constructed index that measures institutionalized democracy and autocracy. It is a regime score that ranges from +10 (full democracy) to -10 (full autocracy). The argument about the influence of political institution on health outcomes appears to support a form of government that have checks on political powers which may prevent rent seeking behaviour but will promote accountability to taxpayers (North, 1990). In line with the literature, I expect a higher regime score to reduce child mortality (Ruger, 2005; Safaei, 2006; Bollyky, et al, 2019).

In controlling for *weather variables*, I use annual series on rainfall and temperature obtained from the University of East Anglia Climatic Research Unit (UEA-CRU, Harris, Jones, and Osborn, 2020). Precisely, I use annual temperature and rainfall anomalies in line with the literature (see for example Marchiori, Maystadt, and Schumacher, 2012; Henry and Dos Santos, 2013; Maystadt and Ecker, 2014). The anomalies indicators show the intensity of abnormal weather and the extent to which the weather variables differ from their 'normal' long-run conditions. I take the mean for a period of 25years (1990-2018) as long run due to data unavailability for some countries in the sample. I describe years with positive and negative temperature anomalies as drought and non-drought years respectively. Similarly, years with positive and negative anomalies are consider as wetter than normal and drier than normal (Maystadt and Ecker, 2014). In line with the literature, I expect deficit in rainfall and high temperature, especially in agrarian subsistence societies, to increase the risk of childhood mortality through the malnutrition and changes in diseases environment routes (Kudamatsu, Persson, and Stromberg, 2012; Baker and Anttila-Hughes, 2020).

Ethnic Fractionalization is defined as the probability that two persons drawn at random from a country's population will belong to the same ethnolinguistic group (0, where all individuals are member of the same ethnic group to 1, where everyone belongs to his/her own ethnic group) and originates from the Composition of Religious and Ethnic Groups (CREG) project initiated by the Cline Centre for Democracy, University of Illinois (Lenka, 2019). Following Wimmer (2015), I argue that countries with a more fractionalized ethnic structure may be less able or willing to provide its citizens with public goods such as education, physical infrastructure, and health. This is because, different ethnic groups are likely to have divergent preferences, values, and beliefs and this might increase collective action and coordination problems with lower levels of public goods provision consequently (Alesina, Baqir, and Easterly, 1999).

A motivation for the inclusion of the *conflict* variable is based on its persistent adverse effect on children over their life course and to subsequent generations given birth to after the conflict has ended as suggested by Wagner et al. (2018). In line with O'Hare and Southall, (2007), I expect countries with recent conflicts to have higher under-five mortality rate compared to countries without recent conflicts (O'Hare and Southall, 2007). In measuring conflict, I use an indicator of a conflict year and the intensity of conflict from the Uppsala Conflict Data Programme/Georeferenced Events Dataset (UCDP/GED). The dataset provides yearly series of armed conflict. In the UCDP GED, armed conflict is defined as any contested incompatibility that concerns government and/or territory where the use of armed force between two parties of which at least one is the government of a state. It is categorized as minor if battle-related deaths are between 25 and 999 and coded 1 in the dataset. It is considered as a war and coded 2 if at least 1,000 battle-related deaths occurred each year. With an alternative source of conflict dataset, the Armed Conflict Location and Event Dataset (ACLED), it is possible to construct a *broader* measure of conflict comprising of the total number of violent conflict events including riots, battles, explosions, and violence against civilians. That is, what constitute conflict in the ACLED has a wider domain compared to the UCDP GED. While UCDP GED restricts its domain to events that results in fatality, ACLED include non-fatal events as well as non-violent events (Eck, 2012).[28] However, in the ACLED, conflict events are only available from 1997 for sub-Saharan African countries. This limits the possibility of testing the robustness of the effect of the conflict variable to alternative data source.

For *safe water*, I use access to safe water measured as the percent of a country's population using an improved drinking water source. In the case of *sanitation*, I use the percentage of the population of a country using improved sanitation facilities. While access to an "improved" water supply has been defined as water availability of at least 20 litres per person, per day, from a safe source of not more than one kilometre from the dwelling, "improved" sanitation provision includes connections to a public sewer or a septic system; also pour-flush latrines, ventilated improved pit latrines and simple pit latrines (WHO/UNICEF, 2000).

I control for *immunization* because it is identified as the most cost-effective health intervention and a crucial determinant in child survival efforts in developing countries (Nelson 2004). It is argued that major causes of under-five mortality are preventable by vaccination. Immunization in this study is measured using the diphtheria, pertussis (or whooping cough), and tetanus (DPT) vaccination coverage rate. The DPT immunization measures the percentage of children ages 12-23 months who received DPT vaccinations before 12 months or at any time before the survey. A child is considered adequately immunized after receiving three doses of the vaccine. The above-mentioned variables and their sources have been described in greater details in Chapter 1 and are briefly presented in Table 2A.1

2.5 Results

2.5.1 Descriptive statistics

I present descriptive statistics of the variables in Table 2.1. To motivate findings, I divide the sample period into two: the pre-MDG era (2000) and post-MDG (2015).

[28] Another issue to consider when using the ACLED as pointed out by Eck (2012) is that the ACLED uses event (violent and non-violent) as the unit of analysis, and this makes no distinction between the intensity and nature of civil war. That is, events irrespective of their nature and intensity are given the same weight.

Table 2.1 - Summary statistics for SSA sub-region: pre-and post-MDGs.

	PreMDGs			MDGs		
Variable	Mean	Min	Max	Mean	Min	Max
U5MR	133.19 (50.48)	13.70	234.00	71.31 (29.58)	14.30	130.50
GDPpc	3789.83 (4331)	630.68	19011.92	5392.10 (6513.98)	852.75	28313.60
Female Education	29.23 (25.26)	4.70	85.50	49.50 (25.79)	13.86	108.75
Ethnic Fragmentation	0.67 (0.2144)	0.057	0.889	0.679 (0.205)	0.054	0.889
Rainfall	1082.09 (612.63)	66.6	2834.9	1108.21 (609.05)	78.1	2808.6
Temperature	24.52 (3.28)	11.6	29.1	24.85 (3.30)	11.6	29.4
Immunization	61.84 (21.49)	19.00	98.00	79.93 (18.54)	16.00	98.00
Sanitation	26.04 (21.25)	3.40	94.14	35.14 (22.41)	6.86	100.00
Safe water	55.96 (19.14)	18.70	99.28	65.88 (15.36)	38.98	99.87
Conflict	0.386 (0.689)	0	2	0.204 (0.461)	0	2
Political regime	1.07 (5.0286)	-6	10	2.833 (4.873)	-7	10
Corruption	-0.574 (0.638)	-1.83	1.2	-0.541 (0.656)	-1.72	1.14

Source: World Bank Poverty Data (2018)

From Table 2.1, there appears to have been progress in lowering child mortality overtime. To be specific, the average under-five mortality rate falls from 133 to 71 deaths per 1,000 live births before and after the introduction of the MDGs. Also, from Table 2.1, there have been increases in average GDP per capita (GDPpc) from 3789 US dollars in 2000 to 5392 US dollars in 2015. In addition to income, there are changes in covariates that are associated with child mortality. For instance, education, the rate of female primary school completion, on average has improved by 20% between 2000 and 2015. Similarly, there have been increases in the percentages of people having access to safe water (10%), improved sanitation (9%), and immunization of DPT (18%). Also, on average, the sub-region appears to be experiencing improvement in the political regime scores which rose from 1.07 in pre-MDG to 2.83 in post-MDG. However, ethnic diversity across the sub-region seems to be high and stable over time. The mean value of the ethnic fractionalization index, measured between 0 and 1, has remain stable in both the pre-MDG era (0.67) and the post-MDG era (0.679). Finally, it is unclear if any SSA countries achieved a sustained 7% annual real GDP growth rate target over the MDG era. It appears that only four countries, Equatorial Guinea (13%), Capo Verde (12%), Comoros (8%), and Mauritius (7%) attained a growth rate above 7% in 2015. While 6 countries had zero growth rate, 17 countries were experiencing negative growth at the end of the intervention (See Table 2A.2, Appendix 2).

2.5.2 Pro-poor growth, poverty measures and child mortality: Descriptive evidence

Before presenting the econometric results, I provide descriptive evidence of the association between growth and poverty measures in the MDGs era for SSA countries with available data. If the pro-MDG growth is pro-poor, I expect the growth in the average income of the poor to be associated with child mortality through increased access to MDG goods and services as well as other poverty measures. Hence, I show whether poverty headcounts, poverty rates, inequality, and most importantly child mortality have declined as a consequence of the pro-poor growth emphasized in the MDGs. In addition to the World Bank data on poverty initiatives described elsewhere, I use data from the World Bank's database of household surveys[29] —PovcalNet—to construct the poverty measures and average income by quintiles. PovcalNet is a database of household surveys administer by the World Bank research department. The dataset as well as the Stata command—povcalnet—use in estimating poverty measures have been described in detail elsewhere (Aguilar, et al., 2019). I estimate the average income of the poor and show its association with key poverty measures. This is possible since the average income by decile groups (average income of 10 decile groups with the poor define as those in the bottom tenth of the income distribution) is provided for in the PovcalNet dataset. Poverty is measured in terms of consumption for all countries (except for the Seychelles where income was used) and adjusted using the 2011 PPP

[29] http://iresearch.worldbank.org/PovcalNet/data.aspx

exchange rates for international price comparisons. Details of the method used, and data are provided in Ferreira et al. (2016) and World Bank (2020).

First, I show the trends in poverty headcount for the SSA sub-region and Nigeria during the period under analysis in Figures 2.3 and 2.4 respectively. I estimate the poverty headcount using the International Poverty Line (IPL) of $1.9 per day. I note that poverty headcount appears to be on a declining trend from 1996 for the sub-region as well as Nigeria (see Figures 2.3 and 2.4).

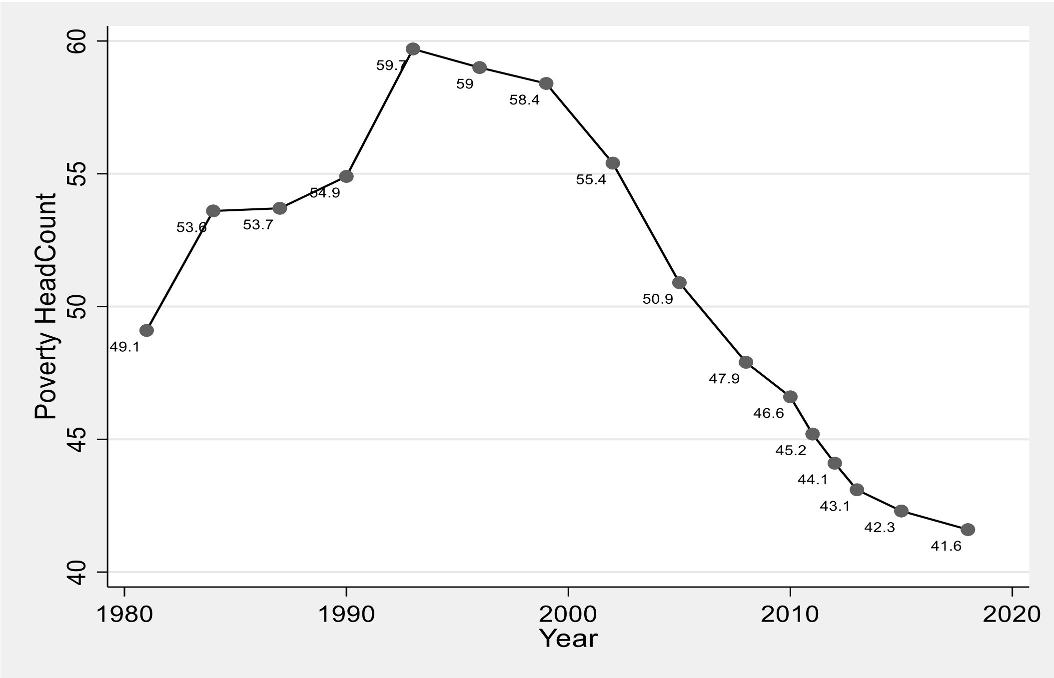

Figure 2.3 - Poverty Headcount Trend for SSA (1980-2015)

The sub-regional trend appears to reflect the poverty headcount trend for Nigeria suggesting the possible role of the later in influencing development indicators for the sub-region. However, a cautious interpretation of the above findings is required given the quality of data. For instance, there are missing annual observations in the poverty headcount series for Nigeria and this raises the concern of how well the trends are reflective of each other.

I investigate this evidence further by exploring whether inequality increases with GDP per capita. The anti-poor bias argument suggests that economic growth can be anti-poor if inequality increases as a consequence of growth so much that the potential benefit of growth can be offset by the adverse impact of rising inequality.

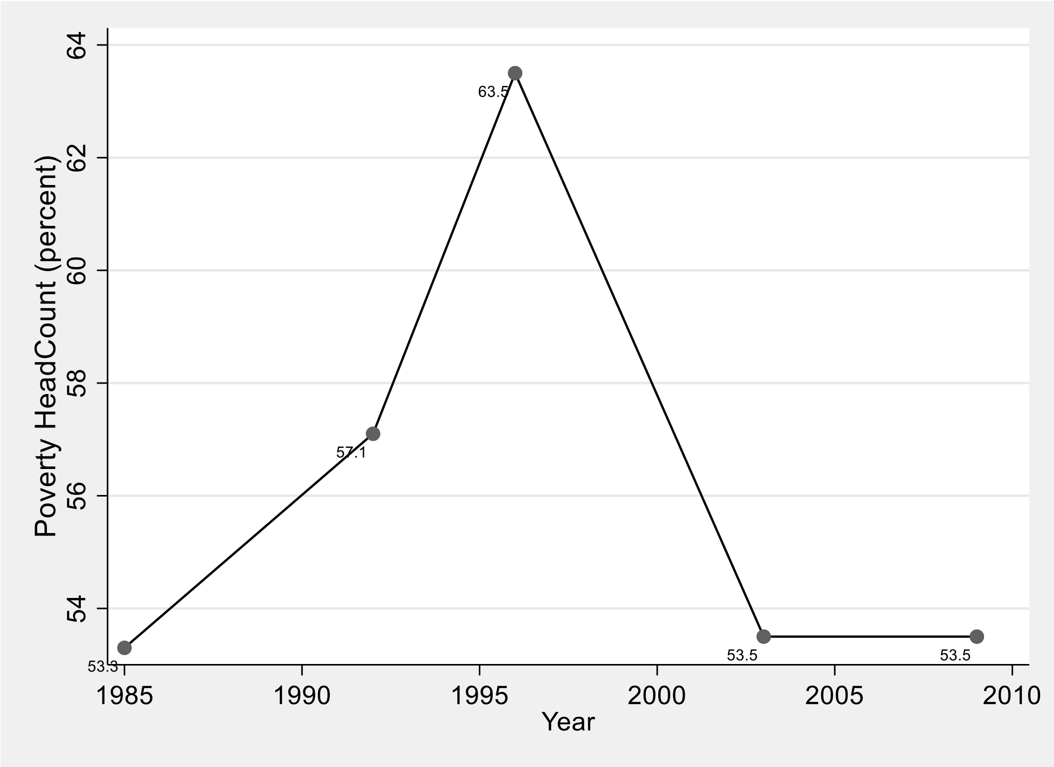

Figure 2.4 - Poverty Headcount Trend for Nigeria (1985-2009)

In other words, if inequality increases with growth, it is likely that the potential gains from growth might be eroded among the poor. Inequality measures in the World Bank dataset are only reported in the survey years. Hence, I use the Gini index for the last available year in each SSA country and match it with corresponding GDP per capita to show the strength of association. From Figure 2.5, the relationship between inequality and growth based on cross-sectional data displays no clear direction. The scatter plot shows wide dispersion of inequality around the fitted line. Put differently, the variance of the Gini index does not appear to decline with GDP per capita income. For the majority of the countries with GDP per capita below US$3,000, inequality appears to vary in an unspecific pattern with GDP per capita. Also, there are countries with Gini indices above 50% but with low GDP per capita. For such countries, the evidence is suggestive of the operation of anti-poor growth. But there are also countries with both (relatively) lower Gini indices and GDP per capita.

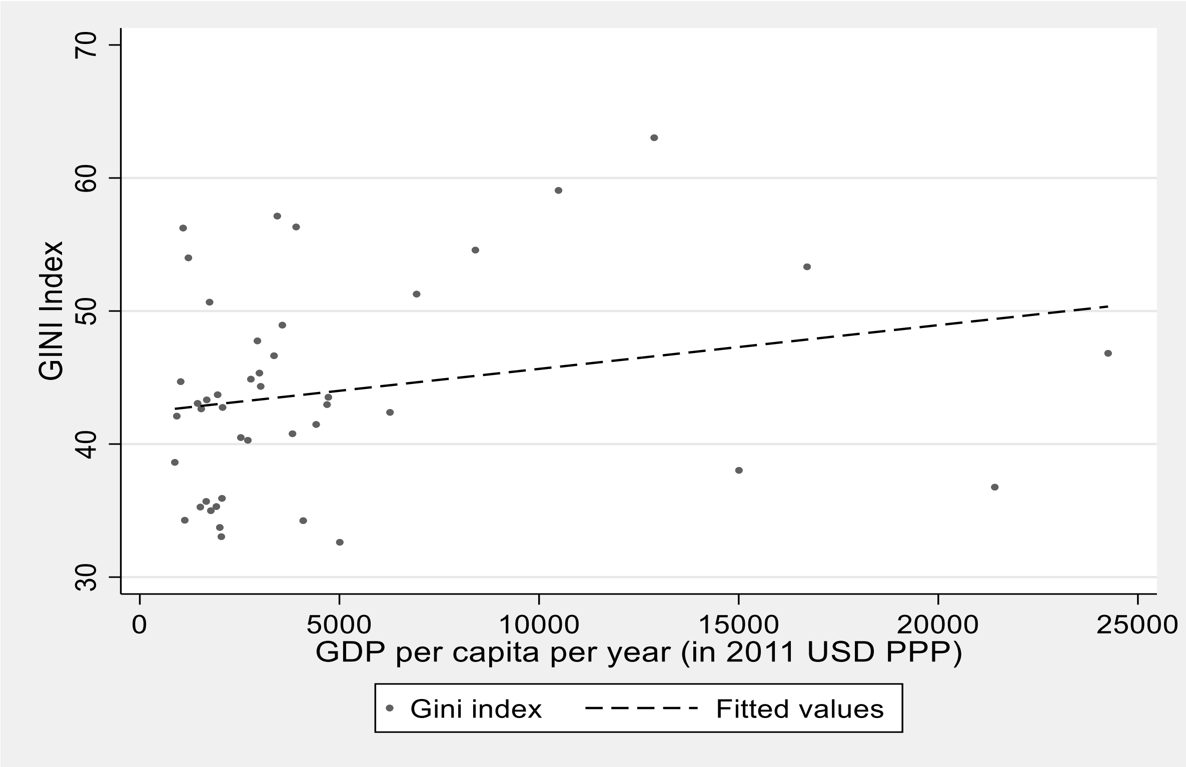

Figure 2.5 - Inequality and GDP for SSA countries (2008-2018)

The ambiguous relationship between growth and inequality has support in the literature. From a review of cross-sectional studies that used OLS to analyse cross-country data, Banerjee and Duflo (2003) document a negative relationship between inequality and subsequent growth. A different conclusion suggesting a positive relationship between inequality and growth was reached using the fixed effect approach. Additionally, a three-stage least squares approach implemented by Barro (2000) found no relationship between inequality and growth but when the sample is split into poor and non-poor countries, a negative relationship in the former, and a positive relationship in the later sub-sample ensued. Banerjee and Duflo (2003) conclude that it is likely that the data do not support the linear structure imposed, hence, the different conclusions. The Kuznets's (1955) hypothesis suggests that the relationship between income inequality and growth follows an inverse-U shape along the development process. That is, during the life cycle of an economy, income inequality rises at the early stage of development, recede during the juvenile stage, and declines at later stages of development as more and more workers join the high-productivity sectors of the economy.

Next, I examine in greater details whether there has been growth in the income of the poor within the period of analysis. To achieve this, I exploit the panel dimension of the data. From the available dataset, only a few countries with annual series having a minimum of two observations within the period of analysis exist. Given that the study interest is in the growth of income of the poor within the MDG period, I filter the data in the following way. I select only countries with observations at the end of 2015 and move back in time until I identify the last observation before or at the start of the intervention.[30] Nine countries had at least two-point data within the period under analysis. These countries include Benin, Botswana, Cote d'Ivoire, Ethiopia, Gambia, Kenya, Namibia, Togo, and Zambia. I exploit the panel structure of the data to show if the poor benefited from the economic growth during the MDG era. Following Aguilar, et al. (2019) and Lakner and Milanovic (2016), I derive Growth Incidence Curves (GICs) for the selected countries. The GICs show the growth rate of mean income between the initial and final year for a given quantile group. To be precise, the slope of a GIC shows whether economic growth has an equalizing (pro-poor) or disequalizing (pro-rich) effect on the income distribution (Aguilar, et al., 2019 and Lakner and Milanovic, 2016). Figure 2.6 shows growth incidence curves (GIC) for the selected SSA countries.

From Figure 2.6, the downward-sloping GIC for Gambia suggests a pro-poor or equalizing pattern of growth. With Figure 2.6, it is possible to compare growth in decile average income, say between the bottom 10% and top 10% of the countries with data. For example, between 2000 and 2015, growth in Gambia can be considered as pro-poor when I compare the growth in the two extreme decile groups. While the bottom 10% grew at about 6.8% per year, the top 10% grew at 2.1%. Similarly, growth was pro-poor in Botswana during the period of analysis. Indeed, in Botswana, growth can be considered as anti-rich given the decline in the share of income growth accruing to the top 10%. In contrast, growth was anti-poor in Benin, Ethiopia, and Ivory Coast given the negative growth in income of the bottom 10% in the face of a rise in income growth of the top 10% in these countries.

[30] This procedure was use by Dollar and Kraay (2002) in a study described earlier to test the hypothesis that the average incomes of the poorest quintile rise proportionately with average income.

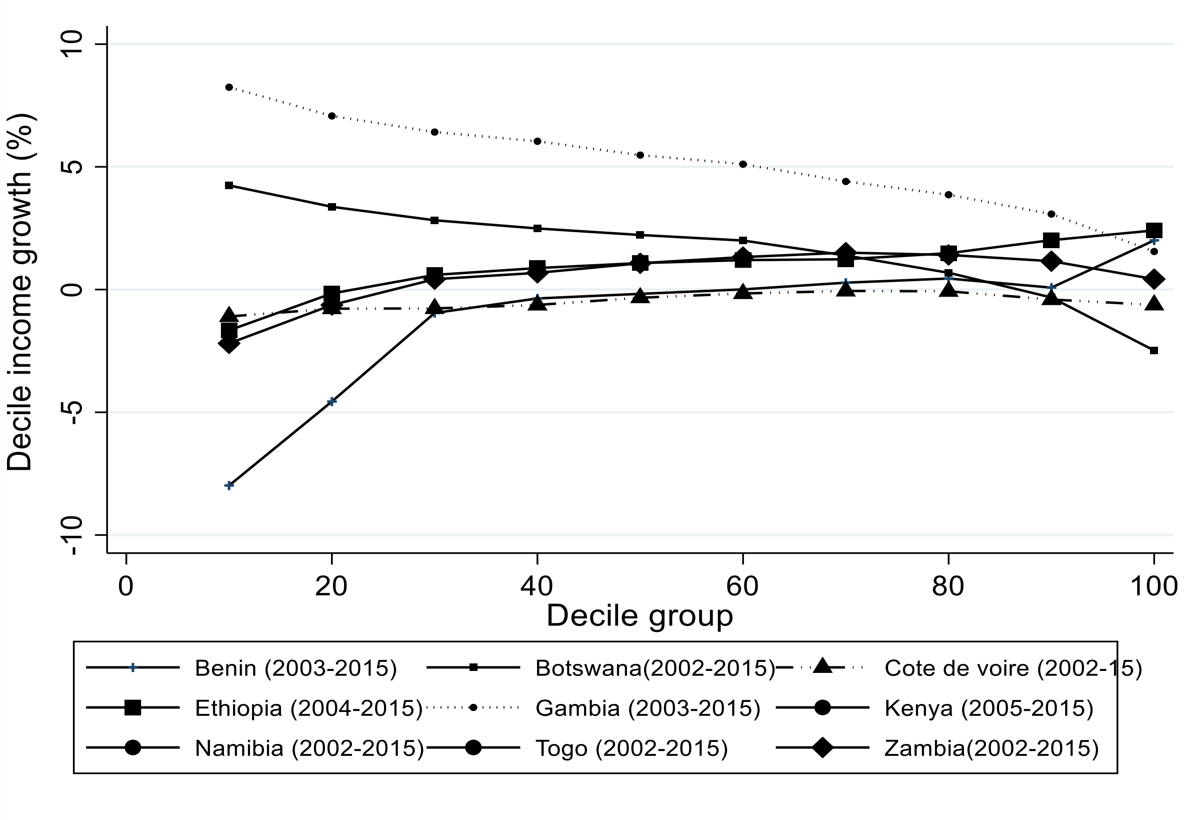

Figure 2.6 - Consumption Growth for selected SSA countries, by Decile Group

Further, comparing the growth in the bottom 10% indicates that only the Gambia and Botswana among the selected countries witnessed positive growth in the income of the poor within the period of analysis. Benin Republic experienced the worst form of anti-poor growth during the period. Importantly, the income of the middle class appears to remain unchanged for all the selected countries. Taken together, the finding is suggestive that growth during the period had a mixed effect on the income of the poor for the selected countries.

Finally, I establish whether growth in income of the bottom 10% is correlated with changes in mortality. The fitted line in Figure 2.7 shows an inverse association between growth in the income of the bottom 10% and under-five mortality within the period under analysis. Under-five mortality rates appear to be lower for countries with positive bottom 10% income growth. For instance, the Gambia had the highest bottom 10% income growth of 10% and witnessed a decline in under-five mortality rate, from 105 under-five deaths per 1,000 in 2003 to 64 under-five deaths per 1,000 in 2015. A similar decline in under-five mortality rate was experienced in Botswana, 81.7 under-five deaths per 1,000 in 2002 to 40 under-five deaths per 1,000 in 2015, with positive income growth of the bottom 10%.

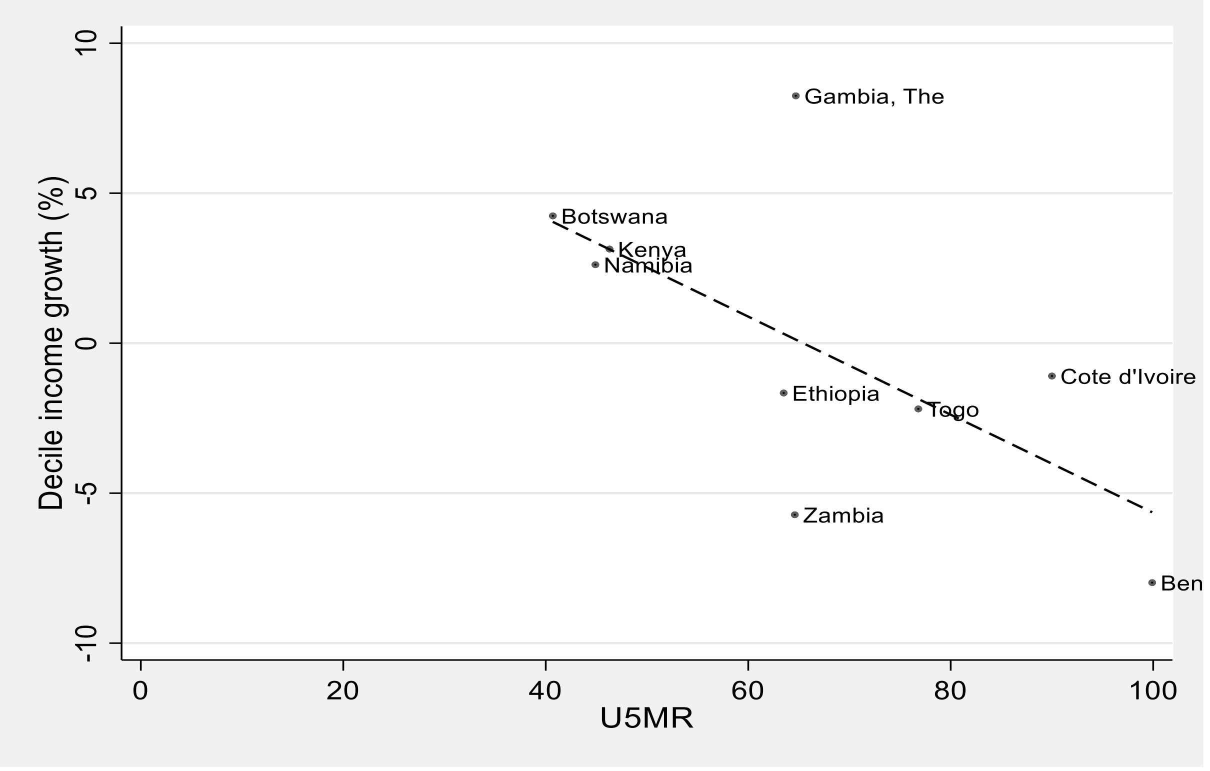

Figure 2.7 - Annual growth in decile income and under-five mortality for selected SSA countries

In summary, from the data exploration conducted, I discover a declining trend in poverty headcount for the SSA sub-region and Nigeria prior to the introduction of the MDG. I note how the regional trend reflects that of Nigeria suggesting the possible impact of the later in influencing the regional developmental goals. Also, I find an unclear pattern relationship between GDP per capita and inequality which is supported in the literature. When I filter countries with deciles for at least two points within the period of analysis to derive the GICs, I discovered that only 30% of the countries with available data witnessed positive growth in the average income of the bottom 10%. Importantly, I note that income growth of the bottom 10% for these countries appears to be inversely associated with under-five mortality. I explore these findings in greater detail in the section below.

2.5.3 Econometrics results

I present the results in two phases. First, I answer the question whether changes in GDP per capita influences child mortality outcome across countries in the SSA sub-region, and over time. From the results, I find that economic growth is negatively associated with under-five mortality rate in the SSA region, but the statistical significance depends on the number of controls. In the second phase, I test the hypothesis whether the economic growth reforms introduced with the MDGs are pro-poor. I failed to reject the null hypothesis that the growth elasticities in the two sample periods are equal. That is, I find evidence of growth in post-MDG not being more pro-poor compared to the pre-MDG era.

In all the GMM estimations, I report p-values for the null hypotheses of the validity of the overidentifying restrictions on the rows for the Hansen J-test (instrument validity test). In all the specifications, I do not reject the null hypothesis, indicating that the models are well-specified. Also, I report the p-values for the first order and second order autocorrelated disturbances on the rows for AR(1) and AR(2) respectively. I do not find evidence of first and second order autocorrelation. In general, the specified tests statistics suggest that the models are properly specified. Finally, the GMM estimations use standard errors that are robust to autocorrelation and heteroskedasticity of unknown form and treat the lagged under-five mortality variable as pre-determined. All GMM estimations are carried out using the xtbond2 package in Stata/MP 17.0 and in line with the procedure in Roodman (2009).

2.5.3.1 Growth elasticity of mortality

In model 1 (Table 2.2), I estimate the effect of economic growth on under-five mortality controlling for income and education as the baseline specification. This is in line with Wang, et al. (1999) where under-five mortality is expressed as a function of real GDP per capita, education, and time. Result from the baseline specification suggests that under five mortality falls with income with an elasticity of -0.42. That is, a random SSA country at the sample mean would avert 42 under-five deaths per 1000 live births if income per head were raised by 1%. Also, the result in model 1 indicates that improving female education will reduce under-five mortality rate (-0.0462). Maternal education may reduce mortality through its influence on fertility schedule, rational response to illness, reception and utilization of health information, nutrition, and empowerment (Caldwell 1979; Gakidou, Cowling, Lozano, Murray, 2010). Next, I control for time-varying confounders sequentially in models 3-5. When I control for corruption and political regime in model 2, the income elasticity (-0.206) and education (-0.036) estimates are robust though with reductions in their effect sizes. Also, the result suggests that the political regime score and the corruption control index are negatively associated with under-five mortality. Precisely, while a unit increase in the political regime score will reduce under-five mortality by -0.075, increasing the intensity of control over corruption by a unit will reduce mortality by -0.266 respectively.

In models 3 and 4, I test the hypotheses whether the quality of institution matter on the effect of growth on under-five mortality. I argue that the quality of institutions may explain the dynamics and heterogeneity of the impact of growth on child health. The results show that increases in the political regime score and control over corruption index may reduce mortality through economic growth but in a statistically non-significant relationship. In theory, I expect *good* economic institution through its ability to create incentives for investment in physical and human capital and technology, to spur economic growth (Acemoglu, Johnson, and Robinson, 2005). Invariably, a weak economic institution may provide little incentives for investment which can constrain the economic prosperity of a society. Similarly, I expect a political system with incentives to reduce rent seeking activities by the government while promoting accountability to taxpayers as pointed out by North (1990), to reduce child mortality through the income pathway. However, from the results in models 3 and 4, I fail to reject the hypothesis that on average, the quality of institutions may not matter in influencing economic growth and consequently child mortality outcomes.

In the final model of Table 2.2, the result suggests that the statistical significance of the relationship between income and mortality is dependent on the number of controls introduced. That is, income elasticity losses its statistical significance with additional controls. I note the relationship between conflict and under-five mortality rate. The result in model 5 suggests that in any conflict year, under-five mortality will increase by 0.137. This effect could persist over the life-course of children as suggested by Wagner et al., (2018) and may be operational, in a gendered pattern, even amongst the unborn as pointed out by Dagnelie, De Luca, and Maystadt (2014). Also, I note that public health programmes such as safe water provision, improved sanitation and immunization could reduce child mortality. The finding that child mortality is strongly associated with access to safe water is supported in the literature (Shi, 2000). Access to safe water reduces the exposure of children to diarrhoea and other communicable diseases risk factors. Increasing access to safe water is expected to stimulate the simple but effective act of hand washing and this has been shown to reduce the transmission of diarrhoea by one-third (WHO/UNICEF, 2000). Also, the result suggests that immunization, proxy by DPT immunization coverage rate, may reduce child mortality in the region. This finding points to a critical role that the Expanded Program on Immunization (EPI) in countries within the sub-region can provide in reducing child mortality.

Finally, the results show that the relationship between climate variables—temperature and rainfall anomalies—and mortality is positive though statistically insignificant. In the literature, this relationship can be ambiguous. For instance, while high temperature is known to increase mortality risk in children (see for example, Kudamatsu, Persson, and Stromberg, 2012; Baker and Anttila-Hughes, 2020), infant mortality is reported to reduce with high temperature but increases with low temperature in rural Bangladesh (Lindeboom, Alam, Begum, Streatfield, 2012; Hashizume, Wagatsuma, Hayashi, Saha, Streatfield, Yunusy, 2009). However, the relationship between the climate variables and mortality may be more direct in a micro-level analysis—spatial heterogeneity effects. In contrast to La Porta, et al., (1999), I did not find a strong association between ethnic fractionalization and child mortality. But the result suggests that the more fractionalized a country is, the probability of under-five survival reduces. This is because, with more different ethnic groups having divergent preferences, values, and beliefs, chances for collective action may reduce but will increase coordination problems and consequently, lower levels of public goods provision (Alesina, Baqir, and Easterly, 1999).

Table 2.2 - Economic growth and child mortality: A two-step system GMM estimation

Variables	(1)	(2)	(3)	(4)	(5)
L1_lnU5MR	1.001***	0.833***	0.992	0.980	0.342
	(0.0437)	(0.0633)			(0.683)
lnGDPpc	-0.420**	-0.206***	-0.208*	-0.060	-0.037
	(0.209)	(0.093)	(0.124)	(0.550)	(0.871)
L1_lnGDPpc	0.257	-1.280**	-0.229	-0.818	-0.523
	(0.363)	(0.616)	(0.399)	(0.529)	(1.028)
Education	-0.0462**	-0.036**	-0.0128	-0.00514	-0.0620
	(0.00562)	(0.0147)	(0.0141)	(0.00845)	(0.0704)
L1_Education	-0.00237	-0.0137**	-0.00919	-0.00510	0.0718
	(0.00591)	(0.00557)	(0.00892)	(0.00798)	(0.0782)
Pol_regime		-0.0747**		-0.0177	-0.0547
		(0.0318)			(0.0729)
Corruption		-0.266**	-0.0279		
		(0.125)	(0.0808)		
GDP*Pol_regime			-0.00294		
			(0.00365)		
GDP*Corruption				-0.00945	
				(0.0137)	
Sanitation					-0.0125
					(0.00760)
Safe Water					-0.0238
					(0.0221)
Immunization					-0.00563
					(0.00742)
Rainfall					0.166
					(0.174)
Ethnic Fraction					3.931
					(4.334)
Conflict					0.137*
					(0.0731)
Temperature					0.0328
					(0.0443)
Constant	0.735	6.042	3.0255	1.923	0.3239
	(1.911)	(3.997)	(2.118)	(1.899)	(0.5187)
Observations	377	332	332	332	101
Number of country2	33	30	30	30	25
AR(1)	0.525	0.0867	0.105	0.337	0.455
AR(2)	0.521	0.477	0.417	0.514	0.502
Spec Test (p-value)					
Hansen J-test	0.9599	0.999	0.9877	0.464	0.9997
Number of Instruments	95	93	93	93	61

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Results in all columns use the GMM of Arellano and Bond (1991), with robust standard errors. The dependent variable is under-five mortality. Year dummies are included in all regression. The AR(1 &2) tests and the Hansen J test indicate that there is no serial correlation, and the overidentifying restrictions are not rejected.

2.5.3.2 Is there a structural break in the effect of economic growth on child mortality?

I have established elsewhere that the pattern of economic growth advocated in the development strategy of the MDGs is pro-poor growth and it is supposed to be facilitated by pro-poor economic policies. Such a pattern of growth is expected to be sustainable, inclusive, and equitable and is therefore argued to result in income poverty reduction and a consequent increase in the consumption of goods and services promoting well-being. Hence, I expect a stronger relationship between economic growth and child mortality post-MDGs. To this end, I test the hypothesis whether the pro-poor growth elasticity is greater comparatively to the traditional growth elasticity. To achieve this, the sample period is truncated into pre-MDG period (1990-2003) and post-MDG era (2004-2015) and the growth elasticities estimated. I have allowed a 3-year lag period after the introduction of the campaign in 2000 for the implementation of policies and agreements by development agencies. As in Bhalotra (2006), I compare the growth elasticities for the two sample periods and test whether the differ statistically. If growth elasticity is stronger after the introduction of the MDGs, then we may conclude that a structural break that is pro-poor have occurred.

I achieve the above by first estimating a GMM model. The results reported in columns 1 and 2 (Table 2A.1, Appendix 2A) shows conditional income elasticities of the pre-and-post MDG era to be -0.292 and 0.124 respectively. Tentatively, I may reject the null hypothesis that the income elasticities do not differ in both eras. The income elasticity is greater in magnitude (and significant) in the pre-MDG era compared to the income elasticity post-MDG. To statistically test for the equality of the growth elasticity parameters in both periods, I employ the chow test. In implementing the chow test, I naively re-estimated the model using the Least Square Dummy Variable (LSDV) estimator and the results are presented in columns 3 and 4 (Table 2A.1, Appendix 2A). The Chow test requires the residual sums of squares (RSS) from both the sub-samples and the full sample respectively. The GMM estimator, by default, does not return the RSS.[31] By applying the chow test, I am able to reject the null hypothesis of equality of

[31] In Roodman (2009 p.103), the LSDV estimator was suggested as a plausible candidate for a dynamic panel data estimation. It transforms the data as a way to remove the fixed effects, drawing them out of the error term by entering dummies for each country, in order to resolve the dynamic panel bias

sub-sample growth elasticities at 5% level of significance. This finding resonates with the Bhalotra (2006) study. It implies that the growth policy in the post-MDGs era may not be associated more with pro-poor growth in comparison with the pre-MDG era. Indeed, when I compared the sizes of the growth elasticities in the different sub-sample periods, it is likely that the growth in the post-MDG era is anti-poor. The descriptive evidence presented earlier further lends credence to this finding.

I investigate the above finding further by testing the hypothesis whether there is heterogeneity in the effect of growth on mortality between resource-rich and resource-poor countries. I argued that economic growth in resource-rich countries can be volatile, and this may adversely affect the economic prosperity of a country (Ogwumike and Ogunleye, 2008). Thus, resource-rich countries are likely to perform differently in terms of economic development compared to resource-poor countries. To test this hypothesis, first I split the sample using the presence of natural endowments into resource-rich and resource-poor countries and estimate the income elasticities.[32] The results in columns 1 and 4 (Table 2A.2, Appendix 2A) show that the impact of growth on mortality was only significant amongst resource-poor countries (0.0488). This is in line with the argument in the literature that resource-rich countries tend to under-perform in terms of economic development compared to resource-poor countries (see for example, Sachs and Warner, 1995). This evidence further supports the natural resource curse hypothesis that point natural resource led growth is prone to rent seeking and conflicts (Boschini, Pettersson, and Roine, 2007). Next, I investigate whether structural break effect exist in the sub-samples and results are presented in columns 2, 4, 5, and 6 (Table 2A.2, Appendix 2A). Applying the chow test, I reject the null hypothesis of equality of sub-sample growth elasticities at 5% and 10% level of significance and may conclude that income elasticities differ in both eras for the two

associated with our specification. Aside the LSDV estimator, there are other more efficient ways such as the difference and system GMM that deals with dynamic panel bias through data transformation but are limited in testing for structural breaks.

[32] Using the World Bank ranking of the resource-rich countries in SSA sub-region by per capita natural resource endowment, the top 10 are Nigeria, South Africa, Angola, Equatorial Guinea, Gabon, Sudan, Tanzania, Zambia, Botswana, and Republic of Congo (Izvorski, Coulibaly, Doumbia, 2018).

sample of countries. In particular, the income elasticity in the pre-MDG era for the resource-poor countries is comparatively greater and statistically significant.

Finally, to capture the potential non-linear relationship between income and health, in a specification I introduce the effect of GDP per capita in a quadratic form in line with the literature (see for example, Benzeval, Judge, and Shouls, 2001). It is argued that there may be a threshold effect, so that income influences individual's health up to a specific level, beyond which the association disappears. Our results in columns 1 and 2 (Table 2A.3, Appendix 2A) show that the relationship may be non-linear implying that income-mortality gradient is likely to exist mainly at lower income levels. That is, income may reduce mortality only below a threshold, after that, additional income will have no effect on mortality. This may provide support for targeting of health actions at poorer populations where the income-health gradient might be steeper. Also, in Table 2A.3, for robustness, I re-defined the mortality variable and use infant mortality. I test the hypothesis of a structural break effect of growth. The income elasticity was robust to the use of an alternative definition in column 2 and the evidence of growth in the post-MDG era been anti-poor re-established in columns 3 and 4 (Table 2A.3).

2.6 Discussion

This study adds to the literature that examines the impact of economic growth on child mortality reduction in the SSA sub-region by investigating the effect of the pro-poor growth advocated in the MDG on child mortality reduction. I am unaware of existing studies that empirically assessed the pro-poor growth—mortality relationship for the SSA sub-region. Nor is there known evidence of the structural break effect of pro-poor growth on child mortality for the sub-region. Using a constructed annual panel dataset, the GMM was implemented, and the study main finding suggests that the growth policy adopted in the post-MDG era may not be more pro-poor comparatively.

I investigate this by first providing qualitative evidence of the effect of pro-MDG growth on average income growth of the poor using the Povcalnet dataset. From the growth incidence curves of countries with available data, descriptive evidence suggests that only few countries experience positive income growth of the bottom 10% of the population in the post-MDGs era. For such countries, I discover that the income growth appears to be inversely associated with under-five mortality rate. I assess the above descriptive evidence in greater detail in several ways. First, using panel data for 46 SSA countries over the period 1990-2015, I find evidence of a growth elasticity of -0.42 which is supported by similar studies such as Pritchett and Summers (1996) and Bhalotra (2008). In particular, it is smaller than the unconditional growth elasticity of -0.7 in the Bhalotra paper for the possible reasons that I have: conditioned growth elasticity on education; used a different data set involving countries that are not Indian states; controlled for a different set of covariates; and implemented a different estimation strategy. Further, controlling for corruption and regime type results in the reduction of the magnitude of growth elasticity by about a half (-0.206). In the fuller model with all the controls, the effect of GDP per capita on child mortality disappears. This is in contrast with the findings from the Bhalotra paper. Though there was reduction in the magnitude of the unconditional growth elasticity comparatively to the estimated elasticities with controls, the growth elasticity is robust to different model specifications in the Bhalotra paper. While the reason for the non-robustness of the growth elasticity estimate in this study is unclear, it is plausible to attribute it to the role of country-specific underlying constraints influencing child mortality outcomes in the region. Hence, this study shed new light on the possible effects of confounders such as culture, institutions, geography, and conflict in influencing mortality outcomes for countries in the SSA sub-region.

When I test the hypothesis whether the growth policy in the post-MDG era was more pro-poor, I find evidence of a possible anti-poor growth. Similar findings suggesting that growth could be anti-poor exist in the literature (see for example Kakwani, 2000; Szekely, 2000; Bhalotra, 2008). Precisely, the study findings resonate with the Bhalotra paper that growth in a post-reform era is less effective in reducing child mortality. This implies that child mortality is still domicile amongst the poor despite the pro-poor growth policy adopted. That is, on average, there is no evidence that the post-MDGs growth policy has improved the quality of life amongst households in SSA countries. Aside from child mortality being concentrated among the poor, the rate of child mortality in a society can be informative about the nature of social inequalities, gender bias, population health, and changing economic and social situations (Sen, 1998). Thus, it is likely that the growth pattern in post-MDG may be marked by rising inequality such that the potential benefit of growth is more than offset by the adverse impact of rising inequality. Perhaps, these findings provide additional support to the assertion by Kakwani (2000) that growth is not necessarily always good for the poor and that income distribution could matter in determining the effect of growth on child mortality outcomes.

Further, when I test the hypothesis whether there is heterogeneity in the effect of growth on mortality between resource-rich and resource-poor countries, the results show that the impact of growth on mortality was only significant amongst resource-poor countries. These findings support an existing argument in the literature that resource-rich countries tend to under-perform in terms of economic development compared to resource-poor countries (Sachs and Warner, 1995). Also, they can be considered as an additional support for the resource curse hypothesis. It is likely that the volatility of economic growth in resource-rich countries may have adverse effect on their economic prosperity (Ogwumike and Ogunleye, 2008). Nigeria is considered a resource-rich and oil-producing country. Perhaps, this in part, may explain why Nigeria, an emerging economy with the biggest economy in Africa, has a significant number of people living in poverty and with the highest number of under-five deaths in Africa. It is likely that the natural resource curse is operation in Nigeria. Windfall gains from the discovery of oil in commercial quantity in the early 1970s crowded out investment from other sectors of the economy, particularly the agricultural sector, a pro-poor sector. It is also likely that the point natural resources may have introduced rent seeking, corruption, and conflicts in Nigeria in line with argument in the literature (for example, Boschini, Pettersson, and Roine, 2007). The inverse relationship between resource abundance and economic outcomes may exists for other countries in the SSA sub-region (for example, Angola, Sierra Leone, Congo DR, and Liberia).[33]

On the other hand, pro-poor growth may influence mortality differently in resource-poor countries. For such countries, growth may generate more resources both at the national level for public investment and at the household level for the poor to purchase child health. At the national level, it may result in greater efficiency (given the absence of resource curse) in public spending on services such as health care, education, safe

[33] There are also counterexamples of countries in the SSA with abundance of natural resources but with better growth performance such as Botswana, South Africa

water provision and sanitation, immunization coverage, and employment provision. At the individual level, increases in per capita income from pro-poor growth may result in greater reduction in household poverty in resource-poor economies. This will facilitate greater access to basic MDG goods and services by the poor.

The study findings on the structural break effect of economic growth on child mortality should be considered within the context of some limitations. First, the income and mortality data are aggregated at the country level, and this limits our understanding of how changes in income inequality due to the growth reform has impacted on equity in child mortality outcomes. The underlying argument of the pro-poor growth strategy suggest the generation of growth from the pro-poor sectors in order to reduce inequality and improve on household outcomes. In assessing the impact of pro-poor growth, it will be important to measure changes in child mortality inequalities by income quintiles. It is argued that a stronger association between income and health may exist at the lowest quintile of the income distribution. Hence, using a disaggregated mortality data by socioeconomic status may shed different light on the structural break effect of growth on mortality. This study use of aggregate income and health outcome data at national level appears to limit the understanding about the precise effect of an increase in income growth of the bottom 10% on mortality amongst the population in the lowest socioeconomic status and this could be a future research priority for evaluating the impact on socio-economic interventions. Effectively, a less aggregated dataset with heterogeneity variables could allow for the assessment of how the impact of income growth on child mortality outcomes vary across socioeconomic groups (poor and non-poor) and regions (rural and urban). Uncovering such heterogeneity across various groups and region should be an agenda for future study and could be vital for intervention targeting.

Second, it is unlikely that the pro-poor economic growth reforms are implemented within a similar time frame across the SSA countries. So, conclusion from an assessment of changes in income elasticity between two sub-sample period using a common structural break point may need to be interpreted in the context of a strong assumption of a common break point. Due to data unavailability, I did not exploit the variability in economic reforms between and within countries. Finally, child mortality data in developing countries are usually underestimated. Reported deaths are likely to be higher because births and deaths of neonates occurring at home are less likely to be counted due to the near absence of a vital birth and death registration system. Importantly, the distribution of unreported deaths might be systematic, concentrating amongst the lowest income quintiles. This could lead to inaccurate estimation of the effect of economic growth on mortality especially amongst the different income quintiles.

2.7 Conclusion

From the study findings, I can conclude that growth in the post-MDG period was less associated with childhood mortality across SSA countries compared to growth in the pre-MDG era. In fact, the evidence suggests that mortality may still be largely concentrated among the poor in spite of the adoption of pro-poor growth policy by countries in the sub-region. As an inclusive growth, it is expected that there will be an increase in the number of children having access to basic capabilities, nourishment, and consequently long and satisfying lives but why this is not the case, may be a scope for future study. However, the heterogeneous effect analysis suggests that growth may matter more in reducing mortality amongst resource-poor countries and it may do so through greater efficiency in public spending. These results have important policy implications especially for Nigeria, a resource-rich country but a significant contributor to global under-five mortality. Perhaps, generating growth through expansion in pro-poor sectors such as manufacturing, and agriculture rather than crude oil exportation can be a valid policy suggestion. This will involve deliberate actions in diversifying the economy from its primary dependence on oil to allow for growth driven by output expansion in the pro-poor sectors. Hence, re-directing interventions to the agricultural sector, in particular, by international institutions and national governments can have the dual impact of reducing poverty and child mortality. In addition to promoting programmes that increase literacy among women, scaling up interventions in provision of safe water and improved sanitation should be considered in the on-going SDGs. From the study finding on the effect of conflict in influencing mortality rate, it will also be important to promote actions that encourage the entrenchment of peace and conflict resolutions at all levels. The reliance on point resources to drive growth could be a source of the recurring armed conflicts that pro-poor growth policy may remedy. The effect of the on-going armed conflict in Nigeria may persist over the life course of children and to subsequent generations given birth to after the conflict has ended. Hence, the study findings on conflict could provide justification for the prioritization of the sustainable development goal of promoting peace, justice, and strong institution and in particular the target of reducing conflict-related deaths per 100,000 population, by sex, age, and cause in the on-going SDGs.

Chapter 3

Public health spending and child mortality: Evidence of cross border spill-over effect from Nigeria

3.1 Introduction

In this chapter I ask the question whether there is public health spending spill-over between Nigeria and neighbouring countries. As I shall argue, the existence of a public health spending spill-over effect may imply additional strain on the health care/social security system of the source country, Nigeria. It is likely to influence efficiency gains in public health spending with consequences for child health outcomes. Also, it may suggest a possible diversion of the source country public resources to meeting health care need of non-citizens. More so, for a source country with porous borders and without a functioning vital registration system, there is the tendency for cross-border utilization of health services especially by non-citizens within *geographical access*. It is possible that non-citizens could be incorporated into pooled health financing arrangements or non-contributory social health protection scheme. Whether such externalities are internalized in the public health spending budget could be crucial in explaining the contribution of Nigeria to global under-five mortality and will be relevant for policy interventions on the on-going SDGs.

I construct an annual panel data of 17 West African states over a period of 2000-2018 to investigate the question of whether there is spill-over effect of Nigeria's public health spending across borders. The results from fixed effect regressions suggest that an expansionary Nigeria's public health spending is associated with reduction in childhood mortality across West African countries. More precisely, results from the specification which includes public health spending per capita of other West African countries, show that increasing the size of Nigeria's public health spending by 1% will reduce, on average, under-five mortality rate by 1.14% across any West African country. This relationship is significant when GDP per capita and female education are control for but disappears with the addition of other covariates including institutions, geography, culture, public health programmes, conflict, inflation, and incidence of malaria in the expanded specification.

Additionally, it is likely that the magnitude of the spill-over effect estimate may depend on the quality of governance in the source country since public health spending must be translated into effective health services for any desired impact to be attained. More so, it may take the existence of strong institution to guarantee that social spending is allocated to social welfare rather than infrastructure as is the case in countries with weak institution (Hu and Mendoza, 2013). Hence, I investigate whether the size of spill-over effect depend on the effectiveness of governance in the source country. To achieve this, I estimate the interaction term of public spending and institution variable. The result shows that having strong institution in the source country will matter (-0.0407) in determining the effectiveness of public health spending across borders.

Further, since distance could be a significant factor in cross-border exchanges, I investigate the role of three dimensions of distance in determining the magnitude of the spill-over effect estimate. First, the geographical distance, define using a criterion of direct continuity of border sharing, could matter in determining the magnitude of the spill-over effect estimate since the farther away a neighbouring country is from the source country, the effect of public spending may become less intense. Second, partitioned ethnic groups across borders but with homeland in the source country could be drawn to their peers from the same ethnolinguistic family, ethnic proximity, and this can facilitate transborder exchanges. Third, transborder exchanges may be different for neighbouring countries with the same first official language, linguistic proximity, as the source country. For partitioned ethnic groups, I use data of homeland ethnic groups in Africa from Michalopoulos and Papaioannou (2013). The authors projected the George Peter Murdock's Ethnolinguistic Map (1959) on a 2000 Digital Chart of the World to identified about 230 ethnicities with at least 10% of their historical homeland falling into more than one contemporary state. When I exploit the distance measures to determine their impacts on the magnitude of the spill-over estimate, for geographical distance, the result indicates a spill-over effect size of 0.08 among immediate neighbours (Chad, Niger, Cameroon, and Benin). Though significant, the fixed effect coefficient is lower compared to the parameter estimate of the full sample. For ethnic and linguistic distance, the results indicate that it may not matter whether a country has ethnic (-0.772) or linguistic proximity (-0.995) to the source country in the determination of spill-over effect.

Finally, since Nigeria is considered a regional source country, and with porous borders, I investigate the potential cross border utilization of health facilities by countries within geographical proximity. I exploit three shapefiles including a settlement shapefile, a population shapefile, and a health facility shapefile. While the settlement shapefile is extracted from the Humanitarian Data Exchange (West and Central Africa Administrative boundaries), the health facility shapefiles is obtained from a World Health Organization spatial database of health facilities managed by the public health sector in the SSA. The population figures and land area for administrative boundaries are extracted from the City Population. To examine the question of whether there are potential geographical accessibilities to health facilities across borders, I estimate the Euclidean distances between health facilities in the source country and settlements across borders using the QGIS. I use thresholds of 25km to a general district hospital (GDH) and 2.5 mile from a general practice (GP) to define potential accessibility. I find evidence of potential cross-border use of health facilities between Nigeria and all countries with shared international borderlines except Chad.

Section 3.2 discusses the rationale for state action in the provision of public goods within a country's borders. Using the principle of territoriality, I argue that the social responsibility of a state does not extend to all persons no matter where they work or live nor to all situations which may arise (Cornelissen, 1996). In section 3.3, I integrate two lines of theoretical and empirical works: the literature that links public spending and child health outcomes; and a contiguous literature that shows the existence of spill-over effects of policies from a source country across borders. I pull together elements from the different lines of literature to analyse the effect of a source country health spending on health outcomes across borders. In section 3.4, I discuss the sources of data, variables, and estimation strategy. I assembled a panel dataset that includes the source country's public health spending as the key independent variable of interest and a vector of time-varying covariates to estimate the spill-over effects. Data sources of all variables (expect ethnic and linguistic proximities variables) included in the model have been described in the previous chapters. In section 3.5, I provide econometric results for the spill-over effects of Nigeria government health spending on neighbouring countries. I use fixed effects regressions to estimate the model. Further, using the concept of potential geographical accessibility to health facilities, I show the possibility of a cross-border utilization of health care. Section 2.6 discusses the findings of the study and conclusions are drawn in the last section.

3.2 Background

The need to mobilize additional domestic public resources as a condition to achieving the SDGs was re-emphasized in the Addis Ababa Agenda on Financing for Development (United Nations, 2015). Other initiatives such as the Monterrey Consensus (2002), the UN Millennium Project (2005), the World Health Organization Commission on Macroeconomics and Health (2001) and the Abuja Declaration (2001) have made similar suggestion of increasing public investment in health through health system financing to achieve human and economic development in Africa in the past. With specific reference to the Abuja Declaration, to address the shortages of resources necessary to improve health in developing countries, heads of Africa Unions met in 2001 and pledge to set a target of allocating at least 15% of their annual budget to improve the health sector (The Abuja Declaration, 2001 p.5). However, after 10 years, only Tanzania achieved the 15% target while eleven countries, including Nigeria, reduced their relative contributions to government health spending (WHO, 2011).[34] Despite the potentials of public health spending in the determination of health outcomes, there has been persistent deficits in the levels of public health investment in developing countries which has been implicated as a reason for their failure to attain targets of international development goals such as the MDGs (Jamison, Breman, Measham, et al., 2006; WHO, 2000; Sachs, 2001).

In the case of Nigeria, aside the effect of deficit in public health investment on health outcomes, public health spending may have spill-over effect across borders. The existence of such a spill-over could imply additional strain on the health care/social security system of the country. Also, it could suggest a possible diversion of the country's public resources to meeting health care need of non-citizens. This is against the principle of territoriality.[35] In principle, the social responsibility of a state does not

[34] According to the WHO Commission on Macroeconomics and Health (2001), least-developed countries will require US$34 per capita to introduce essential health interventions, hence the Commission recommends increasing health investment to reduce poverty and promote economic development.

[35] The principle of territoriality refers to the freedom of sovereign countries to use territorial elements to define their scope of social security schemes and to determine the qualifying conditions and the conditions of payment of benefits.

extend to all persons no matter where they work or live nor to all situations which may arise (Cornelissen, 1996). A predefined territory will make it easier for both public and private funding bodies to organise health services efficiently given information on the size and characteristics of the population they cover, the number of providers deliver care, and the type of care required and supplied (Glinos, Baeten, Helble and Maarse, 2010). In other words, it is critical that health systems are nationally bounded to allow for the maximization of scarce public resources for health within given territorial constraints (Pacock and Phua, 2011). Therefore, it is less likely for a source country with porous borders, to maximise efficiency gains from its public health spending.

However, a source country public health spending may generate positive health externalities across borders—public health spending spill-over. Cross-border health externalities, action of one country having consequences on another country, is likely to occur from government funding of public health goods. Public health spending in Nigeria funds services ranging from surveillance and prevention of communicable diseases, provision of safe water and improved sanitation, the provision of health information, and child and maternal health. These services may have significant positive externalities that could influence child mortality outcomes in the source country as well as neighbouring countries. Specifically, funding of immunization programmes by a source country may reduce mortality from vaccine preventable diseases and improve quality of life through herd immunity for both the source country and neighbouring countries. While the above public goods might not be pure, it has significant elements of non-rivalry and non-excludability such that the source country benefiting does not preclude any neighbouring country from doing so, nor is it possible to exclude any neighbouring country from benefiting. Indeed, the cross-border positive health externality could operate in a similar pattern as a financial contagion. Also, public health spending in a source country could involve the incorporation of more individuals into existing pooled health financing arrangements and non-contributory health protection schemes either as insurance enrolees or as people eligible for publicly provided care (FanWilliam and Savedoff, 2014). Such financial protection against illnesses and from financial consequences of accessing preventative care especially for children and women can influence health outcomes.

Nonetheless, the effect of public spending on health outcomes may depend on the quality of governance in the source country. It is important that public health spending is translated into effective health services for any desired impact to be attained. This may involve the effective functioning of budgeting institutions of a country to ensure that resources are allocated and monitored appropriately. Also, it may take the existence of strong institution to guarantee that social spending is allocated to social welfare rather than infrastructure as is the case in countries with weak institution (Hu and Mendoza, 2013). Empirically, Rajkumar and Swaroop (2008) investigate how quality governance through public health expenditure impact on child mortality by modelling the interaction between public spending and governance indicators (corruption and bureaucratic quality). Public health spending was discovered to reduce child mortality rates in countries with good governance. Similar findings were earlier documented in Wagstaff and Cleason (2004) when they show that good policies and institutions are vital in determining the effect of public spending on health outcomes. Hence, it is likely that the magnitude of cross border spill-over effect from public health spending may depend on the effectiveness of institutions in the source country.

African borders were designed in European capitals at a time Europeans had barely settled and had limited knowledge of local conditions (Michalopoulos and Papaioannou, 2016, p.1802). Consequently, there are about 177 partitioned ethnic groups among different countries in Africa (Asiwaju, 1985).[36] For instance, the Hausa and Yoruba ethnic groups are partitioned by the international boundary lines dividing Nigeria—Niger and Nigeria—Benin borders respectively. In effect, when tribal areas are partitioned by political national boundaries, as pointed out by Michalopoulos and Papaioannou (2013), spill-over effects from areas where partitioned ethnicities reside to neighbouring border regions may occur due to ethnic proximity. Further, it is argued that individuals are likely to migrate to a country with the same first official language—linguistic proximity—as compared to one with a distant language (Adsera and Pytlikova, 2015). Thus, linguistic distance could provide less incentive for individuals to seek health care abroad due to the migration cost associated with acquiring fluency

[36] Broadly defined, a partitioned ethnicity consists of ethnic groups that their historical homeland falls into more than one contemporary state irrespective of the size of the partitioning (Michalopoulos and Papaioannou, 2013).

in a foreign language. Also, the decision to seek health care across border may depend on the cost of information about the quality of health care as well as benefit-schemes and such costs decrease with linguistic homogeneity (Dietrich, 1999, p.9). In essence, the distance between the source country and a neighbouring country could matter in determining the magnitude of the spill-over effect from public health spending since as neighbouring countries become farther away from the source country, the effect of public spending may become less intense.

3.3 Related literature

This study integrates two lines of theoretical and empirical work. There is the literature that links public spending and child health outcomes, and a contiguous literature that shows the existence of a cross-border spill-over effect of policy. From the review of related literature, while evidence of the impact of public health spending on child mortality remain mixed, empirical evidence of health spending spill-over from source countries to neighbours in the SSA sub-region appears sparse or non-existence.

There is renewed interest in public health expenditure as a policy tool to influence health outcomes in developing countries. Public health spending can be protective of the poor especially in the absence of social health protection scheme. Increasing public health spending—the volume of resources flowing into the health sector—implies broader access to health care and services and in consequence, decrease in childhood mortality (Anyanwu and Erhijakpor, 2007, p.15). Specifically, public health financing mechanism such as mandated insurance can provide financial protection against illnesses and from financial consequences of accessing preventative care especially for children and women. Thus, state action in the provision of health is usually justified on the basis of market failure since the private market in developing countries is often considered to be underdeveloped and is likely to yield undesirable outcomes which appropriate state intervention might correct (Musgrove, 1996). Also, the need to provide public goods—commodities that are non-excludable and non-rivalrous in consumption—with positive externalities in health is another reason for state intervention in the health market. Effectively, the provision of public goods will require public finance since free-riding could make it difficult to get the same result through other means (Musgrove, 1996, p.12). This creates a vital role for the public sector in the provision of health care services in developing countries. Indeed, the emphasis of the Abuja Declaration (2001) on the imperative to increase public health investment as a condition to achieve development goals in Africa, explains in part, the renewed interest.

There is rising evidence of the positive impact of public health spending on child mortality outcomes (see for example, Gottret and Scieber, 2006; Bokhari et al, 2006; Ssewanayan and Younger, 2004; Wang, 2002; Anyanwu and Erhijakpor, 2007; Kiross, Chojenta, Barker and Loxton, 2020; Cremieux, Ouellette and Pilon, 1999; Nixon and Ulmann, 2006). Findings from a study of 81 low—and middle—income countries by Gottret and Scieber (2006) suggest that increases in public health expenditure reduces both under-five mortality and maternal mortality and the impact is greater, comparatively to the effect of education, roads, and sanitation. Similar findings were re-echoed by Bokhari et al (2006) where they found that the effect of public spending in reducing under-five and maternal mortalities is comparable with the effect of per capita income. Using the DHS datasets from more than 60 low—income countries between 1990 and 1999, Wang (2002) investigates the determinants of health outcomes for rural and urban areas at the national level and reports that public spending significantly reduces child mortality. In a study involving 47 African countries over a period of 1999 and 2004, Anyanwu and Erhijakpor (2007) reported a statistically significant public health expenditure effect on both infant and under-five mortalities. Their finding was re-echoed in a recent study that used panel data from 2000 to 2015 covering 46 Sub-Saharan African countries. Results from a random effects model indicates that both external and domestic public health care spending reduces infant and neonatal mortalities (Kiross, Chojenta, Barker and Loxton, 2020). A country-specific study in Uganda corroborated the above finding that public health spending through expanded vaccination coverage reduces infant mortality (Ssewanayan and Younger, 2004).

The above relationship exists for developed countries. For instance, the result from a Canadian data show that a reduction in public health care spending will increase infant mortality and decrease life expectancy (Cremieux, Ouellette and Pilon, 1999). Similar conclusion was drawn from a panel data study of 15 former members of the European

Union over a 15-year period by Nixon and Ulmann (2006). Their findings also indicate that increases in health care expenditure will significantly improve the chances of infants' survival and that the effect is greater relative to life expectancy.

However, the effect of public spending on health outcomes could vary with factors including the socio-economic status of individuals and the quality of governance. Using a disaggregated dataset of health status by wealth quintiles in 44 countries, Gupta, Verhoeven, and Tiongson, (2003) shows that public health spending has greater impact on the poor who were discovered to have worse health status compared with the non-poor. This finding was consistent in a larger sample of over 70 countries. Further, Rajkumar and Swaroop (2008) investigate how quality governance through public health expenditure impact on child mortality by modelling the interaction between public spending and governance indicators (corruption and bureaucratic quality). Public health spending was discovered to reduce child mortality rates in countries with good governance. Similar findings were earlier documented in Wagstaff and Cleason (2004) when they show that good policies and institutions are vital in determining the effect of public spending on health outcomes. In contrast, Hu and Mendoza (2013) reported a counterintuitive result on the interaction effect between good governance and public health spending on child mortality though the direct effects of both public health spending and governance indicators were statistically significant in reducing child mortality.

There are studies that found no statistical relationship between public health spending and child mortality (see for example, Filmer and Pritchett, 1999; Thornton, 2002). More precisely, finding from a cross-sectional study by Filmer and Pritchett (1999) indicates a small and statistically insignificant relationship between public spending and child mortality outcomes. They found that independent variation in public health spending explains less than one-seventh of 1% of the differences in mortality across countries. Similar finding showing statistically insignificant effect of medical expenditure in explaining mortality was obtained from a cross-sectional study of the United States using a 1990 data by Thornton (2002).

Several reasons could be responsible for the lack of statistically significant relationship between public spending and health outcomes. For instance, Bidani and Ravallion

(1997) argued that the effect of public health spending on mortality could be different between rich and poor countries. This could be seen in a study by Issa and Ouattara (2012) that disaggregated health expenditure into private and public within two set of countries classified as rich and poor, and found that public expenditure reduces child mortality, and the effect is greater amongst poor countries. Also, the inconsistency in the effect of public health spending on child health outcomes might be due to the varied methods and datasets used in investigating the relationship as pointed out by Baldacci, Guin-Siu, and de Mello (2002). Gupta, Verhoeven and Tiongson (1999) argued that lack of data comparability between countries and limited information about expenditure allocation within the health sector could be vital in explaining the relationship between the two variables. It is likely that there are country-specific or regional factors explaining the nature of the relationship. For developed countries, it is possible that diminishing returns to medical care use may have set in such that additional public resources to health care will yield little if any improvement in lowering mortality (Thornton, 2002). The relationship between public spending and health outcomes might also depend on whether incremental government expenditure is allocated towards an extensive or intensive margin (Bokhari, et, al., 2006). To be precise, the impact of public expenditure on health outcomes may be insignificant where marginal funds are used in purchasing expensive but low productivity machines.

A second line of research establishes the possibility of cross-border spill-over effects from policy in a source country. For instance, Eklou, Joanis and Richard (2015) investigated the cross-border effect of fiscal consolidations taking place in Germany and the US on (i) long term interest rates and (ii) bond issuance among peripheral countries. Results of their findings suggest that GDP point increase in the size of fiscal consolidation in source countries (Germany and US) produces an average reduction in borrowing cost and increases the net bond issuance among peripheral countries (OECD countries). In a related study, Goujard (2013) used trade flows to examine the international transmission of fiscal consolidation shocks among OECD countries. In any OECD country, fiscal consolidation in export markets is discovered to be associated with a decrease in domestic growth. In the European Union, there is also evidence of fiscal spill-overs via trade (Beetsma, Giuliodori, Klaassen 2014). International trade was discovered to be relevant for the cross-border transmission of fiscal shocks within the EU. Beetsma, Giuliodori, and Klaassen delineate a mechanism that suggest fiscal expansion in an EU country will stimulate domestic activity, increase both domestic imports and exports and consequently boost foreign income. Chua (1993) provides empirical evidence that a country's growth rate depends not only on domestic investment but also on the investment of its neighbouring countries.

This study contributes to the literature in two ways. First, I integrate the above two lines of the literature and contributed to providing evidence about the existence of public health spending spill-over across borders. This may shed new light on the question of why Nigeria, an emerging economy, is still the highest contributor to under-five mortality deaths in the SSA sub-region and second only to India. Second, I show using spatial analysis the possibility of cross-border utilization of health care services. While it is unclear whether health interventions in Nigeria internalise these possible cross-border use of health care services, the effect of such free-riding behaviour by neighbouring countries could have wider implications for health outcomes.

3.4 Method

3.4.1 Model and estimation strategy

In estimating the spill-over effect, I follow the procedure in Eklou, Joanis and Richard (2015). They investigated the cross-border spill-over effect of fiscal consolidations in Germany and the US on the long-term interest rates and bond issuance of peripheral countries (OECD countries) using fixed effects regressions. Results of their findings suggest that a GDP point increase in the size of fiscal consolidation in the source countries (Germany and US) reduces interest rates and increases the net bond issuance among the peripheral countries.

In line with the development literature, I specify childhood mortality outcome as a function of public health spending and a vector of covariates (Bokhari et al, 2006; Filmer and Pritchett, 1999; Wang, 2002; Anyanwu and Erhijakpor, 2007; Kiross, et al., 2020). In particular, the studies by Anyanwu and Erhijakpor (2007) and Kiross, et al. (2020) are comparable to this work in terms of empirical specification and context. Their studies used panel data estimation techniques to investigate the effect of public health spending on child mortality across SSA countries, and over time. Effectively, child mortality is specified as a function of government health expenditure per capita, GDP per capita and a vector of time-varying factors.

$$Y_{i,t} = \beta GHE_{i,t} + \propto lnGDPpc_{i,t} + \boldsymbol{X}^{*}_{i,t}\boldsymbol{\Phi} + \delta_i + \gamma_t + u_{i,t} \qquad 3.1$$

Where $Y_{i,t}$ is the mortality outcome in i country over time t, $GHE_{i,t}$ is government health spending per capita, $GDPpc_{i,t}$ is GDP per capita, $\boldsymbol{X}^{*}_{i,t}$ is the matrix of predictor variables and $\boldsymbol{\Phi}$ is the matrix of coefficients. Also, δ_i and γ_t represent the cross section and period specific effects respectively and $u_{i,t}$ are the error terms for $i = 1, 2, 3..., M$ cross-sectional units observed for years $t = 1,2,3, ... T$.

I extend equation 3.1 in line with the procedure in Eklou, et al. by including a spill-over variable, public health spending from a source country, and re-specify the equation as:

$$Y_{i,t} = \beta_1 GHE_t + \beta_2 GHE_{i,t} + \propto lnGDPpc_{i,t} + \boldsymbol{X}^{*}_{i,t}\boldsymbol{\Phi} + \delta_i + \gamma_t + u_{i,t} \qquad 3.2$$

where $GHE_{i,t}$ is the public health spending of any given neighbouring country i over time t and GHE_t is Nigeria's public health spending per capita and the coefficient of interest is β_1. A statistical significance test of $\beta_1 < 0$ implies that a spill-over effect exists, and that increasing Nigeria's public health spending may reduce child mortality outcome across borders. I interpret a statistically significant coefficient β_1 as evidence of public spending spill-over.

There are potential sources of bias of the estimate β_1. There are country-specific historical factors that may influence government spending of a source country and consequently child mortality outcomes of neighbouring countries. These factors are likely to bias the parameter β_1. If they are time-invariant, the inclusion of fixed effect will remove them and their sources of bias. To identify the spill-over effect of public health spending, I control for country-specific time-invariant factors by including country fixed effects. For this study, it is plausible to assume that the most relevant omitted variables could be time-invariant. Also, I include a large set of time-varying controls in the model in order to minimize the problem of omitted variable bias. Specifically, I control for corruption, political regime, ethnic fractionalization, rainfall and temperature anomalies, conflict, and public health programmes in the model. In addition, I rely on the exogenous variation in the source country's public health spending to identify the spill-over effect in the sample countries. In other words, I consider public health spending from Nigeria as exogeneous.

Though I include relevant control variables to address the issue of omitted variable bias, I do not claim to have controlled for all unmeasured confounders along the dimension of variance in the model. Nor do I claim to have satisfy all the causal identification assumptions with the panel data model. For instance, I did not control for time shocks in the model. A strategy is to use a two-way fixed effects to present a single estimate of public spending on mortality while controlling for cross-country heterogeneity and time-shocks. Given the restrictive identification assumptions of a two-way fixed effects model, it is less likely whether our model will be interpretable or whether the interpretation of the estimate from the model will match the research question been investigated. As pointed out by Kropko and Kubinec, (2020), that the parameter estimates from a two-way effects are derive from a complex amalgamation of cross-sectional and temporal effects, does not isolate either the variation across countries or the variation across time in the panel data. Using series of equations, they show that the two-way FE model could be unidentified when the within-country slopes are fixed across countries at the same time as the within time slopes are fixed across time points. Finally, while causal inference is vital, estimating regressions that addresses questions of practical relevant to policy is equally important.

3.4.2 Data and variables description

Several sources of data are used to construct annual panel to address the research questions. The World Bank Poverty database, which has been described in the previous chapters, is used to source annual series of child mortality outcomes, public health spending per capita, and GDP per capita. Under-five mortality rate is the probability per 1,000 that a new-born will die before reaching age five. Public health spending per capita measures government expenditure on health from domestic sources per capita expressed in international dollars at purchasing power parity. It captures the volume of resources flowing into population health. In line with the literature, I expect that an increase in government health spending per capita will improve access to health care and services and in consequence, reduce under-five and infant mortality (Gottret and Scieber, 2006; Bokhari et al, 2006; Ssewanayan and Younger, 2004; Anyanwu and

Erhijakpor, 2007). However, the effect of public spending on health outcomes may likely depend on the quality of governance in the country. It is vital that resources allocated into health spending be translated into effective health services for any desired impact to be attained. I use the control of corruption index as a proxy for the effectiveness of governance in a country and argue that it is more likely to structure incentive for human capital investment through the supply of public services such as education and health care in societies (Reinikka and Svensson, 2004). Indeed, corruption and especially in developing countries, may influence how public spending is utilize in the provision of health care services (Vian, 2008). The corruption index is source from the World Bank worldwide governance indicators (WGIs). It captures the perceptions by experts, households, and businesses of the extent to which public power is used for private gain. It has a value of -2.5 to 2.5; the higher value signifying stronger institution.

I use a dimension of distance, ethnic proximity, as exposure to public health spending from the source country. I argue that ethnic groups partitioned by international boundaries may be drawn to their peers from the same ethnolinguistic family across borders and this can facilitate transborder exchanges. I use data of homeland ethnic groups in Africa from Michalopoulos and Papaioannou (2013). I identified 23 ethnic groups with 66 partitions across 6 countries: Benin (11); Niger (12); Burkina Faso (2); Cameroon (32); Togo (3); and Chad (6). Michalopoulos and Papaioannou (2013) projected the George Peter Murdock's Ethnolinguistic Map (1959)—a map that depicts the spatial distribution of African ethnicities at the time of the European colonization in the late nineteen and early twentieth century—on a 2000 Digital Chart of the World. They identified about 230 ethnicities with at least 10% of their historical homeland falling into more than one contemporary state. I extract a list of countries with partitioned ethnic groups in Nigeria and is presented in Appendix 3A.1. I construct a dummy for ethnic proximity that takes the value of 1 when a country has at least an ethnic group with partitioned ethnicity in Nigeria.

In measuring the effect of income, I use GDP per capita based on Purchasing Power Parity (PPP) in constant 2011 international dollars and it is sourced from the World Bank data initiative. It is argued that income per capita may affect infant and child mortality through the wealth and survival chances pathway (Hojman, 1996). Most childhood deaths in developing countries are preventable and occur due to dearth of household resources. Increasing the incomes of individuals is expected to facilitate access to health care goods and services and this will improve survival chances for children (Sarkar, 2007). I control for weather variables using rainfall and temperature anomalies in line with the literature (see for example, Marchiori, Maystadt, and Schumacher, 2012; Henry and Dos Santos, 2013; Maystadt and Ecker, 2014). The rainfall and temperature data are sourced from the University of East Anglia Climatic Research Unit (UEA-CRU, Harris, Jones, and Osborn, 2020).

In addition, I capture the influence of conflict using indicators of a conflict year and the intensity of conflict sourced from the Conflict Data Programme/Peace Research Institute Oslo dataset version 20.1. In line with the literature, I argue that conflict can influence child mortality indirectly through its effect on displacement and malnutrition as shown in Avogo and Agadjanian, (2010); Aaby et al, (1999); and Depoortere et al, (2004), Cliff, et al., (1997); and Grein et al., (2003). Thus, countries with recent conflicts are likely to have higher under-five mortality rate compared to countries without recent conflicts (O'Hare and Southall, 2007). To control for the effect of political institution, I use the political regime score variable sourced from the Centre for Systemic Peace/Integrated Network for Societal Conflict Research data. It is a regime score that ranges from +10 (full democracy) to -10 (full autocracy). Finally, I include ethnic fractionalization in the model. As pointed out by Alesina, Baqir and Easterly (1999) and Wimmer (2015), different ethnic groups are likely to have divergent preferences, values, and beliefs and this might increase collective action and coordination problems with lower levels of public goods provision consequently. Hence, decrease in fractionalization—movement from heterogeneity to homogeneity—will result in better infrastructure and improved child health outcomes (Anyanwu and Erhijakpor, 2007). I source the data on ethnic fractionalization from the historical index of ethnic fractionalization (HIEF) dataset (Lenka, 2019). It is measured as the probability that two persons drawn at random from a country's population will belong to the same ethnolinguistic group (0, where all individuals are member of the same ethnic group to 1, where each individual belongs to his/her own ethnic group).

The sample period for this study covers 2000-2018 mainly because of data unavailability on earlier period for the key independent variable (government health spending). All variables listed have been described in greater details in previous chapters.

3.5 Results

3.5.1 Descriptive statistics

In this section, I present summary statistics for the full sample and a sub-sample of countries defined by a criterion of direct continuity of border sharing and are hereafter, referred to as neighbours, in Table 3.1. I note the variation in estimates between the full sample and sub-sample of neighbours. For instance, the maximum government health spending per capita (GHEpc) in the full sample is US$240 and this corresponds to the Capo Verde in 2018. Among the sub-sample of neighbours, it is about 8 folds lower (US$29.6). Also, the average government health spending as a proportion of total health expenditure (GHE/THE) is lower amongst neighbour countries (21.64%) relative to the full sample (24.79). On average, individuals pay about US$45 (OOPpc) annually to buy health in the sub-sample of neighbour countries. Indeed, in Cameroon, individuals pay about twice this amount (about US$100 in 2008). Child mortality outcomes appear to be poorer amongst neighbour countries compared to the full sample. On average, under-five mortality rate is about 10 points higher amongst neighbours compared to the full sample. Similarly, income per head is about US$700 lower among neighbours compared to the full sample. Also, I note higher incidence of malaria amongst neighbour countries with about 342 per 1,000 population are at risk of having malaria in a year. In fact, about 50% (492 per 1,000) are likely to have malaria in a year in Niger. On average, a neighbour country is more heterogenous in terms of ethnic diversity (0.79) and have lower rainfall (838mm) than any random country in the full sample.

Table 3.1 – Summary statistics

	Full Sample				Neighbours			
Variables	Mean	Sd	Min	Max	Mean	Sd	Min	Max
GHEpc	31.14	37.43	3.6	240.4	15.82	5.212	3.859	29.64
OOPpc	56.54	15.94	20.25	83.14	59.50	10.27	37.41	78.80
GHE/THE	24.79	14.26	4.154	73.35	21.64	6.405	4.166	38.02
GHE/GDP	1.236	0.749	0.146	3.613	1.064	0.573	0.146	2.675
Unemploy	5.130	3.099	0.320	12.24	2.437	1.554	0.320	7.600
GDPgr	4.561	4.760	-30.15	33.63	4.785	4.601	-6.256	33.63
Malaria	309.0	151.9	0.0076	589.3	342.2	92.46	164.8	492.7
U5MR	112.2	42.02	19.50	234	122.8	34.22	69.80	226.1
CPI	5.187	6.029	-8.975	34.70	2.413	3.271	-8.975	12.43
GE/gdp	12.17	4.031	0.952	20.71	11.86	4.209	3.603	20.71
GDPpc	2,651	1,398	897.3	6,864	1,942	864.6	897.3	3,604
IMRT	69.37	22.97	16.70	142.4	71.36	13.96	47.40	100.5
Ethnic	0.765	0.102	0.436	0.889	0.793	0.0833	0.666	0.880
Rainfall	1,068	695.3	78.10	2,809	838.2	529.7	132.6	1,660
Temp	27.34	1.362	23.40	29.40	27.29	1.149	24.80	28.70

Note: GHE/THE= Government health expenditure as a proportion of total health expenditure, GHEpc= Government health expenditure per capita, GDPpc=Gross Domestic Product per capita, GDPgr=Gross Domestic Product growth rate, OOP/THE=Out-of-pocket payment as proportion of total health expenditure, OOPpc=Out-of-pocket expenditure per capita, Unempl=unemployment, GE/GDP= general government final consumption expenditure as a percentage of GDP, GGD/GDP= Gross government debt as percentage of GDP, CPI=Consumer price index, Prep=Precipitation, Temp=temperature, GHEgdp=Government health expenditure as a proportion of GDP, Malaria=incidence of malaria, and Ethnic=ethnic diversity index.

3.5.2 Econometrics results

In this section, I provide results of cross-border spill-over effects of public health spending. First, I estimate models using a dataset of all West African countries over a period of 16 years (2000-2018). I argue that Nigeria is a member of the Economic Community of West African States (ECOWAS), which means that citizens of neighbouring states are allowed unrestricted access into and out of Nigeria within the context of the ECOWAS Protocol on Free Movement of Persons, Rights of Residence and Establishment. Next, using the same specification but restricting the sample to countries with geographical proximity, ethnic proximity, and linguistic proximity, I estimate the public health spending spill-over. The reason is to investigate the hypothesis whether distance matters in determining the size of the spill-over effect.

Public spending spill-over effect

Table 3.2 presents the result of the estimation of equation 3.2 using the West Africa dataset. The results show that a source country's public health spending reduces child mortality across borders. Results from model 1, the specification which includes public health spending per capita of other West African countries, show that increasing the size of Nigeria's public health spending by 1% will reduce, on average, under-five mortality rate by 1.14% across any West African country. This relationship appears consistent, but as expected, the coefficient decreases in size as more controls are added to the model. In particular, the coefficient shrinks from 1.2 to 0.49 when I control for income and female education in model 2. While I control for corruption, weather variables, and ethnic fragmentation in model 3, public health programmes (such as safe water provision and sanitation), conflict, inflation and incidence of malaria were controlled for in model 4. The results from specifications 3 and 4, nonetheless, suggest that Nigeria's public health spending is negatively associated with under-five mortality, but the statistical significance of the relationship appears to depend on the number of controls. That is, the significance of the uncover association is sensitive to the addition of controls.

Quality of institution, Distance, and spill-over effect

In model 1 (Table 3.3), I investigate the role of quality governance in determining the effect of public health spending spill-over. I argue that strong institution may provide the incentive to guarantee that public spending is effectively allocated to social welfare. Hence, it is likely that the size of the spill-over effect may depend on how effective governance is in the source country. The result in model 1 shows that having strong control over corruption in the source country will matter (-0.0407) in determining the effectiveness of public health spending in improving health outcomes across borders. Next, I exploit the distance measure in models 2-4 to show whether it matters in determining the magnitude of public health spending spill-over. The distance between two countries can be measured in terms of the geographical (border distance) and cultural distances (linguistic differences and language/ethnic distance) (Fenoll and Kuehn, 2014, p.4).

Table 3.2 - Public health spending spill-over effect

VARIABLES	(1) FE	(2) FE	(3) FE	(4) FE
n_GHEpc	-1.143***	-0.485**	-0.0465	0.140
	(0.155)	(0.223)	(0.123)	(0.107)
GHEpc	-0.364	0.196	0.341**	0.245**
	(0.253)	(0.155)	(0.127)	(0.112)
LnGDP		-45.68**	-26.40	-39.56***
		(17.30)	(16.31)	(13.34)
Literacy		-1.388***	-1.509***	-0.0122
		(0.243)	(0.374)	(0.623)
Corruption			1.332*	-0.168
			(0.735)	(0.666)
Governance			-1.643	-0.128
			(2.239)	(0.725)
Rainfall			7.646**	2.015*
			(2.649)	(1.105)
Temperature			-9.053*	-4.191
			(4.769)	(2.422)
Ethnic Frag			293.7	1,222
			(674.2)	(755.4)
Safe water				-0.544
				(1.008)
Sanitation				-1.780
				(1.520)
Immunization (DPT)				-0.897***
				(0.300)
CPI				0.0494
				(0.186)
conflict				1.335
				(2.837)
Malaria Inc				-5.807
				(6.775)
Constant	156.2***	520.6***	147.2	-335.6
	(8.067)	(134.1)	(520.6)	(502.4)
Observations	342	216	148	142
R-squared	0.146	0.587	0.589	0.769
Number of country1	18	18	16	16
Control	NO	YES	YES	YES
Country FE	YES	YES	YES	YES
Year FE	NO	NO	NO	NO

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In model 2 (Table 3.3), I estimate a separate fixed-effect coefficients on public health spending for neighbour countries. The result indicates a statistically significant effect (0.08) of source country public spending on reduction of mortality among immediate neighbours (Chad, Niger, Cameroon, and Benin). I had expected a stronger relationship between source country health spending and child mortality due to geographical proximity and the porous nature of borders that could facilitate cross-border use of health care. A comparatively lower estimate from the full sample would have implied that our estimate is not capturing all the spill-over effect. The evidence of negative but statistically insignificant public health spending spill-overs appear consistent in further split sample analysis. In models 3 and 4 (Table 3.3), our results indicate that it may not matter whether a country has ethnic (-0.772) or linguistic proximity (-0.995) to the source country in the determination of spill-over effect. However, comparing the magnitude of the spill-over effects with that of the full sample estimate, the results suggest that countries with shared historical past in terms of ethnic partitioning or official language with the source country may benefit from positive health externalities from source country's public health spending.

Table 3.3 - Good governance, distance, and public health spending spill-over effect

VARIABLES	(1) Governance	(2) GeoProx	(3) EthnicProx	(4) LinProx
n_GHEpc	-0.509**	-0.086*	-0.772	-0.995
	(0.239)	(0.047)	(0.689)	(0.661)
GHEpc	0.149	-1.927	-0.747*	-0.0039
	(0.146)	(1.712)	(0.369)	(0.103)
GHE_Corruption	-0.0407*			
	(0.0202)			
Constant	519.2***	759.0*	757.5**	273.2
	(170.7)	(286.5)	(239.0)	(448.8)
Observations	200	60	87	56
R-squared	0.573	0.574	0.656	0.615
Number of countries	17	4	6	6
Controls	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Year FE	NO	NO	NO	NO

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

All models contain the set of covariates in the baseline specification.

Robustness

For robustness, I use alternative definitions of the dependent variable and the key independent variable. Specifically, I use public health expenditure as a percentage of general government expenditure in place of public health spending per capita, and infant mortality instead of under-five mortality. The result is only robust to the use of alternative definition of childhood mortality and not public health spending (See column 1 and 2, Table 3A.2 in Appendix 3A). In addition, it is plausible to argue that current health outcome is likely to be determine by past health outcome. Also, current government health spending may be a function of previous health outcomes. That is, national governments are likely to adjust their health care spending in a current year in response to a poor health outcome in a previous year. Thus, I investigate dynamism and as pointed out by Bokhari et al., (2007) included lags of the variables in the model so as to eliminate the potential source of bias. I employ the GMM estimator and in particular, the Arellano and Bond system GMM and results are presented in Table 3A.2, columns 4 and 5 in Appendix 3A). The results suggest that public health spending in the source country is associated with child mortality in neighbouring countries in a non-statistically significant manner.

Finally, in line with the literature, I consider the argument that climatic factors such as drought and flood can result in the displacement of large number of people to migrant-source country especially in agrarian societies (McLeman and Smit, 2006). As a livelihood diversification strategy, populations especially in developing countries emigrate to a migrant-source country in a circular pattern (Cordell, Gregory and Piche, 1996; Rain, 1999). For example, as a result of land degradation, violence, and drought in the arid and semi-arid areas of Mali, Senegal, Burkina Faso and Niger, there has been both intra and inter-country migration southward and in consequence, increases in the populations of cities like Dakar, Bamako, Ouagadougou, Niamey, and Kano (Dietz and Veldhuizen, 2004). Hence, I investigate whether the occurrence of extreme weather events across countries in the sample influences the magnitude of the spill-over effect over time.[37] The results in Table 3A.1 show that public health spending spill-over may not be affected whether there is extreme weather event or conflict in a year. I had expected the coefficient from the interaction terms to be negative and significant, reflecting the net effect from the source country's public health spending in any given year of extreme whether events or conflict in neighbouring countries.

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[37] Data on flood and drought were requested from the Emergency Events Database of the Centre for Research on Epidemiology of Disease (CRED) (ED-DAT, 2018). The ED-DAT contains data on the occurrence and effects of over 22,000 mass disasters in the world from 1900 to 2018.

3.5.3 Spatial Analysis: Potential geographical accessibility to health facilities across borders

In this section, I shall argue that Nigeria borders, which are colonially negotiated boundaries and are permeable without any significant barrier, could facilitate cross-border utilization of health services especially among residents of border regions. Nigeria shares international boundaries with four countries that are French speaking. It is bounded to the north-west by Niger Republic, to the east by Cameroon, Benin Republic to the west, to the north-east by Chad and to the south by the Atlantic Ocean. Migrants cross these borders daily with little or no regard for formalities (Labo, 2000). Indeed, the borders are perceived by neighbouring countries as "corridor of opportunities" (Flynn, 2008). Hence, for a source country with porous borders and without a functioning vital registration system, there is the likelihood for cross-border utilization of health services especially by non-citizens within *geographical access*. In this section, I provide evidence of potential geographical access to health facilities across borders. Figure 3.1 shows Nigeria borders.

The Nigeria—Benin border

The border between Nigeria and Benin Republic which is about 700 km in length has no natural boundaries or exact demarcation in some areas. In the border region where natural boundaries such as lagoons or rivers exist, they are used as transport/trade routes. For instance, the lagoon linking Porto Novo to Lagos facilitates the transportation of agricultural goods, such as rice and cooking oil (Blum, 2014). In another instance, the Okpara river which also forms part of the international border is considered by the border settlers as less a boundary dividing them into two nations than a bridge linking them in mutual interdependence (Flynn, 1997). In fact, Flynn suggested the emergence of a border identity by border landers which is based on their perceived territorial claims to the region and rights to participate in transborder trade. More precisely, there appear to be a collective identity among the border landers which serves as a means of capitalization for their economic strategies.

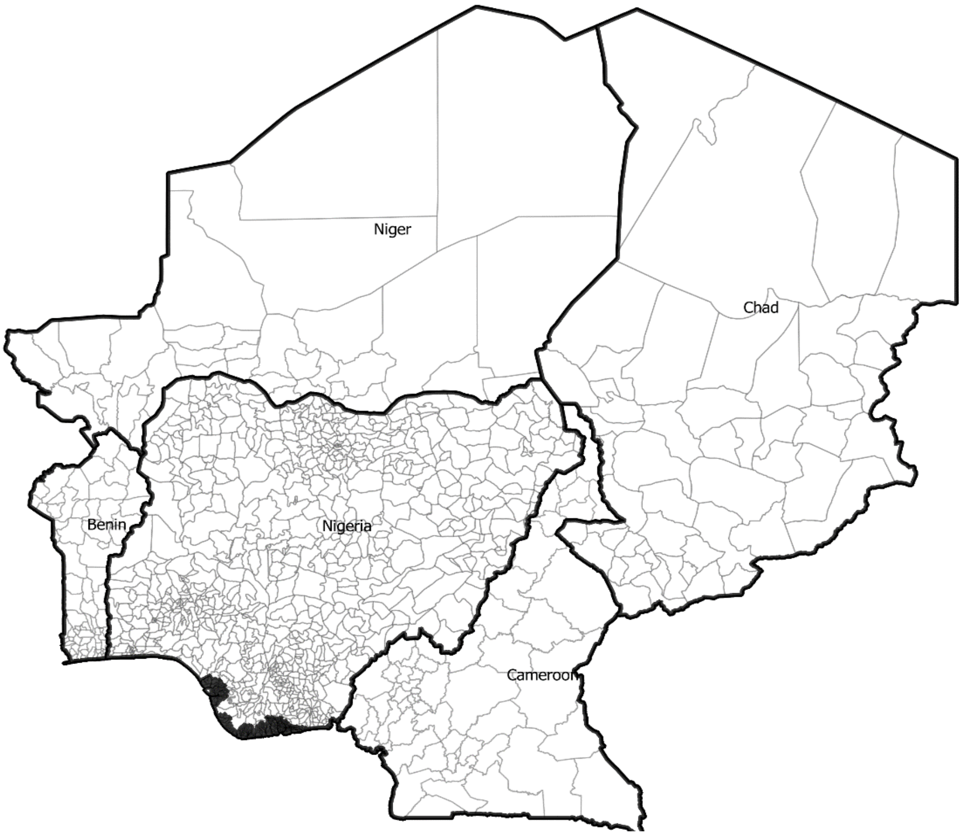

Figure 3. 1 - Map of Nigeria and Neighbours showing administrative districts

The Nigeria-Benin border is a corridor for informal cross border trade which is estimated to range from 20% of GDP in Nigeria to 75% in Benin with women as majority of traders (Afrika and Ajumbo, 2012). Additionally, the Abidjan-Lagos corridor which is a travel route between the five coastal countries of West Africa: Benin, Cote d'Ivoire, Ghana, Nigeria, and Togo, facilitates trade and movement of population between these countries (Chakrapani and Gwin, 2006).

The Niger—Nigeria border

The Niger Republic and Nigeria border stretches about 1,500 km and has the Kano—Katsina—Maradi axis as a prominent border territory between the two countries. The axis is made up of the states of Katsina and Kano in Nigeria and the Maradi province in Niger. The axis is one of the most densely populated areas in West Africa (Abdoul, Dahou and Tr´emoli`eres, 2004). It has a network of dense urban centres which are organised around the city of Kano, a city known for intensive trade in especially agricultural products and livestock. Migration into Kano and Katsina from the Niger Republic, especially during the dry season, is an established fact that predates the colonial era (Weiss, 2003). This is more so because, Maradi—a border town in the Niger Republic—was part of the Kingdom of Katsina in Nigeria until 1816. Indeed, the population structure of the Maradi province is closely linked to the development of the Hausa towns in north Nigeria, such as Katsina, Kano and Gobir. Because of its historic status as a trading town, population densities in Kano have always been high and this explains in part, the similarity in population density along the Kano-Katsina-Maradi axis, though there could be other reasons for the concentration of people along international borderlands ranging from soil fertility to location of markets.

The Cameroon—Nigeria border

The border between Nigeria and Cameroon is 1,700 km and the longest international boundary that Nigeria shares with a neighbouring country. The sharing of common bonds of language, culture, tradition, and the existence of sub-regional integration projects provide scope for cross-border cooperation (Bonchuk, 2012).[38] Along and astride the Nigeria—Cameroon borderlands are ethnic groups such as the Boki, Ejagham, Tiv, Fulani, Hausa and Mandara that are artificially partitioned by the 1913 Anglo-German boundary adjustment. Also, the disparity in income, livelihood, poverty, unemployment, and demographic patterns gives rise to illegal cross-border smuggling and commerce (Bonchuk, 2014). The border area consists of both high mountains such as Mandera, Mambilla and Bamenda and coastal lowlands that receive sufficient rainfall throughout the year as both countries border the Atlantic Ocean to the south (Adejuyigbe, 1989; Bonchuk, 2014).

The Nigeria—Chad border

Nigeria shares an 87 km length border with Chad Republic. The Lake Chad essentially constitutes the border between the two countries. It is surrounded by four countries: Chad, Cameroon, Nigeria, and Niger and plays strategic economic roles in these

[38] Historical ties between Cameroon and Nigeria were reported to date back as far as 1919 when both the Northern and Southern Cameroons were administered as part of the Nigerian Federation under the British rule, and then later by the National Council for Nigeria and the Cameroons (Fube, 2018).

countries. The lake water and its tributaries are a major source of water, food (fish) and trade for the Sahelian population (Zeiba, Genesis, and Tom, 2017). There is dependence of populations around the Sahelian region on a common water source for farming, fishing, and pastoralism and this appears to create a common identity for the Sahelian pastoral nomadic and farmers populations. Consequently, populations around the lake have over time been integrated, with strong cultural, social, and trade ties (Zeiba, Genesis, and Tom, 2017). Additionally, there are nomadic routes traversing the northern states of Nigeria (considered as gateways) and the lake Chad region, and this makes Nigeria a probable destination for transboundary nomadic population (Bawa, et al. 2018) perhaps due to its arable land and water resources.

From the above, it is clear that cross-border movements occur between Nigeria and neighbouring countries. Nigeria borders as mere artificial constructs that divide ethnic nationalities existing in pre-colonial era are permeable without any significant barrier. There are existing trade routes that further integrate border regions. All these could facilitate cross-border utilization of health facilities since migrants are likely to have unrestricted access to health services in Nigeria due to the absence of functional vital registration system. Next, I provide qualitative evidence of potential geographical access to health facility across borders.

Analytical approach

I examine the question of whether there are potential geographical accessibilities to health facilities across borders by estimating the Euclidean distances between health facilities in the source country and settlements across borders. This is in line with the procedures proposed by Apparicio, et al. (2008). They outlined three ways of assessing distances on maps: (i) Computing of distances between the centroid of the census tracts and the services (ii) Computing a population-weighted mean centre of the census tract and distance to the services (iii) Computing the distance between services and each centroid of spatial units completely within a census tract and then calculating the average of these distances, weighted by the total population of each unit. In this study, I measure accessibility using the closest distance to health facilities from the centroids of settlements. Effectively, I use the geographical information system methods in computing the Euclidean distances from neighbouring country settlements to the nearest health facility across the border.[39] It is expressed as:

$$d_{ij} = \sqrt{((X_i - X_j)^2 + (Y_i - Y_j)^2)}$$

where X_i and Y_i = X and Y coordinates of point i with a plane projection

I assume that every member of a settlement within geographical access to a health facility is a potential user such that the pattern of spatial access will depend on the relative location of the settlement to the health facility. In other words, if settlements are within threshold proximity in the source country, individuals from neighbouring countries are likely to utilize the health facilities. Thus, “variations in accessibility feed through into variations in the uptake of both health care services” (Haynes, p.15 in Martin and Myfanwy, 2003). In line with the literature, I use thresholds of 25km to a general district hospital (GDH) and 2.5mile from a general practice (GP) to define potential accessibility (Jordan, Roderick, Martin et al., 2004).

I use the analysis tool and Geoprocessing tools in QGIS 3.8 to compute distance matrices and implant buffer zones between border settlements in neighbouring countries and health facilities in the source country. This is made possible by approximating the location of border settlements of neighbouring countries as a centroid and the health service locations as points defined by coordinates on the source country national grid. The Euclidean distance between the settlements and health facilities is then estimated using the Pythagoras theorem. Fundamentally, as the unit of analysis is the settlement, I assume that every member of a settlement within geographical access is a potential user of the health facility across the border. This allows the allocation of the same distance to health facility across the border to all individuals in the settlement. Hence, the pattern of geographical accessibility will depend on the relative location of the settlement and health facility.

[39] Apparicio et al., (2008) identify three types of distances for calculating accessibility measures: Euclidean distance, Manhattan distance, shortest network, and shortest network time distances. While Manhattan distance is the distance along two sides of a right-angled triangle opposed to the hypotenuse, the Network distance and network time distance represent the shortest and fastest paths between two points using a street network respectively (it is the physical travel path or road a caregiver of a sick child would follow to reach the nearest health facility). The latter is more complex and will require for their computation geometric network files with directions, speed limits, turning restrictions, and delays available for each street segment integrated into a specialized GIS designed for transportation analysis.

The choice of Euclidean distance was necessitated by the limited nature of the available data. For instance, to produce more accurate measurements such as the network distance, I will require path and road network files with directions and average speed limits as well as possible details of barriers on the road surface. Other distance measures will require more detailed individual-level data on actual healthcare trips, drive time between a patient’s home address, and the health facilities utilized linked to individuals in a spatial unit of analysis. This information is missing in the available shapefiles for this study. Nonetheless, there are studies in the literature that have examined geographical accessibility of health facility by measuring the accessibility of the closest facility using Euclidean distance (see for example Hewko, Smoyer-Tomic and Hodgson, 2002; Lovett, Haynes, Sunnenberg and Gale, 2002).

I use three sets of shapefiles for this analysis: a settlement shapefile; a population shapefile; and a health facility shapefile. While the settlement shapefiles were extracted from the Humanitarian Data Exchange (West and Central Africa Administrative boundaries), the health facility shapefiles were obtained from a World Health Organization spatial database of health facilities managed by the public health sector in the SSA. Also, population figures and land area for administrative district boundaries were extracted from the City Population. The City Population is a database of population statistics for countries, administrative divisions, cities, and urban areas agglomerations. The shapefiles are available online.

Is there potential geographical accessibility to health care facilities across borders?

In providing evidence whether there is potential geographical accessibility to health care facilities from across the borders, first, I show the distribution of health facilities in Nigeria from a geo-coded master health facility list. The health facility master list consists of an inventory of 20,800 health facilities scattered across Nigeria. These health facilities include dispensaries, clinics, primary health care centres, general hospitals, comprehensive health centres, and teaching hospitals. Figure 3.2 shows the health facilities density of Nigeria. From Figure 3.2, it is apparent that there is dense concentration of secondary health facility around the southern borders relative to the northern borders. The map shows a significantly disproportionate distribution of the geo-coded secondary and tertiary health facilities, with more concentration in the southern part of the country where there are greater population densities.[40]

Next, I show whether there is convergence of populations along the Nigerian border that could suggest possible cross-border health services utilization. I argue that densely populated borderlands could create incentives for cross-border utilization of health care facilities. To achieve this, I extract population figures and land area in kilometres square for administrative district level boundaries from the City Population to estimate population densities. Figures 3A.1, 3A.3, 3A.5 and 3A.7 in Appendix 3 show maps of Nigerian health facility distribution and population densities along the boundaries of neighbouring countries. From the maps, it is clear that populations are dense along international borders of Nigeria. This suggests the existence of economic activities along the border regions which could act as pathway to cross border utilization of health facilities.

Finally, I extract borderland settlements within administrative district level of neighbouring countries from the Humanitarian Data Exchange shape files described above. This allows for the use of the analysis tool in QGIS to estimate the distance matrix between neighbouring countries' settlements to the 3 closest Nigerian health facilities across the border.

To identify the number of settlements within range, I superimpose a buffer on the health facilities using the 25km and 2.5 miles thresholds. In the QGIS, the buffer zones are in degree latitude, and this is converted to kilometres using 1^{o} Latitude =111km. I specify 2.5miles (4.02km) and 25km buffer zones using the straight-line measure. I dissolve the rings and apply spatial overlays to allow for visual assessment of the number of settlements within each ring. This technique has support in the literature (Parker and Campbell, 1998).

[40] According to WHO (2009, p. 240), while a general hospital refers to health facility that provides a range of different services for patients of various age groups and with varying disease conditions, a primary health care centre provides services which are mainly the first point of contact with a health professional such as general practitioners, dentists, community nurses, pharmacists, and midwives, among others.

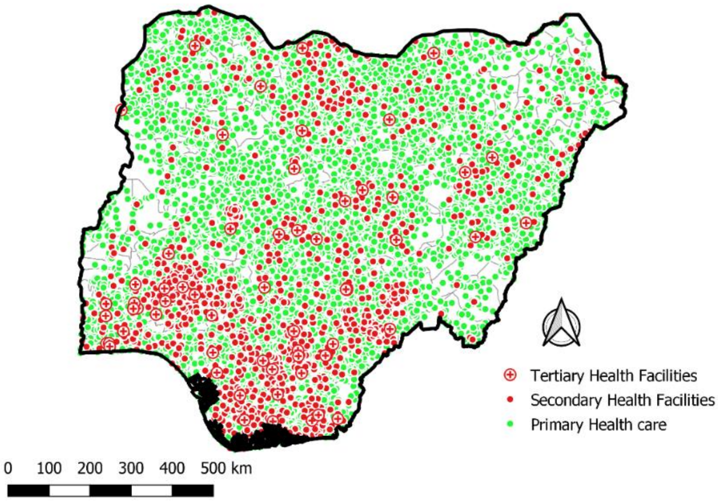

Figure 3. 2- The distribution of 20,800 public health facilities (geo-coded) in Nigeria.

From the study findings, I first note that there are about 15 Beninese administrative districts that border 10 Nigerian districts directly. While the Nigerian districts have 168 geo-referenced health facilities consisting of Primary (n=157) and Secondary (n=11) with no tertiary health facilities, the Beninese districts have about 1,515 geo-referenced settlements (see Figure 3A.2, Appendix 3). Using the analysis tool in QGIS, I estimate the distance matrix between Beninese settlements to the 3 closest Nigerian health facilities. From the results (Table 3A.3, Appendix 3A), about 94 of the 1,515 Beninese settlements are within 25km of health facilities across the Nigerian border, with the Aro, Abule and Alari settlements in the Benin Republic having the shortest distance of about 0.6 km to the Alaari Health Centre in Nigeria. Using this technique, I discover that 6.2% of settlements in Benin borderland administrative districts are within the 5km accessibility threshold to a health facility in Nigeria. When I use the 2.5 miles threshold, only 32 settlements are within range. Figure 3A.2 (Appendix 3) shows the 2.5miles and 25km straight-line distance bands centred on health facilities in Nigeria.

Second, I discover that the border between Niger and Nigeria which stretches about 1,500 km has 13 Nigerien administrative districts bordering 24 Nigerian districts. In the Nigerian districts, there are about 622 health facilities bordering 7,516 settlements within the Nigerien administrative border districts (See Figure 3A.4, Appendix 3). The 622 geo-referenced health facilities, consisting of Primary (n=594), Secondary (n=27) and a Tertiary health facility in Kebbi state (Nigeria), are finely distributed along the Nigerian border with the Niger Republic. The estimated distance matrix between Niger border settlements to the 3 closest health facilities across borders revealed that 117 settlements are within 2.5 miles to health facilities in Nigeria and 272 settlements are within 25km to health facilities in Nigeria. I discover that the closest Nigerien settlements to any health facility across the border are less than 1km straight line distance. These settlements include: Gashagar to Gashiga health facility (0.62km); Guidan Ahamet to Langego Dispensary (0.67km); Rigal Hardo Bohari to Jeke Health Post (0.69km); Jiran Tabi to Ginzo Health Clinic (0.83km); and Dan Kokouroun Foulani to Ginzo Health Clinic (0.95km). Figure 3A.4 (Appendix 3) shows the 2.5miles and 25km straight-line distance bands centred on health facilities in Nigeria.

Third, I note that the 1700km long border between Cameroon and Nigeria have 576 geo-referenced Nigerian health facilities distributed within 20 administrative districts directly bordering 12 Cameroonian districts with 5,982 settlements (see Figure 3A.6, Appendix 3). The Nigeria health facilities distribution consists of 541 primary health centres and 35 secondary hospitals, with no tertiary health facility. From the estimated distance matrix results, there are about 125 Cameroonian settlements that are within 2.5 miles to health facilities in Nigeria. Figure 3A.6 (Appendix 3) shows the 2.5miles and 25km straight-line distance bands centred on health facilities in Nigeria.

Finally, the 52.82 miles long border between Nigeria and Chad has 205 Chadian settlements within an administrative district bordering the Lake Chad Basin area. Also, there are 89 health facilities, 6 General Hospitals and 83 Primary Health Care centres, distributed within the closest administrative border district in Borno State, Nigeria (see Figure 3A.7, Appendix 3). When I estimate the straight-line distances between the settlements and health facilities across the border, the closest Chadian settlement to any health facilities across the border is Madey (90Km), which is the same distance to Tigini

Health Centre and Metele Health Centre in Borno State. That is, I did not find any Chadian settlement within potential geographical access to Nigerian health facilities.

3.6 Discussion

Findings from this study suggest that an expansionary Nigeria's public health spending is associated with childhood mortality reduction in neighbouring countries and on average, across West African countries. I interpret this as evidence of a public health spending spill-over across borders. Government health spending may involve the provision of public health goods and services that generates positive health externalities. More precisely, public health spending in Nigeria funds services ranging from surveillance and prevention of communicable diseases, provision of safe water and improved sanitation, the provision of health information, and child and maternal health. These services are likely to have significant positive externalities for children in the source country as well as neighbouring countries. Communicable disease immunizations for example, could have significant marginal social benefits that can reduce mortality through herd immunity in both the source country and neighbouring countries. It could save health cost associated with treating diseases. In corroborating the above finding, a study in the US suggests that every dollar spent on childhood vaccinations saves US$3 from a payer perspective and US$10 from a *societal perspective* (Zhou, Shefer, Wenger, Messonnnier, et al., 2009). Funding of other services with public health externalities include screening for tuberculosis, HIV/AIDS, and other communicable diseases. Hence, it is likely that a source country's institutional and technical capacity to respond to disease outbreaks and to embark on preventative research may provide externalities that could influence mortality outcomes across borders. Also, public health spending in Nigeria involves subsidizing health services such that prices do not reflect actual costs. An increase in public health spending may further widen price and quality differentials between the source country and neighbouring countries and this provides incentives for cross border use of health care. Also, it is likely to facilitate cross-border exchanges in medical commodities and such spill-over may reduce child mortality. Thus, increasing government health spending in a source country with porous borders, may increase access and utilization of health facilities by individuals located within the perimeters of geographical accessibility to health facilities and consequently, reduce child mortality.

From our results, I find evidence that with good governance, additional public health spending will reduce child mortality in neighbouring countries. That is, the effectiveness and efficiency of resource use in addressing health needs will matter in determining the effect of public health spending on child mortality. This finding is supported in the literature (Wagstaff and Claeson, 2004; Rajkumar and Swaroop, 2008). Also, our results indicate that the existence of partitioned ethnic group in neighbouring countries or neighbouring countries having similar official language with the source country may not matter in determining the magnitude of spill-over effect. However, it remains unclear whether these findings will be consistent if the hypotheses are investigated with finer level of data.

From the spatial analysis, I find evidence of potential cross-border use of health facilities. I argue that if settlements are within geographical accessibility threshold, patients are likely to utilize the health facilities across borders. I explain the use of cross-border health care in line with four factors pointed out by Glinos, et al., (2010) as reasons for patient mobility across international borders. They include availability, affordability, familiarity with the health care system, and perceived quality. First, patients are likely to cross borders from neighbouring countries into Nigeria if the desired type of care in their country of residence is unavailable. Seeking specialised care facilities especially when it implies shorter distances than travelling domestically could be a factor for patients' migration. Second, maternal and child health care services, which appear to be more subsidized in Nigeria comparatively, could be a motivation for cross-border mobility of patients. Nigeria acts the role of a medical tourism hub for the sub-region. Government health spending in the form of subsidies is an attraction for medical tourists from neighbouring countries whose public financing of health facilities may be under-funded. The subsidized maternity services and under-five treatment in government-owned health facilities in most getaway states across Nigeria could be a vital motivation for cross-border utilization of health facilities. For example, Kano state, which borders the Niger Republic has subsidized maternal medical services and under-five treatments in all of its secondary and tertiary health facilities (Galadanci, et al., 2010). This may be a possible draw for medical tourists within the parameters of geographical accessibility across borders. Finally, a source country, perceived quality of healthcare may be a pull factor for patient mobility across borders.

The study has several implications. First, when it is taken as given that the high number of under-five deaths in the SSA sub-region and particularly Nigeria is preventable, any condition that mitigates progress towards attaining child mortality reduction targets should be worthy of investigation. While public health spending in a source country generates positive health externalities across borders, it may lead to reduced welfare for Nigerians especially when they have to finance subsidized services consumed by non-residents. The existence of a public health spending spill-over could imply additional strain on the health care/social security system of the source country. Also, the evidence of spill-over effects may have fiscal implications for the source country. It suggests a possible diversion of the country's public resources to meeting health care need of non-citizens. Deficits in the levels of public health investment which has been considered as a reason for the failure of developing countries to attain the MDGs targets (Jamison, Breman, Measham, et al., 2006; WHO, 2000; Sachs, 2001) and may likely compromise on-going actions to achieve the SDGs, appears to be a persisting issue for Nigeria. The extent to which this explains the persistent health financing gap in Nigeria could be relevant in drafting public health expenditure framework. More so, with porous borders, it is difficult for health system of a source country to be nationally bounded, and this may constrain the maximization of efficiency gains from scarce public resources spending on health. That is, it is less likely for a source country with porous borders, to maximise efficiency gains from its public health spending.

Further, with porous borders, public health spending and in particular, health insurance coverage which has been identified as one of the most significant predictors of cross-border utilization of health care services, could result in the enrolment of citizens and non-citizens alike. This may reduce access to financial protection of the poor against illnesses and from financial consequences of accessing child and maternal preventative care in the source country. Evidence of the impact of health insurance on access to health care or health outcomes has rich support in the literature (Institute of Medicine, 2009). The uninsured are less likely to use preventative services and this has many harmful consequences that results in poorer health (Institute of Medicine, 2009). With porous borders and given the possibility of patient migration, in the case of vaccination, it will be difficult to determine the optimal fraction of the population to be vaccinated. This is important given the rising threat of infectious diseases outbreaks. Also, the possibility of using health care across borders may provide less incentives for neighbouring countries to develop their health systems. It might reduce the tendency for residents in neighbouring countries to exert political pressure to improve their domestic health systems.

The existence of public health spending spill-over effect across border should be considered within the context of several study limitations. First, the association between public health spending in a source country and childhood mortality outcomes in neighbouring countries may be affected by unmeasured confounding factors or residual confounding. Though we have controlled for large set of confounding factors, it is possible that country specific factors that drive mortality or interactions effects between covariates that may explain health outcomes were omitted. Also, the observed confounding factors are aggregated at the country level which make them susceptible to information loss from the aggregation process hence they might be prune to measurement errors—residual confounders. Therefore, I do not claim to have treated all endogeneity concerns that may bias the spill-over effect.

Second, it is difficult to compare the estimates on spill-over effects with other study findings similar in design and methodology. The literature on health spending spill-over is still incipient especially in the SSA sub-region. However, there are studies establishing the existence of neighbour effect in Africa (for e.g., Easterly and Levine, 1998; Ades and Chua, 1993). While Easterly and Levine provided evidence of a robust relationship between a country's growth rate and that of its neighbour—growth contagion, Ades and Chua suggested that unfavourable characteristics of one's neighbours in the form of low investment or political instability could have spill-over effects across borders on a country's growth performance.

Third, the evidence on cross-border use of health care should be interpreted as descriptive. The study is limited by a lack of finely measured geo-coded data. Data on cross border use of health facilities in the study region are sparse and anecdotal. The study data are aggregated at settlement—facility levels and this limits our understanding of the precise pattern of cross border use of health facilities. With a less aggregated geo-coded dataset at individual level with information on health outcomes alongside a set of relevant covariates (such as doctor visits, inpatient care, drug purchases and socio-economic characteristics), it would have been possible to directly test series of hypothesis using spatial econometric models. Also, such a dataset would allow for the restriction of our estimation to areas close to the border using the geographical accessibility thresholds, hence, I can investigate variation in health outcomes due to exposure to utilization of health facilities across border. For data unavailability, I can further investigate certain hypothesis raised in the study in a more rigorous manner with advanced identification strategy. For instance, with data at local level, it will be possible to compare health outcomes in localities across borders belonging to the same historical homeland of an ethnic group but exposed to different public health spending policy. For further research, the shapefiles used for the spatial analysis will need to be complemented with individual level data from the DHSs of sampled countries over the period of analysis to allow for a more robust estimation of the spill-over effects. To be precise, maps could be constructed, health facilities and settlements within and out of range can be selected using the settlement and health facilities data, and then clusters from the DHSs will be distributed over the maps using the GPS shape file data obtained from the DHSs. This will make it possible to identify clusters within range as exposed and clusters outside range as unexposed. In essence, value will be added to the present study if a further microeconomic analysis of the implications of cross-border use of health care and its determinants is carried out. Our study shed light on the imperative of collecting individual level data on the use of health facilities across borders for all source countries in the SSA sub-region and Nigeria in particular. Findings from the analyses of such data should feed into the design and implementation of public health budgets by source countries.

3.7 Conclusion

The study findings show that Nigeria public health spending reduces child mortality across borders. I interpret the findings as spill-over effect from public spending of a source country. Also, I show the possibility of cross-border use of health facilities in Nigeria by neighbouring countries. It is unclear whether health interventions that are designed to reduce child mortality in Nigeria internalise these possible spill-over effects. While there may be welfare gains for child health in neighbouring countries, the source country may face additional strain on its health system, and this could constrain progress in attaining health and development goals. In line with the principle of territoriality, the social responsibility of a country should not extend to persons outside the territorial bounds of a country. Hence, it is vital that health actions between neighbouring countries be coordinated such that no country is worse off than they should otherwise be if spending actions were uncoordinated. Importantly, with the possibility of cross-border use of health facilities, investment in capacities to respond to epidemic outbreaks could be coordinated between countries—acting together could produce greater externalities and will minimise free-riding. This is important given the recent threats of disease outbreaks and the growing burden from humanitarian crises. In effect, greater externalities could be created through a planned resource allocation where the source country may act as a social planner. Alternatively, source country may consider health care protectionism characterised by strict eligibility requirements for accessing social security benefits.

Chapter 4

Bargaining power, household decision-making and child health outcomes: The example of Nigeria

4.1 Introduction

As I shall argue in this chapter, an understanding of the domestic economy of Nigeria could be vital in explaining its child health outcomes, social health spending notwithstanding. Specifically, I address the question of whether, and if so, to what extent, gender matters in intrahousehold resource allocation with regards to child health outcomes. Put differently, I investigate how gender relations within Nigerian households could influence child health outcomes. I argue that the decision to allocate resources or use health care services could be influenced by the dynamics of intra-household relations. That is, the asymmetric control over household resources when household preferences are heterogeneous could be an important influence on child health outcomes. Also, I investigate heterogeneity in the effect of decision-making right on child nutrition across demography such as education, ethnicity, location of residence, and landownership. Importantly, I examine the hypothesis whether the unitary model defines decision-making processes within the Nigerian households with respect to child health outcomes. Finally, I empirically identify drivers of decision-making rights within the Nigerian households.

The concept of Demand Side Financing (DSF) is initiated partly as a direct response to the concerns of financial barriers associated with the low uptake of interventions.[41] However, evidence of the influence of demand-sided policies on uptake of health interventions appear mixed. Indeed, the efficacy of demand-side programmes in improving household outcomes remains unclear (see for example, Witter, Fretheim, Kessy, and Lindahl, 2012; Jutting, 2001; Glassman, Duran, Fleisher, Singer, et al, 2013). Nor is there clear policy action on social spending supporting families, that is gendered. Further, there is increasing evidence of a low rate of maternal and child health services, especially among the poor and vulnerable in developing countries (Victora, et al. 2004; Gwatkin, 2004; Schellenberg, Victora, Mushi, et al, 2003). It was shown in

[41] DSF initiatives in developing countries include, but are not limited to, Conditional Cash Transfer programmes, Voucher programmes, and Community Based Health Insurance.

Indonesian that the decisions to take up prenatal interventions and the place of delivery were influenced by the extent of the women's control over economic resources, among other factors such as her education, and the relative education level and asset possession of the woman's father (Beegle and Thomas, 2001). This suggest that a driver of demand, asymmetric control over household resources, could be a relevant factor in the uptake of health interventions. Effectively, this study investigates to what extent a woman's decision-making authority influences household resource distribution and ultimately child anthropometrics. In theory, women having decision-making rights, which reflects their bargaining power, can impact on child health outcomes. This is because, if preferences of the decision makers within the households differ along gender lines and there is bargaining, household decisions will vary according to the relative strengths of each individual's bargaining power (Quisumbing, 2003). Hence, any gender imbalance in decision-making rights could influence the assertion of such preferences, and consequently, child health outcomes.

Using the Nigerian Demography and Health Survey (NDHS) data set of 2018, the latest dataset in the series of DHS conducted in Nigeria, I investigate the effect of gender asymmetry in decision making on different child anthropometric measures. Specifically, I use relative decision-making right as an indicator of bargaining power and examine its effect on child nutrition. I argue that the decision-making right index can be a more direct measure of power. The results suggest that the probability that a child will be stunted, wasted or underweight, is reduced if a woman is part of the household decision-making process with regards to her health, visit to relatives and household expenditures. Specifically, compared to women with no decision-making rights, the average marginal effects that a child will be stunted, underweight, or wasted are 3%, 6.6%, and 4% less for women that are involved in at least one of the decision-making spheres. When I test which model defines the decision-making process within the Nigerian household with respect to child health outcomes, the result supports the collective model prediction of intrahousehold inequality. Precisely, finding indicates that children anthropometric failure rate in households with women having decision making right is lower -0.071 ($p<0.01$) compared to children in households where men autonomously make decisions, and the result is robust to different estimators used. Additionally, I investigate heterogeneity effects and the results suggest that the effect of decision-making rights on the probability of child anthropometric failure is comparatively lower for women with basic education, urban women, and women with landownership. Finally, I uncover that media exposure, education, land ownership and not being poor (poverty) are significant predictors of women autonomy in decision-making in Nigerian households.

The remainder of the chapter is structured as follows. Section 4.2 reviews related literature outlining procedures to test models' predictions. Data and empirical strategy are laid out in Section 4.3. Results are presented in section 4.4. The last section concludes.

4.2 Background

In Nigeria, there appears to be an increasing realization that social health spending can be a meaningful way to improve household welfare. This is being implemented through demand-sided as well as supply-sided programmes at the different tiers of government. The Subsidy Reinvestment Programme Maternal and Child Health Initiative (SURE-P MCH) and The National Social Investment Programme (NSIP) are clear examples of programmes that sought to improve the supply and demand of health care services.[42] Before now, the emphasis of health policy intervention tend to be on increasing the supply of health care services with emphasis on the role of the state. The growing interest in the potentials of demand sided policies through cash-based social protection to promote and protect livelihoods may, however, require guidance. Perhaps an understanding of the internal functioning of the domestic economy might be relevant in the evolving of welfare regimes that could impact on household outcomes through the DSF initiatives.

Women household decision making authority could influence child health outcomes in several ways in the Nigerian households' context. First, the decision to visit friends and

[42] The Government of Nigeria's Sure-P Maternal and Child Health Initiative (SURE-P MCH) was launched in 2012 using funds from the removal of subsidies on petroleum. The initiative was designed to improve the supply and use of health care services for pregnant women and their babies. It included training and placing of midwives and community health extension workers in understaffed health facilities and cash transfer for pregnant women who registered for antenatal clinics. The National Social Investment Programme (NSIP) are a group of programmes including Conditional Cash Transfer (CCT), Home Grown School Feeding Programme (HGSFP), Government Enterprise and Empowerment programme (GEEP), and N-Power under the Nigerian National Social Investment Office.

relatives can be crucial in the formation of social capital by providing social networks that can be used to mobilize financial capital in the event of health shocks. In other words, individuals are likely to command resources by virtue of their membership of social networks as pointed out by Portes (1998). These resources could also be at community-level as observed by Putnam (1995) and are usually reflected in the structure of social relationships facilitated by the mobility of the woman. Also, social network facilitates the flow of information on health education and innovations. There is evidence that females organize their social network differently from males (Szell and Thurner, 2013)[43]. Second, the decision over household expenses can influence food distribution within the household as suggested by Piwoz and Viteri (1985) and especially if such rights are reinforced by control over financial resources. The decisions over household expenses could imply making daily dietary and lifestyle decisions for the household. The preference for child welfare is likely to affect household food expenditure if women with decision-making authority assert their preferences. Third, the right to decide over one's health can be important for women's survival as well as their children. Precisely, having control over child-bearing decisions will reduce the frequency of pregnancies, especially those that are at greater-than-average risk of maternal, perinatal, and child mortality (Cleland, et al., 2012). There is empirical evidence that women with relatively higher power can influence negotiation about safer sexual practices (condom use negotiation). Findings from a study of 388 women in the USA suggest that women with high levels of relationship power were about five times more likely to report consistent condom use compared to women with low power (Pulerwitz et al., 2002).

Nigeria appears to be an appealing test case for several reasons. It is a heterogeneous society with autonomous communities having distinct cultural practices. Ethnic groups differ in terms of the level to which they are stereotypically patriarchal or the extent of gender biases in their educational attainment, labour force participation, and decision-

[43] Szell and Thurner (2013) provided evidence that females and males manage their social networks in substantially different ways using a behavioural dataset of an online-game society of about 300,000 players. Females were found to have more communication partners, stronger homophily effect, higher clustering in trade network.

making rights. Guyer (1997) provides an insightful discussion of the many ways in which sources of power could vary according to the social, economic, and cultural contexts. Culture, for instance, in the Nigerian context, is likely to be relevant in shaping the pattern of decision-making within households. Several comparative studies across different cultures have shown that there is a less joint decision-making and more male domestic dominance in a less egalitarian and more patriarchal society (Mann, et al., 1998). Thus, the role of culture/ethnicity in the modelling of household decision-making in Sub-Saharan African countries may be better illustrated by analysis of households in Nigeria. Second, of the two regions (SSA and Central and Southern Asia) that account for more than 80% of the 5.3 million under-five deaths in 2018, half of all under-five deaths occurred in just five countries: India; Nigeria; Pakistan; Ethiopia; and the Democratic Republic of the Congo. India and Nigeria alone account for about a third (WHO, 2019). Severe malnutrition is a major contributor to both mortality and morbidity. Perhaps an understanding of the domestic economy dynamics in relation to decision-making rights and preference assertion might be an inroad to understanding, or perhaps decoding the child mortality black box of Nigeria and the SSA region in general.

4.3 Review of related literature

It is traditional to model households along two broad strands: Unitary models (Samuelson, 1956; Becker, 1981) and Collective models, which are further classified into Cooperative Bargaining models (see for example, McElroy and Horney, 1981) and Non-cooperative models (see for example, Lundberg and Pollak, 1993; Ulph, 1988). An outline of each model and their core assumptions has been provided in two separate studies by Doss (1996; 2011). In brief, with the Unitary models, a utility function that aggregates all preferences of decision-making units within the household structure is specified. This is made possible by the assumptions of transferable utility that allow for the redistribution of utility as well as the consistency of preferences for both individual and aggregate household members (Bardhan and Udry, 1999). That is, a homogeneous utility function (assuming homothetic preferences) is specified for all household members such that maximization of the aggregated utility function is equivalent to individual utility maximization. Using the “Rotten Kid Theorem”, Becker (1981) demonstrated the internal consistency of the logic of aggregating family preferences by incentivising the “selfish child” to align his/her preferences with that of the family.

An alternative framework for analysing household decision-making processes is the class of collective models. In a generic sense, collective frameworks are either modelled as cooperative bargaining or non-cooperative models. Using a game theoretic model, bargaining situations within the household are analysed assuming a two-person household of major decision makers in McElroy and Horney (1981) and Manser and Brown (1980). The bargaining power of a spouse is assumed to be dependent on his or her “outside options” also known as threat points, which are defined as utility outside marriage or potential welfare entitled to a spouse if not a member of the household. These threat points can be influenced by some extra household environmental parameters (EEPs) such as institutional demographic and legal factors (Folbre, 1992). The EEPs are otherwise known as the “shifters” of threat points which provide policy space to influence bargaining power. A common prediction of the cooperative bargaining model is that changes in intrahousehold allocation can be stimulated by changing the utility of an outside option. For instance, divorce as a threat point can be influence by increasing the amount of government transfer to divorced women.

The central thesis of the non-cooperative models is the independence of household members in making decisions on production and consumption of all goods, these decisions being interrelated given that resources are not pooled. A point of departure from the cooperative models is the rejection of an automatic pareto-efficient outcome, but rather the insistence that the non-cooperative class of models is consistent with both Pareto efficient and Non-Pareto efficient outcomes (Doss, 2011). Specifically, individuals operate as autonomous sub-economies with differing preferences, locked in unbinding and unenforceable contracts with each other. A major prediction of the non-cooperative models is the likelihood of household transitioning into a corner solution. Lundberg and Pollak (1993) predict that in the event of a collapse of cooperation amongst spouses—the “non-cooperative agreement points”—the traditional gender roles would eventually specify each spouse’s activities as well as contributions. Where the provision of public goods is involved, households are unlikely to be efficient.

In determining the best fit model for households, one approach in the literature is to test the validity of the model's assumptions against the data and to investigate if the observed outcome from estimations is consistent with the predictions of the models. More precisely, in searching for a unitary model, the core assumption of income pooling or homothetic preference is investigated by observing variations in preferences from an income shock and statistically testing whether "the ratio of the male income effect to the female income effect is unity" (Dunbar, Lewbel, and Pendakur, 2012). That is, the allocation of family resources to child health could be affected by transitory events such as income shocks and price changes.

Incomes of households in agricultural economies could vary significantly due to weather. Hence, rainfall shocks can be used as a proxy for income shocks as pointed out by Rose (1999), and this can be exploited to show whether intrahousehold inequality exist, and its effect on child nutrition. In an agrarian society, more rainfall will increase the incomes of households, thus, a positive rainfall shock can be considered as a positive income shock since it increases output and consequently, earnings in the society. Using rainfall shocks, it will be possible to investigate a gender pattern in income increases with positive rainfall shocks, and to identify consequent differential parental allocations of resources to children. It will also be possible to investigate gender asymmetry in child nutrition from positive rainfall shocks. In essence, identifying the precise household model for Nigeria is possible using rainfall shocks. However, this will require annual rainfall data at, say at cluster level, that can be merged in the DHS. Rainfall anomalies can then be computed using the long-term mean and imputed for individuals in the dataset. Variation in child anthropometrics or mortality amongst a cohort can then be traced to rainfall shocks during a particular period.

The existing empirical studies on intrahousehold resource allocation measured bargaining power using indicators such as assignable income (see for example, Folbre, 1984; Garcia, 1990; and Hoddinott and Haddad, 1995), unearned income and aggregate sex ratios on the labour market (see for example, Rao and Greene, 1993; Chiappori, Fortin, and Lacroix, 2002); consumption or expenditure pattern (see for example, Lundberg, Pollak, and Wales, 1997; Ward-Batts, 2001). In this study, I fill the empirical evidence gap for SSA countries by investigating the impact of bargaining power on household outcomes in Nigeria, a microcosm of SSA countries, using decision making rights as an indicator of power. In addition, there appear to be an unresolved debate on the exact nature of the internal process of household economy consistent with a specified theoretical framework for SSA countries. For instance, while Burkina Faso households were considered to be inefficient in the allocation of farm resources (Udry, 1996), Pareto efficient outcomes were reached amongst pastoralists in Northern Kenya (McPeak and Doss, 2006). Similar mixed findings exist with respect to the efficiency of households' expenditure patterns in Ethiopia and South Africa (Quisumbing and Maluccio, 2003).[44] To my knowledge, there are no known studies identifying the effect of gendered pattern on child health outcomes or empirically establishing the existence of a model that describe the Nigerian households. The success or otherwise of any welfare policy could depend on the accurate predictions from the operational household model in a country.

A study close in spirit to this research is Allendorf (2007). In her study, the right of land ownership is used as an indicator of bargaining power to tease out the effect of female power on child health outcomes. This study builds on Allendorf in a number of ways. First, in measuring power, I use the decision-making rights of women relative to their male partners as an indicator of bargaining power. In line with Frankenberg and Thomas (2001), I argue that decision-making right is a direct consequence of power and can better capture how preferences are asserted to yield household outcomes. Also, the use of decision-making rights as a proxy for bargaining power has support in the literature (Majlesi, 2016). Hence, I construct a composite index of relative decision-making rights between spouses and use this to test whether preferences vary, and which operational model describes households in Nigeria. To be clear, if the decision-making right of husband and wife have no differential effect on child health outcome, then the

[44] The impact of women bargaining power, proxy by resources brought to marriage, on household outcomes (measured as household level expenditure shares on food, education, health, child clothing, and alcohol and/or tobacco) was mixed in (Quisumbing & Maluccio, 2003). For instance, while women's assets increase expenditure shares on education in South Africa and Bangladesh, it is men's assets that have this effect in Ethiopia. Similarly, while men's assets increase expenditure shares in Bangladesh, it is the contrast in Ethiopia. For other expenditure shares such as child clothing, health, and alcohol/tobacco, gender appear not to matter (pp 310).

unitary model holds. On the other hand, if the *allocation* arising from bargaining results in pareto-efficient outcomes for children, the collective models can be said to be reached. Second, I use a comprehensive measure of child anthropometrics, the Composite Index of Anthropometric Failure (CIAF). I consider the CIAF as a compendious measure of child nutritional outcome because it provides a more disaggregated classification of malnutrition. By it construct, it sets out specific failures as well as combinations of failures, and this is likely to have greater predictive power relative to the use of single nutritional indicator such as stunting or underweight (Svedberg, 2000). In other words, it can identify all undernourished children in a society, whether they are stunted and/or wasted and/or underweight. Using a modelled distribution of different combinations of anthropometric failure in a population, Svedberg (2000) showed how the CIAF is more robust and capable of providing an all-inclusive estimate. Finally, our study is different from Allendorf (2007) in terms of context, methods, and measures of bargaining power.[45]

4.4 Method

4.4.1 Model

In identifying a household model that describes the Nigerian data, I investigate whether gender asymmetry in the decision-making process exist, and to what extent it affects child health outcomes. Effectively, I follow the procedure in Quisumbing and Maluccio (2003; 1999) to test whether or not a collective model is reached. In a static framework, Quisumbing and Maluccio (2003; 1999) suggest that the unitary model predicts that individual resources of husband and wife should have no effect on intra-household allocations. Hence, I test the question of whether or not differences in child health

[45] More precisely, Allendorf (2007) measured bargaining power in terms of land ownership right amongst Nepalese women. In the Nigerian Demographic and Health Survey, the indicator, "ownership of land", appear to be limited in information. It is unclear whether ownership entails the right to: manage the land, keep others off the land, or transfer the land rights to others. Also, the certainty with which land is own and the extent to which women can enforce land rights appears not to be captured by the "ownership of land" indicator in the Nigerian dataset but this may have different implications when used as a proxy for bargaining power. For instance, bargaining power for women, could depend on whether ownership implies the right to invest or use the land as collateral to secure loans. This will be a meaningful pathway through which ownership of land can translate into power. Finally, in testing the model that describe Nigerian households, we use the propensity matching score estimator. We consider the method to produce a less biased estimate that would be required to shape welfare policy on households.

outcomes are consistent with relative bargaining power amongst spouses as reflected in their decision-making right. I argue that individuals with power will likely assert their preferences through the household decision-making process.

To achieve the above, I use the CIAF as the outcome variable. I argue that the CIAF is a comprehensive measure of child nutrition that identifies all undernourished children whether they are stunted and/or wasted and/or underweight. Hence, it is likely to be a measure of child nutrition with greater predictive power since it provides a more disaggregated classification of malnutrition which sets out specific failures as well as combinations of failures (Svedberg, 2000). I construct a bargaining power index using the indicators of decision-power. I use scores from the three decision-making indicators: Decisions on household expenses; decisions on visit to relatives; and decisions on wife's health. I assume equal weights in aggregating the scores and collapse the three response categories of the indicators into binary with female autonomy/shared decision-making right=1. The decision-making right indicators can be considered as direct outcomes of the dynamics of power within households and are likely to be determined by factors outside the marriage (e.g. culture).

The model specification is:

$$P(CIAF = 1) = \Phi(\alpha + \beta_1 BP_w + \beta_2 BP_h + \beta_i X_i) \qquad 4.1$$

Where X_i is a vector of child/women characteristics, BP_w and BP_h are bargaining powers of husbands and wives respectively. The basic insight is that if preferences differ, one cannot accept the null hypothesis that β_1 *and* β_2 equal zero. If I reject the unitary model, it leaves open the possibility that households are operating in a manner that is consistent with the collective model.

I use the propensity score analysis to achieve the above.[46] I argue that children and women characteristics are likely to be associated with both the probabilities of women

[46] A propensity score analysis is used to account for imbalance in covariates between treated and comparison groups. A propensity score is estimated which represents the probability of receiving a treatment (having decision making right), conditional on a set of observed covariates (Garrido, et al., 2014). In this study, we consider women decision making right as a form of treatment. We divided our target population (under-five children) into treatment group (children whose mothers have decision

having decision making right (treatment selection) and children having anthropometric failure (outcome). In other words, it is possible that the distribution of women with decision making rights (a dichotomous treatment assignment) is not random across the target population. This may lead to different distributions of covariates within the *treatment* and *comparison groups* (Garrido, et al., 2014) and can confound the effect of decision-making right on child anthropometric failure. To isolate the effect of decision-making right, I balance covariates between children who did and did not receive "treatment" using the propensity score. In essence, the propensity score balances measured covariates across treatment and comparison groups and provide an improved approximation of the counterfactual for the treated children.

In estimating the treatment effects, I follow the procedure in Garrido, et al., (2014). First, I estimate the propensity scores by modelling treatment as a function of a set of covariates which are related to both the outcome and treatment using probit regression. Next, I establish balance using series of balance diagnostics. Specifically, I show that there is overlap (balance) in the range of propensity score across treatment and comparison groups (*common support*) using graphs. I verify the achieved balance by further checking the standardized differences that takes into consideration both the means and variances. Finally, I interpret the treatment effect in terms of the average treatment effect (ATE). The ATE, which is the estimated average effect of women decision-making right on child anthropometric failures, covers the entire sample including children of women with and without decision- making right.

Further, to investigate the heterogenous effects hypotheses of this study, I am interested in the interaction effects of certain dichotomous variables. To be precise, I estimate the interaction terms between bargaining power and covariates (binary) such as land ownership status, education, and locality of residence.

From a probit model with a normal cumulative distribution function $F(.)$:

$$F(u) = \Phi(\beta_1 x_1 + \beta_2 x_2 + \beta_{12} x_1 x_2 + X\beta) \qquad 4.2$$

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making rights and comparison group (children whose mothers have no decision-making rights within the households).

for continuous variables x_1 & x_2, their interaction effect is the double derivative with respect to $x_1\ and\ x_2$ and is expressed as:

$$\frac{\delta^2 F(\mu)}{\delta x_1 \delta x_2} = \{\beta_{12} - (\beta_1 + \beta_{12}x_2)(\beta_2 + \beta_{12}x_1)\mu\}\Phi(\mu); \qquad 4.3$$

However, when the variables of interest are binary in nature, their interaction effect is expressed in terms of a discrete double difference:

$$\frac{\Delta^2 F(\mu)}{\Delta x_1 x_2} = \Phi(\beta_1 + \beta_2 + \beta_{12} + X\beta) \qquad 4.4$$

$$-\Phi(\beta_1 + X\beta) - \Phi(\beta_2 + X\beta) + \Phi(X\beta)$$

There are conflicting discussions in the literature on the interpretation of such interaction terms in non-linear models. Norton, Wang, and Ai (2004) proposed the use of "inteff" command in Stata to compute the "correct marginal effect" of a change in two interacted variables and their standard errors for logit or probit modelling. They argued that the "inteff" command will produce the correct effect estimate alongside standard errors for interacted terms. An alternative approach to estimating and interpreting the interaction term involving binary variables has been suggested by Buis (2010). This involves presenting interactive term effects as multiplicative effects in odd ratios. It allows the dependent variable to be measured in the odds metric rather than in the probability metric. Hence, the "marginal effect" can be computed as the expected odds of a dummy variable (when flipped on and off). In effect, using the procedure in Buis (2010), it becomes possible to estimate, more precise marginal effects of interaction terms, computed as the differences between the expected odds (obtained from fitting a logit model to data) when the variables of interest are flipped on and off. I adopt this approach in estimating and interpreting interaction terms for analytical convenience. Specifically, I investigate heterogeneous effect of bargaining powers on child anthropometric measures across demography such as education, ethnicity, locality of residence, and land ownership.

4.3.2 Data

To investigate the effect of relative decision-making rights of spouses on child health outcomes, I use the Nigerian Demography and Health Survey (NDHS) data set of 2018.

The 2018 NDHS is the latest dataset of a national representative sample survey that provides information on fertility levels, marriage, fertility preferences, awareness and the use of family planning methods, child feeding practices, nutritional status of women and children, adult and childhood mortality, awareness and attitudes regarding HIV/AIDS, female genital mutilation, and domestic violence (NPC, 2019). It is the sixth in the series of demographic and health surveys conducted in Nigeria with previous surveys conducted in 1990, 1999, 2003, 2008, and 2013. The NDHS data were sourced through a stratified two-stage cluster sample design using a sampling frame that consists of a list of 1,400 enumeration areas for the first stage. In the second stage, a representative sample of 41,821 households was selected for the survey. This study used the DHS because it contains suitable indicators of decision-making right variables, making it possible to assess the impact decision-making power on child anthropometrics.

4.4.3 Variables description

I use different child anthropometric measures as outcome variables including stunting, wasting and being underweight. These are constructed as binary indicators of children nutritional status. Formally, a child is described as stunted if their height is more than 2 standard deviations below the international reference median for their age. Similarly, a wasted child is one whose weight is more than 2 standard deviations below the international reference median for their height. A child is considered underweight if the weight is more than 2 standard deviations below the international reference median for their age. In line with Nandy and Svedberg (2012), I consider stunting as retarded skeletal growth which reflects chronic malnutrition. Wasting, which is defined as loss of fat and lean tissue, could be an indicator of more acute malnutrition. Being underweight can be as a result of stunting or wasting, or combinations thereof. However, there might be children who are simultaneously stunted, wasted and underweight, hence, more likely to have a very severe malnutrition condition or be at a greater risk of mortality. For this category, I construct a measure that identifies all undernourished children, whether they are stunted and/or wasted and/or underweight, known as the Composite Index of Anthropometric Failure (CIAF). I follow Svedberg (2000; 2007) and Shailen and Svedberg (2012), in the construction of the variable. I construct a binary index of the CIAF by adding together all categories of malnourished children (stunted and/or wasted and/or underweight) excluding those not experiencing any form of anthropometric failure. A child with an anthropometric failure is assigned 1 (see Table 4.1).

The key explanatory variables are decision-making right indicators. I consider the *decision variables* as proxies for bargaining power in line with the literature (see for example, Majlesi, 2016). I exploit three spheres of household decision-making including expenditure, social capital, and maternal health. I argue that decisions on these spheres are likely to define the dynamics of intrafamilial resource allocation in a Nigerian household. For household expenses (Decision HH_E), I consider the survey question indicating the "Person who usually decides on large household purchases earnings". Another candidate for this is the survey question asking about the "Person who usually decides how to spend a wife's earnings" (Decision on Spending Wife's Income). The decision on social capital formation is proxy by the decision to visit relatives' (Decision HH_V) and is directly measured by the survey question asking the "Person who usually decides on visits to family or relatives". Two questions indicating decision-making right over maternal health in the DHS are: "Decision maker for using contraception" (Decision on Contraceptive Use), and "Person who usually decides on wife's health care" (Decision HH_H). I choose the latter to proxy decision-making right over maternal health.

I consider land ownership (Land_own) as a key predictor of decision-making right especially in an agrarian economy. Land could be an asset that can be sold to offset unexpected financial difficulty especially resulting from health shocks. Depending on the location, it can be used as collateral to secure loan from a financial institution. Information on whether it was owned prior to marriage, marriage, or after marriage is unavailable in the DHS. It is also unclear from the dataset whether legal titles are associated with these lands. I include education of spouses in the variable list and measure it both as a continuous variable (education in years) and as categorical with no education as the reference and higher education as the highest educational level attained. I construct an ethnicity variable and control for it in a specification. As an ethnically diverse country, differences in ethnicity will be potentially relevant in understanding intra-household decision making patterns. I identify eleven ethnic groups in line with the 2008 DHS classification, namely: Ebira; Fulani; Hausa; Ibibio; Igbo; Ijaw; Kanuri; Nupe; Urhobo; Fulfulde; and Yoruba. Other minority ethnic groups are classified as ‘others’ and used as the reference category.

Finally, a set of child characteristics is included as controls: sex, age, age squared, and birth space. Also, I control for a vector of socio-demographic determinants of child nutrition. They include, but are not, limited to wealth index (WealthIndex), household size (HHSize), religion (Wire_rel), locality of residence (Rural), and geopolitical zone (geoZone). The wealth index is a principal components analysis of the flooring material, toilet facilities, cooking fuel, water source, electricity, ownership of radio, television, and bicycle adjusted by the number of household members and measured as: 1 Poorest (ref); 2 poorer; 3 Middle; 4 Richer; and 5 Richest. Religion refers to the religion of the wife measured as a categorical variable with Catholic as a reference category, Other Christian, Islam, and Traditionalists. Household size is measured as the list number of household members. Locality is defined as the place of residence: Urban (ref); and Rural. This is used to measure neighbourhood effects and culture on child health. Geopolitical zone of residence captures the country’s six geopolitical zones including North Central, North East, North West, South East, South South, and South West. All the variables used are described in Table 4.1.

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Table 4.1 - Descriptive variables

Variable	Description
CIAF	1 if child has anthropometric failure and 0 otherwise
Stunting	1 if a child is stunted and 0 otherwise
Wasting	1 if a child is wasted and 0 otherwise
Underweight	1 if a child is underweight and 0 otherwise
Decision Right Index	Binary index of Decision on Expenses, Health, and visit
Decision Expenses	1 if respondent has DMR on household expenses and 0 otherwise
Decision Health	1 if respondent has DMR on health and 0 otherwise
Decision Visits	1 if respondent has DMR on visit to relatives
Woman Age	Age of the respondent at the time of the interview and
Locality	1 if respondent resides in rural area and 0 if urban
Household size	Number of people who live in the household
Land Ownership	Takes value of 1 if respondent owns land and 0 otherwise
Religion	1 if respondent is Islam, 0 otherwise
NC Region	1 if North Central region, 0 otherwise
NE Region	1 if North East region, 0 otherwise
NW Region	1 if North West region, 0 otherwise
SS Region	1 if South South region, 0 otherwise
SE Region	1 if South East region, 0 otherwise
SW Region	1 if South West region, 0 otherwise
Employment Status	Takes value of 1 if respondent is employed and 0 otherwise
Poverty	Recoded wealth index: 1 if respondent is poor and 0 not if not poor
Male Child	Number of male children in the household
Other Wives	Presence of other wives in the household
Quintiles	Household wealth status in 5 quintiles: 1 if quintile 1, 0 otherwise; 1 if quintile 2, 0 otherwise; 1 if quintile 3, 0 otherwise; 1 if quintile 4, 0 otherwise; 1 if quintile 5, 0 otherwise.

Notes: DMR=Decision Making Right; CIAF=Cumulative Index of Anthropometric Failure, NC=North Central, NE=North East, NW=North West, SS=South South, SE=South East, SW=South West.

4.5 Results

4.5.1 Descriptive statistics

I present the descriptive statistics of the above variables in three ways: First, I show whether there is a pattern in the basic characteristics of households by locality of residence. A pattern in the household characteristics by locality will be useful in explaining any potential variance in child health outcomes. Second, I search for descriptive evidence of variations in child health outcomes by female characteristics, and decision-making rights of women. Third, I show whether decision-making rights of spouses are associated with ethnicity descriptively.

In line with the literature, I apply weight in estimating the descriptive statistics to improve precision since the DHS purposively sample with different probabilities from different part of the population (Solon, Haider, and Wooldridge, 2015). More precisely, to ensure sample representativeness, the DHS will oversample in less-populous states and under-sample in populous states hence, estimating descriptive statistics without adjusting for survey weight will bias the estimate. Effectively, I use weight to adjust for disproportionate sampling and to restore the national representativeness of the sample. Also, the use of sample survey weight will yield unbiased and consistent estimate of the descriptive statistics of interest. I use household weight (hv005) for household analysis and the women weight (v005) for women analysis.

From Table 4.2, I discover that on average, the mean number of years of education is relatively higher for men and women in urban areas (8.85 and 7.33) compared to rural areas (4.89 and 3.24). Similar disparity can be seen in the mean household size (6.23 vs 6.92), mean number of under-fives living in the household (de jure) (6.23 vs 6.92), probability that the household head is female (0.153 vs 0.096), and mean birth interval (1.99 vs 1.96). Also, I note that the distributions of under-fives by gender and the mean age of women included in our sample are similar across the locality of residence.

Table 4.2 – Descriptive statistics (1)

	Urban			Rural		
Variable	Mean	Min	Max	Mean	Min	Max
Hus Edu (Yrs)	8.85	0	20	4.89	0	19
Wife Edu (Yrs)	7.33	0	20	3.24	0	20
HH Size	6.23	0	35	6.92	0	29
Under-five in HH	1.19	0	8	1.55	0	9
Age (Woman)	28.93	15	49	28.77	15	49
Birth Interval	1.99	1	3	1.96	1	3
Child Sex	0.5	0	1	0.5	0	1
HH Head Sex	0.153	0	1	0.096	0	1

Note: Hus Edu=Husband Education in years; Wife Edu=Wife Education in years; HH =Household

Next, I show whether poor child health outcomes vary by female characteristics. I estimate the proportion of children with different poor child health outcomes by characteristics of women. From Table 4.3, it is clear that there are higher proportions of children with CIAF (0.58), stunted growth (0.61), wasted (0.53) and underweight (0.63) in households where women have no basic education relative to those with higher levels of educational attainment. Also, children with poor health outcomes are more concentrated amongst the poorest income group (CIAF—0.31, stunted—0.26, wasted—0.32, and underweight—0.29).

Table 4.3 – Descriptive statistics (2): Child health outcomes by female characteristics

Variable	CIAF	Stunting	Wasting	Underweight
Mothers' Educations				
No Education	7129(0.58)	5504(0.61)	2272(0.553)	4214(0.63)
Primary	2384(0.195)	1752(0.196)	769(0.187)	1211(0.18)
Secondary	2340(0.191	1499(0.167)	911(0.222)	1105(0.165)
Higher	356(0.029)	204(0.027)	157(0.003)	134(0.02)
Wealth Index				
Poorest	2932(0.31)	1119(0.26)	2237(0.32)	3695(0.29)
Poorer	2692(0.28)	1060(0.25)	1959(0.28)	3482(0.27)
Middle	1903(0.20)	808(0.19)	1296(0.18)	2555(0.20)
Richer	1283(0.14)	735(0.17)	959(0.14)	1933(0.15)
Richest	731(0.07)	553(0.13)	591(0.08)	1245(0.10)
Land Ownership				
No Land	10462(0.868)	7699(0.87)	3537(0.87)	5803(0.884)
Own Land	1583(0.13)	1125(0.127)	527(0.123)	765(0.116)
Locality				
Urban	3522(0.273)	2319(0.243)	1411(0.33)	1849(0.263)
Rural	9388(0.727)	7222(0.75)	2864(0.667)	5193(0.737)
Religion				
Islam	8511(0.708)	6388(0.726)	2858(0.71)	4980(0.76)
Other	3494(0.291)	2407(0.274)	1189(0.294)	1568(0.239)
Geo-political Region				
North Central	1605(0.124)	1204(0.126)	447(0.105)	728(0.10)
North East	2990(0.232)	2301(0.24)	914(0.21)	1641(0.233)
North West	5474(0.424)	4167(0.436)	1885(0.441)	3442(0.488)
South East	653(0.05)	387(0.04)	293(0.068)	279(0.039)
South South	1046(0.08)	690(0.07)	374(0.087)	444(0.063)
South West	1142(0.085)	792(0.08)	362(0.0847)	508(0.072)

Further, land ownership status of women appears to matter in the determination of child health outcomes. Women with no land ownership account for over 80% of under-five children with poor health outcomes in all cases. It is also clear from Table 4.3 that the majority of under-five children with poor health outcomes are from rural areas (over 60% in all cases) and have mothers not practising other religions. By geo-political zones, the North-West has the highest proportion of children with poorer health outcomes (greater than 40% in all cases), compared with other zones.

I check whether there is a pattern in poor child health outcomes related to the decision-making rights of women. I define women decision-making right as women having absolute autonomy and/or a share in the decision-making process. From Table 4.4, children appear to be in better health if women have autonomy or a share in the decision-making process in relations to household expenses (stunted-0.72 vs 0.28, wasted-0.72 vs 0.28, under-weight-0.75 vs 0.25 and CIAF-0.72 vs 0.28). A similar pattern exists with respect to having a say in visiting relatives and over their health provision.

Finally, I provide descriptive evidence of whether ethnicity is likely to shape the decision-making rights of women. From Table 4.5, there appears to be an ethnic imbalance in these rights. Ethnic groups such as Ebira, Ibibio, Igbo, Urhobo, and Yoruba have strict female dominance in the household decision making process.

Table 4.4 – Descriptive Statistics (3): Child health outcomes by decision making-rights

	Stunted	Wasted	Understand	CIAF
Decision on HH_Expenses				
Husband	6163(0.72)	2801(0.72)	4761(0.75)	8314(0.72)
Wife	2372(0.28)	1112(0.28)	1604(0.25)	3312(0.28)
Decision on Wife_Health				
Husband	6041(0.71)	2731(0.70)	4644(0.73)	8141(0.70)
Wife	2497(0.29)	1179(0.30)	1721(0.27)	3484(0.30)
Decision to Visit				
Husband	5308(0.62)	2418(0.62)	4144(0.65)	7151(0.62)
Wife	3225(0.38)	1493(0.38)	2218(0.35)	4473(0.38)

These are mainly ethnic nationalities from the southern part of the country. In comparison with the north, child health outcomes are relatively elevated. On the other hand, ethnic groups such as Fulani, Hausa, Kanuri, Nupe, and Fulfulde, which are located in the northern part of Nigeria appear to have higher male autonomy over household decision-making processes with corresponding poorer child health outcomes. The Ijaw ethnic group makes an interesting case with higher female autonomy in two of the three decision-making spheres, household expenses and decisions to visit relatives, but have male dominance in the decision-making process with respect to the health of women.

In summary, our descriptive evidence suggests that urban spouses are likely to be more educated than their rural counterparts with smaller household sizes, higher birth intervals between children, fewer number of under-five children within the household, and with their women more likely to head the households. Also, we note the likelihood of children having anthropometric failure (CIAF), stunted growth, wasted, or underweighted if mothers have lower levels of education, belong to the poorer income groups, own no land, and are resident in rural areas. Importantly, our descriptive evidence indicates a pattern in child health outcomes in relations to the decision-making rights of women. Under-five children appear to be in better health if women have greater autonomy over the household decision making process. Finally, our evidence is suggestive of the role of ethnicity in shaping the decision-making rights of women. This suggests that cultural norms could be potential drivers of women decision-making rights. I investigate these findings further in the subsequent section.

Table 4.5 – Descriptive Statistics (4): Child health outcomes by ethnicity

Variable	Husband	Wife	Husband	Wife	Husband	Wife
Ebira	265(0.29)	645(71)	224(0.24)	691(0.76)	152(0.17)	763(0.83)
Fulani	8072(0.88)	1082(0.12)	7744(0.85)	1407(0.15)	6754(0.74)	2426(0.26)
Hausa	33068(0.89)	3924(0.11)	32218(0.87)	4776(0.13)	29110(0.79)	7844(0.21)
Ibibio	478(0.31)	1067(0.69)	686(0.45)	845(0.55)	472(0.31)	1067(0.69)
Igbo	3744(0.33)	7466(0.67)	3625(0.32)	7603(0.68)	2726(0.24)	8528(0.76)
Ijaw	1608(0.43)	2155(0.57)	2322(0.62)	1435(0.38)	1677(0.45)	2081(0.55)
Kanuri	1466(0.86)	230(0.14)	1338(0.79)	354(0.21)	1250(0.73)	457(0.27)
Nupe	1136(0.72)	445(0.28)	1151(0.73)	431(0.27)	956(0.60)	627(0.40)
Urhobo	360(0.28)	922(0.72)	388(0.30)	894(0.70)	346(0.27)	936(0.73)
Yoruba	2830(0.23)	9251(0.77)	2820(0.23)	9255(0.77)	1429(0.12)	10659(0.88)
Fulfulde	1473(0.94)	97(0.06)	1446(0.92)	124(0.079)	1433(0.91)	137(0.09)
Others	14087(49)	14614(51)	14225(0.495)	14507(0.505)	12196(0.42)	16550(0.58)

4.5.2 Econometric results

I present the econometric results in phases. In the first phase, I estimate different child health outcomes specifications using the leave-one-out cross validation technique on the decision-making right index. This is because each health outcome represents a distinct biological process (WHO, 1995). In the second phase, I investigate the hypothesis whether the unitary model describes the decision-making process within the Nigerian households with respect to child health outcomes. Next, I provide evidence on the heterogeneous effects of decision-making rights on demography such as ethnicity, education, locality, and landownership. Finally, I empirically determine predictors of decision-making rights within the Nigerian households.

In estimating the models, I report standard errors that account for clustering at the cluster level. I motivate the adjustment for clustering in geographical dimension mainly because of the sample design. The DHS emanates from a sampling design that follows a multi-stage process where first, a subset of clusters is randomly sampled from a population of clusters, and units are randomly sampled from the subset of clusters. This follows that a common unobserved random shock may be present at the cluster level and could result in all observations within a cluster been correlated. That is, errors for observations within the same clusters may be correlated. In fact, Abadie, Athey, Imbens and Wooldridge (2017) argue that cluster adjustment should matter even when both residuals and regressors are uncorrelated within clusters. In general, since our data comes from a multi-stage sampling procedure, it is important to consider the survey weight and cluster in the estimation of unbiased and consistent parameter estimates. Hence, I use a survey setting (svyset) that adjust for weight, cluster, and strata in estimating all the specifications. All estimated coefficients are presented in their Average Marginal Effect (AME) terms.

4.5.2.1 Bargaining power and child health outcomes

Tables 4A.1-4A.3 (see Appendix 4A) answer the question of whether children will have better health when women share in the decision-making process of the household. The results show the directions and the strengths of the effects of decision-making right on child outcomes. From the results, on average, the probability that a child will be stunted, wasted or underweight, is reduced if a woman is part of the household decision-making process with regards to her health, visit to relativesm, and household expenditures.

For the stunting model, the unconditional AMEs estimated if a woman shares in at least a decision-making sphere is 14.5% as reported in column 1, Table 4A.1 (see Appendix 4). It is higher for women who participate in making decisions on household expenses (15%) but lower for women that decide on their health (13.5%) or decide on whom to visit (13%) as shown in columns 3, 5, and 7 (Table 4A.1). When I control for household characteristics in columns 2, 4, 6, and 8, the effects of decision-making rights on stunting outcome are consistent though with expected reduction in magnitudes. Specifically, while the AME is 3% if women are involved in at least one of the decision-making spheres, the AMEs if women participate in decisions on household expenses, visits to relatives and their own health are 2.14%, 2.37%, and 1.50% respectively (see Table 4A.1).

Findings from the wasting models (Table 4A.2, Appendix 4) indicate lower unconditional AMEs of decision-making rights in comparison with the stunting models. The unconditional probability that a child will be wasted if a mother shares in at least a decision-making sphere is 7.5% less compared to a mother that do not participate in any form of household decision-making. The effect is similar if mothers share in household expenditure decision (7.1%), health care decision (6.7%), or social mobility decision (6.8%) (see columns 3, 5, and 7). Though the conditional AMEs are higher in comparison with the stunting models, the effects of decision- making rights appear to be more consistent in the presence of controls in the wasting models. The result after controlling for household characteristics indicates that the probability a child will be wasted is 4% lower for women with at least a decision-making right (see column 2). It is 3.2%, 3.1%, and 3.8% lower for children whose mothers decide on household expenditures, their health, and visits to relatives respectively (see columns 4, 6, and 8, Table 4A.2). Put together, the results suggest that women participation in household decision making process may have greater impact on whether a child suffers from acute malnutrition (wasting) relative to a child being stunted.

In the underweight model, the conditional probability that a child will be in poor health if the mother has any form of decision-making right is lower, and statistically significant (6.6%), compared to a child whose mother do not participate in any of the decision-making spheres. It is 5.2% less if the mother shares in decisions over household expenses, 4.6% less if the mother is involved in decision over her health, and 5.5% lower if she has a say on whom to visit (Table 4A.3). The unconditional probabilities are within the range of 14%, and similar to the stunting models.

From the results in Tables 4A.1-4A.3, I note also gender imbalance in child health outcomes. I find increased probabilities of male children having poorer nutritional outcomes. These effects are consistent when the decision-making rights index is disaggregated and may suggest a preference for female children. Specifically, in column 2 (Table 4A.1, Appendix 1), the result indicates that the probability of the male child becoming stunted is 4.14% greater compared to a female child. The effect is similar in the models with women who only participate in household expenditure decision-making (column 4), own health decision-making (column 6), and decision to visit relatives and friends (column 8). Also, in column 2 (Table 4A.2), I note that male children are 2.1% more likely to be wasted compared to female children in the model with women participating in at least a decision-making sphere. The results in columns 4, 6, and 8 (Table 4A.2), suggest that the magnitude of the effect of gender on wasting outcome is similar across all models with varied participation of women in decision-making. Finally, the results in Table 4A.3 (columns 2, 4, 6, and 8), indicate a similar gender imbalance, an increased likelihood of male children becoming under-weight compared to female children with about 3.5%, across the models with different levels of women participation in household decision-making. It is unclear why poor child health outcomes differ for females from males especially in a largely patriarchal society, but a plausible explanation could be that women are likely to show preference for their gender especially at early childhood stage. Further, the gender preference is likely to be related to the potential benefits of assistance with domestic and economic activities that female children are known for across ethnic groups in Nigeria. This finding may indicate the elevated odds of female child labour in Nigeria societies. Also, I discover that the probability of a child being in poor health is age-related (Tables 4A.1-4A.3). It is possible that as supplementary feeding is introduced with age, the probability that under-five children fall into poor health is reduced.

Maternal factors such as education, employment status, wealth profile, locality of residence, and land ownership status are controlled for in all the models. I discover that whether women are employed appears not to matter in the determination of child health outcomes. Indeed, the female employment variable was not statistically significant in all child health outcomes and in all the varied model specifications. Perhaps, the concentration of women in the informal sector in developing countries where wages and working conditions are generally poor is a possible explanation for the statistically insignificant effect. Similarly, I note the inverse association between wealth and child health outcomes, but the relation is only statistically significant in the stunting model. It is also clear from the results that there are reduced probabilities of children being in poor health in all cases if women own land (see Tables 4A.1-4A.3). While the education of spouses will reduce poor child health in all cases, increasing household size will elevate the probabilities of children becoming underweight and/or stunted. Higher education for both spouses will, in all cases, reduce the probability of children falling into poor health.

From the foregoing, it can be summarily argued that Nigerian households with women being involved in the decision-making process over the identified spheres of household decision-making can be crucial in influencing child health outcomes. However, decision-making rights can impact on child health when they are supported by the power to allocate resources in line with individual's preference. In general, women being involved in the decision-making process could impact on the welfare of their children through their ability to act if children's welfare is threatened. The effects from women having rights over different spheres of decision-making can be reinforcing to result in improvement in child health.

4.5.2.2 The Nigerian household model

In the second phase, I identify a household model that describes the decision-making process within the Nigerian household with respect to child health outcomes. From the descriptive evidence, I note a gendered pattern in household decision making. Thus, it is plausible to test whether the collective models describe the Nigerian households. A basic prediction of the collective models is the existence of heterogeneous preferences within households. In testing the varied preference hypothesis, I investigate whether the bargaining power of wives relative to husbands has any differential effect on child health outcomes. Effectively, I answer the question of whether differences in child health outcomes are consistent with varied bargaining power amongst spouses as reflected in their decision-making rights. I argue that individuals with power are likely to assert their preferences in the household decision-making process. I will fail to reject the unitary model if relative power of spouses has any effect on child health outcomes.

To achieve this, I use a propensity score analysis as described in the method section. From our *common support* as displayed in Figure 4.1, there appears to be an overlap with similar distribution in the range of propensity scores across treatment and comparison groups.[47] When I verify the balance by checking the standardized differences, the findings from Table 4A.6 (Appendix 4A) show that all the included covariates had standardized differences greater than 10% before matching. After matching, means of all covariates appear balanced across the treatment and comparison groups with standardized differences of less than 10%. As a rule of thumb, covariates are assumed to be balanced if the mean of the standardized differences and the variance ratios in the matched data approximate zero and one respectively (Garrido, 2014; Austin, 2009).[48] In the final estimations, our result in Table 4.6, column 1 (the PS-Match estimator) indicates that children Anthropometric failure rate in households with women having decision making right is lower -0.071 ($p<0.01$) compared to children in households where men autonomously make decisions. The result is robust to different estimators used (RA, IPW, and IPRA) as indicated in Table 4.6.

[47] We achieve balance by re-specifying our basic model in equations 4.1.1. Essentially, we dropped variables such as child-age, child-age squared, child sex and Residence, that we consider to be theoretically less relevant in influencing child anthropometric failures. Also, we recategorized the continuous education variable.

[48] According to (Garrido, 2014), after computing propensity score for each observation, it then become necessary to ensure there is overlap in the range of the propensity scores across both the treatment and comparison groups. This is called common support and can be assess by examining if overlap exist from a graph of propensity scores across treatment and comparison groups.

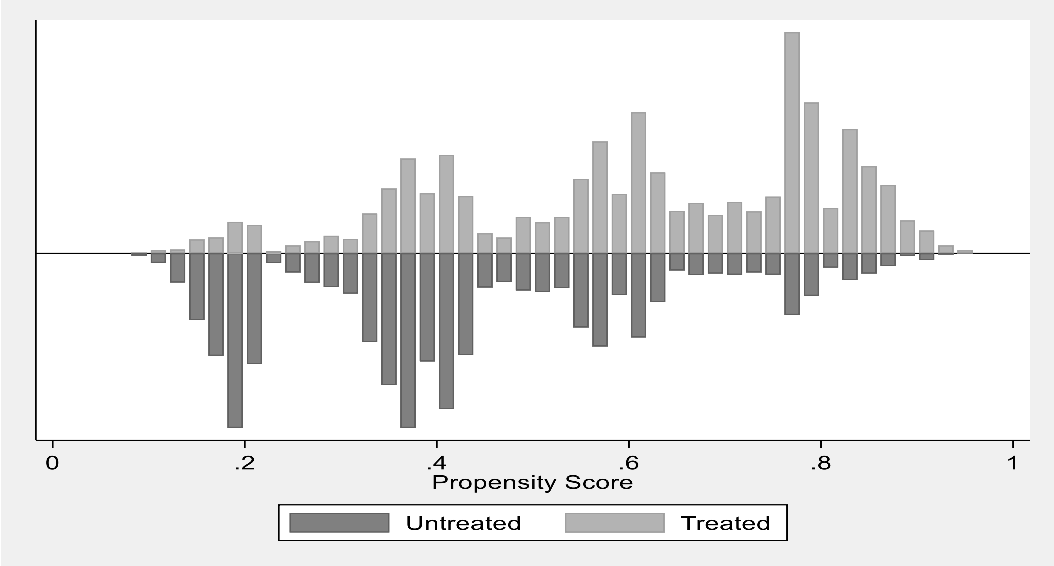

Figure 4.1 - Distribution of propensity score across treatment and comparison groups

To be precise, the effect of women sharing in the household decision making process relative to male autonomy is an average decrease of 7% in the probability that a child will have any form of anthropometric failure. In other words, I find evidence which supports the collective models' prediction, in the context of child health outcomes, that the gender of the decision maker in a household, matters with respect to child health in Nigeria.

Table 4.6 - Treatment effect using PS-matching, NN-matching, RA, IPW and IPRA

	PS-Match b/se	NN-Match b/se	RA b/se	IPW b/se	IPRA b/se
ATET	-0.071***	-0.071***	-0.081***	-0.072***	-0.076***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
N	23,372	23,372	23,372	23,372	23,372

Robust standard errors in parenthesis **p<0.05, p***<0.01

Notes: PS-Match=Propensity Score Matching, NN-Match= Near-Neighbourhood Matching, RA=Regression Adjustment, IPW= Inverse Probability Weighting, IPRA=Inverse Probability Weighted Regression Adjustment.

4.5.2.3 Does the effect of decision-making rights depend on women's locality of residence, education, and land ownership status?

In this phase, I answer the question of whether there is heterogenous effect of decision-making rights across demography such as education, locality of residence, and land ownership. Essentially, this involves estimating interaction terms of dichotomous variables within a probit framework. More precisely, I estimate the interacted coefficient between decision-making right index and educational status, locality of residence, and land ownership status of women in the child health model. In interpreting the interaction effects of the above, I follow Buis (2010). Bius interprets these interaction effects by presenting them as odd ratios, which he argues can be an alternative to interpreting interaction effects in terms of marginal effects. To be clear, a logit model is first fitted to data to obtain multiplicative effects (odd metrics). Then, the marginal effect is computed as the difference between the expected odds when the variable of interest is flipped on and off.

First, I examine the interaction effect of decision-making rights and education (education variable is re-coded as binary). I discover that, while for women with decision making right but without basic education, the odds of children having anthropometric failure is 1.72, it is 0.54 for women having decision making right and at least basic education as seen in column 1 (see Table 4A.5 in Appendix 4). Using the lincom command, the odd difference -1.18 is statistically significant (-1.18472; $p < 0.01$). The result suggests that women education through decision making rights reduces the likelihood of children having anthropometric failures.

Second, I investigate whether the effect of female decision-making rights on child anthropometric failures varies with locality of residence. I note that children whose mothers reside in urban areas and have decision making rights have reduced odds (0.56) of having anthropometric failure compared with their counterparts whose mothers resides in rural areas but with decision making rights (1.11). I discover a locality of residence marginal effect of 0.55 that is statistically significant using the lincom command.

Third, I test whether land ownership status amongst women with decision-making rights has a varied effect on the probability of children having anthropometric failure. From Column 3 in Table 4A.5 (Appendix 4), I report odds of 0.91 for children having anthropometric failure if women have no land but are involved in the decision-making process. On the other hand, the odds of children drifting into anthropometric failure if women participate in the decision-making process and own land is 0.55. Using the lincom command, the marginal effect of land ownership status for women with decision-making rights is 0.54 and is statistically significant.

Finally, I provide support for the above findings using graphs as presented in Figure 4A.2-4A.4 (see Appendix 4). It is clear from Figure 4A.2 that the probability of children having any form of anthropometric failure declines with higher level of education for women with decision-making rights. Also, Figure 4A.3 supports the finding that there is an urban advantage, that is having better access to available health care facilities in the urban area, that interacts with the years of education to influence child health outcomes for women with decision making rights. A similar effect of decision-making rights on education exists for women with land ownership status, as shown by Figure 4A.4. That is, the AME of decision-making rights for women with land ownership is relatively higher compared to women without land ownership but increases with higher years of education.

In summary, I discover that the odds of an anthropometric failure of a child if the mother has decision-making rights but owns land, has at least basic education, and resides in an urban area, are significantly lower compared to the odds of children with mothers not having land or basic education or residing in rural areas. That is, I discover statistically significant average marginal effects in terms of reduced probabilities of children having anthropometric failures if women with decision-making rights also possess basic education, own land, and have access to urban amenities. A possible explanation for the marginal effect of locality of residence on child health outcomes can be linked to having better access to available health care facilities in the urban area. Also, the decision-making rights of a woman are likely to be influence by her locality of residence. Gender roles and expectations may be more closely observed in rural areas than urban. For a largely patriarchal society, we expect rural women to participate less in the household decision-making process. For urban women, I expect urban advantages to interact with increased likelihood of female involvement in decision-making to produce better health outcomes in children. I explain the pathways through which education and land ownership can influence decision-making rights of women in the section below.

4.5.2.4 What explains female decision-making rights in Nigeria?

To identify factors that predict decision-making rights of women, I perform probit regressions on a vector of covariates that are supported in the literature to be associated with household decision-making processes. I follow Acharya (2010) in modelling female decision-making rights as a function of education, wealth, employment, locality of residence, age, and number of living children. In addition to the above factors, I assess the role of the mass media in influencing awareness of women's rights. In line with Wakefield, Loken, and Hornik, (2010), I argue that the mass media has the potentials to disseminate behaviourally focused messages to large audiences repeatedly, over time, in an incidental manner, and at a low cost per head. I investigate these determinants in the decision-making right index and specific decision-making spheres in Table 4A.6 (Appendix 4). In column 1, I uncover that media exposure, education, land ownership and not being poor (poverty) are positively associated with at least having right over one decision making spheres within the household.[49] These findings are supported in the literature (Acharya, et al., 2010).

The finding that increases in the year of school for women will increase their likelihood of having autonomy over decision making can be explain through multiple pathways. Education is likely to impact women decision making right through increased chances of finding better jobs, higher wage, and financially independence. Women with higher education are likely to face better marriage market option with higher reservation utilities (Hidrobo and Fernald, 2013). Put differently, women with higher years of school are more likely to have better out-of-marriage options and this can influence the extent of their assertion of decision-making rights within the household. Education increases the ability of women to contribute to household economic resources. However, this may introduce struggle for power within the household in the study area context.

Similarly, the finding that poor women are less likely to have decision-making rights can be explain through the pathway of financial dependence. This is because, women living in impoverished conditions are more likely to have partners/husbands with high

[49] We re-classified wealth quintiles into a binary indicator: 0=poorest/ poorer; 1=Middle/Richer/Richest.

levels of stress and consequently, more prone to assert control over household decision-making. Also, our results that women with land ownership have higher likelihood of having control over household decision making can be explain in terms of land being a valuable asset especially in rural households' portfolios. I argue that women with land rights may invest on their lands, sell, or lease the land to generate income making them to be more resilient to income shocks. This can be a strategy to smooth consumption. Hence, land can be indicative of their strength of a fall-back position and places them in a favourable position to bargain. For a woman with land ownership status, it is likely that the threat of withdrawing from the marriage or withdrawing her land from household use will give her some power over household decision-making. Indeed, land ownership can engender women's economic empowerment in an agrarian economy and provide a sense of economic security. It can be a vital determinant of economic livelihood with potentials of influencing the balance of power in households. Finally, while it is unclear from the result why having more sons will decrease the likelihood of women's autonomy, it is reasonable to suggest that women are more likely to condone and be complacent over partners' assertion of autonomy as their number of children increases. Again, this finding appears to support an earlier finding of an increased odds of female child labour in the Nigerian society.

4.6 Discussion

The study finding that the Nigerian household decision-making process supports the basic prediction of the collective models of heterogeneous preference with its potentials to impact on child health outcomes is likely to provide additional guidance for social policy and welfare regime. It is an insight that may explain the current functioning of the domestic economy especially as it relates to its current response to demand sided financing options designed to improve child health outcomes. I discover that children are likely to be in better health if women participate more in the decision-making process. This is because women are more likely to assert their child welfare preference within the scope of their autonomy in decision-making. The findings indicate that women having control over the identified decision spheres such as decision right over household expenses, visit to relatives, and health can be vital in influencing the likelihood of children having anthropometric failure. Similar findings exist in the literature (Desai and Johnson, 2005; Schmidt, 2012; Smith, 2003).[50] In Desai and Johnson (2005), using hierarchical linear models, the effect of women's decision-making power on children's height-for-age was estimated for 12 countries across the Sub-Saharan Africa, Asia, and Latin America/Caribbean. In general, the findings indicate that women autonomy tends to be positively associated with child nutritional status.

I explain the rights to visit family and friends as crucial in the formation of social capital. There are three possible ways through which having such rights can influence social capital formation and consequently, child health outcomes. First, it is likely to facilitate the flow of information on health education and innovations. For instance, changes in prenatal health behaviour of females might occur from social network. Indeed, the decision of members of a social group to take up prenatal intervention might influence the decision of other members within the group. Second, in the event of health shock, social networks are known to be a source of insurance for financial health risk. Third, it can be associated with the mobilization of financial capital. Government transfers and micro-credit grants are usually conditional upon being a member of a social network in Nigeria. If these actions are gendered, it may be having the dual effect of empowerment and creation of social capital. It can be a means of accessing community-level resources such as health information and innovations.

On the finding that the decision-making right over household expenses can affect child health, we argue that such right can influence food distribution within the household especially if it is reinforced by control over financial resources. The decisions over household expenses could imply making daily dietary and lifestyle decisions for the household. The preference for child welfare is likely to affect household food expenditure if women with power assert their preferences. Also, our finding that the woman's right to decide over her health is associated with child health can be explain in terms of the connection between child and mother's survival. To be precise, having

[50] Schmidt (2012) uncover a statistically significant relationship between height-for-age of children and the decision-making authority of their mothers. Precisely, children whose mothers participate in decision making for household purchases are on average 0.118 standard deviation units taller than children whose mothers do not participate.

control over child-bearing decisions may reduce the frequency of pregnancies, especially those that are at greater-than-average risk of maternal, perinatal, and child mortality. Such right can determine the early initiation of antenatal visits, appropriate birth interval, and decision to use contraception or health care services.

Also, reducing malnutrition may involve increasing the schooling opportunities for women and providing decent employment as this will increase the likelihood of female participation in household decision-making. This information is critical, especially in the face of efforts by the Nigerian government to provide social welfare services and reduce the absolute number of children dying annually from avoidable causes. The finding is suggestive that a gender-blind social expenditure may undermine the achievement of child health goals.

Finding from the study suggests gender imbalance in child health outcomes. I find increased probabilities of male children having poorer health outcomes. These effects are consistent when the decision-making rights index is disaggregated and may indicate a preference for female children. It is unclear why this is the case especially in a largely patriarchal society, but a plausible explanation could be that women are likely to show preference for their gender. The gender preference is likely to be related to the potential benefits of assistance with domestic and economic activities that female children are known for across ethnic groups in Nigeria. This finding indicates the existence of an elevated odds of female child labour in Nigeria societies.

An alternative explanation is that women empowerment measured in terms of autonomy in household decision-making, particularly in sexual relationship, reduces fertility and consequently, increases human capita per child. Gender-based power in sexual relationship is a known determinant of family planning (Carr et al., 2012). It is found to reduce the odds of unwanted pregnancy (Abada and Tenkorang, 2012), increases birth interval (see for example, Al Riyami and Afifi, 2003), and is positively associated with smaller ideal family size preferences (see for example, Woldemicael, 2009). Indeed, women autonomy, in different decision-making spheres, have been shown to be inversely associated with number of children. For example, while women mobility autonomy is discovered to be inversely associated with total number of children in rural Bangladesh villages (Balk, 1994) and India (Moursund and Kravdal, 2003), absence of women autonomy in decision-making on household expenditure can associated with having large family sizes (Woldemicael, 2009). Thus, increasing women empowerment will result in smaller family composition—demographic change— and consequently, increases in human capital investment per child. This relation is based on the seminal work by Becker and Tomes (1976) that specifies the trade-off between the quantity of children and their quality. An increase in the quantity of children will raise the cost or shadow price of the quality of children, and vice versa.

At present, Nigeria is second only to India in its contribution to child mortality globally. If cash transfer is to be use in breaking financial barriers with respect to uptake of nutrition interventions, the gender of the recipient of the transfer of any social security payment should matter. This is vital in guiding and feeding into on-going social welfare scheme especially in the Northern region of Nigeria, where the norms are largely patriarchal. It remains largely unclear if the on-going National Social Investment Programme is not invisible to gender.

From the study findings, I identify drivers of female decision-making rights in Nigeria to include exposure to mass media, education, asset/land ownership, and socio-economic status. Short-run policy prescriptions to promote female participation in decision-making could include female financial empowerment as a means of enhancing the socio-economic profile of women. The mass media can be used to set agendas for women right advocacy, and this can influence changes in intra-household relations. In the long run, strategies to be encouraged could include strengthening educational campaigns aimed at female children as currently advocated through the Sustainable Development Goals, the formation of legislation to promote female social mobility (the Pudah practice in Northern Nigeria), and enlightenment to forego cultural practices that deplete female agency. Also, in the long run, policy and programme intervention relating to gendered land rights may be needed but should be guided towards unbundling cultural norms and values that reinforces gender inequality.

4.7 Conclusion

This study contributes to the literature on intrahousehold resource allocation and child health outcomes by investigating the impact of gendered household decision-making rights on children's nutritional outcomes in Nigeria. I conclude that asymmetric control over resources as reflected in the decision-making process exists within the Nigerian households and this has implications for child health outcomes. State intervention, specifically in the design of social policy and a gender sensitive welfare regime would be required to break financial barriers in the use of interventions. To be clear, the findings identify a policy scope for social spending to influence gender relations in Nigerian households. In other words, gender relations in the context of decision-making rights should shape social spending policy of pro-poor growth. A gender-blind social spending policy may not exert optimum impact on household outcomes such as child health. In general, the finding on a gendered pattern in household decision making could be relevant towards the evolving of a social spending mix that links the state and household welfare. It could be an important feed into the on-going National Social Investment Programme rolling out across all states in Nigeria. However, in transferring resources to women as suggested by the findings, there is the potential effect of alteration in the division of labour within households. A new gender relation is likely to evolve.

Chapter 5

Conclusion

This thesis explores and explains levels and rates of change in child mortality, using Nigeria as a country case study. It presents empirical evidence on a range of topics in development literature that explains child health outcomes within the context of SSA countries and Nigeria in particular. The analysis uses a wide range of methodological tools. Though there is literature explaining child mortality rates and levels in developing countries, this thesis provides a different insight into why Nigeria, as an emerging economy, substantially contributes to the global aggregate of under-five deaths.

Chapter 1 investigates the effect of the MDG campaign on child mortality reduction in the SSA region with particular reference to Nigeria. Using a quasi-experimental design—the ITS—I estimate the treatment effect of the MDG on child mortality. The results suggest that the MDG effect in reducing child mortality in Nigeria, as well as countries in the SSA sub-region, is largely unclear. For Nigeria, though child mortality declined with the introduction of the MDGs, the existence of a significant underlying decreasing trend, and the absence of a further decline in mortality rates when the pre-MDG and postMDG slopes are compared, are inconsistent with the ITS causal effects' identification assumptions. Indeed, the evidence of an MDG effect is less conclusive when adjustment is made for confounding factors in the model. The case of Nigeria is similar to the majority of the countries in the SSA. In fact, in some countries I find evidence of rising trends with the introduction of the MDGs. While the reason for the mixed MDG effect is unclear, it is plausible that the MDG interventions might be compromised by country-specific constraints identified in this study.

From these findings, it is unlikely that the MDG intervention has started a health/epidemiological transition in the region. A sustainable decline in under-five mortality will be necessary in relation to the fertility reduction efforts needed to exit a possible demographic trap. It is also uncertain whether the SDG3 target will be achieve by 2030 for most SSA countries, given the pattern of mortality change uncovered by the study findings. Hence, while fast-tracking progress in child survival efforts is imperative, particular attention should be given to societies where there are underlying constraints such as conflicts, weak institutions, ethnic fractionalization, and unfavourable geographical characteristics with frequent climatic shocks.

However, these findings should be interpreted within the context of some limitations. For instance, it proved difficult to control for treatment interference from other interventions running concurrently with the MDGs. The influences of such interventions on mortality change before and after the MDG campaign should be isolated to estimate a precise MDG effect. This will require an ITS design that clearly identifies a specific intervention targeted at a population. Also, the study uses an ITS design for a single group. Future studies should consider the use of more robust ITS designs that create real counterfactual groups to improve on the validity of the intervention effect estimate. In addition, it will be a significant value addition to the present study if further research considers statistically testing for non-stationary or secular trends in the outcome series. Identifying whether the mortality series is increasing or decreasing over time irrespective of any intervention, or the existence of some seasonal or cyclical trends in the series, could be an additional test for showing the existence of any underlying trend.

Chapter 2 address the relationship between economic growth and child mortality, and whether there was a structural break in the effect of growth on child mortality after the introduction of the MDGs. Specifically, the chapter investigates whether changes in economic growth patterns influence child mortality outcomes across countries in the SSA sub-region, and over time. The study exploits the structure of an assembled panel dataset of 48 SSA countries using the Arrelano and Bond system GMM to estimate the relationship. The results indicate that under-five mortality falls with income per capita with an elasticity of -0.42. This is smaller than the unconditional growth elasticity of -0.7 estimated in a related paper by Bhalotra (2008). The study also investigates whether there is heterogeneity in the effect of growth on mortality between resource-rich and resource-poor countries and discover that the impact of growth on mortality is only significant amongst resource-poor countries. This finding can be considered as an additional support for the resource curse hypothesis. Perhaps this explains the apparent paradox that Nigeria, a resource-rich and oil-producing country, has the highest number of under-five deaths in Africa. It is likely that the existence of point natural resources which may have introduced rent seeking, corruption, and conflicts, can be detrimental to the performance of the country in achieving development goals.

The study findings on the relative presence of a structural break in the effect of economic growth following the introduction of pro-poor growth suggests that child mortality is still prevalent amongst the poor despite the adoption of the pro-poor growth policy. That is, there is no evidence that the MDG growth policy has improved the quality of life amongst households across SSA countries. It is likely that the growth pattern is marked by rising inequality such that the potential benefit from growth is more than offset by the adverse impact of rising inequality. However, these findings should be interpreted within the context of certain limitations. For instance, the income and mortality data are aggregated at a country level, and this limits the understanding of how changes in income inequality due to the growth reform have impacted equity in child mortality outcomes. In effect, the distribution of income could matter in the relationship between health and income. Exploiting variations in income quintiles may shed a different light on the structural break effect of growth on mortality by socioeconomic status. Uncovering such heterogeneity across various groups and regions should be an agenda for future study. Also, in identifying the structural break effect, the study assumes that growth reforms were implemented within a similar time frame across the SSA countries. This assumption should be considered when drawing any conclusions from an assessment of changes in income elasticity between two sub-sample periods using a common structural break point. Finally, child mortality data in developing countries are usually underestimated. Reported deaths are likely to be higher because births and deaths of neonates occurring at home are less likely to be counted, due to the near absence of birth and death registration. Importantly, the distribution of unreported deaths might be systematic, concentrating amongst the lowest income quintiles. This could lead to inaccurate estimation of the effect of economic growth on mortality especially amongst the different income quintiles.

In Chapter 3, I consider the role of porous borders in explaining child mortality for a source country like Nigeria. A motivation for the chapter hinges on the argument that the impact of social spending as a policy tool to improve household outcomes could be attenuated for a source country if cross-border spill-overs exist. There could be a loss of efficiency gains in government health spending with consequences for child health outcomes due to spill-over effects. Chapter 3 addresses the question of whether Nigeria's public spending on health has spill-over effects on neighbouring countries. The results from fixed effect regressions suggest that an expansionary Nigeria's public health spending is associated with a reduction in childhood mortality across West African countries. These findings are interpreted as evidence of a spill-over effect. It is likely that such externalities are a strain on the health care/social security system of the source country, and a drain on the public resources of the source country.

The study makes two contributions to the literature. First, it integrates two lines of theoretical and empirical work—the literature that links public spending and child health outcomes, and a contiguous literature that shows the existence of a spill-over effect of policy from a source country across borders—to provide new evidence of the existence of public spending spill-over across borders. It also contributes to the literature on cross-border utilization of health services by providing spatial evidence of potential geographical access to health facilities by countries within geographical proximity to Nigeria. Whether such externalities are internalized in the public health spending budget could be vital in explaining the contribution of Nigeria to global under-five mortality and will be relevant for policy interventions relating to the on-going SDGs.

These findings should be considered within the context of two limitations. First, the association between public health spending in a source country and childhood mortality outcomes in neighbouring countries may be affected by unmeasured confounding factors or residual confounding. Though I have controlled for a large set of time-varying confounding factors, it is unlikely that all country specific factors that drive mortality or interaction effects between covariates that may explain health outcomes were controlled for in the model. Also, the observed confounding factors are aggregated at the country level, which makes them susceptible to information loss from the aggregation process, hence they might be prone to measurement errors—residual confounders. Second, the evidence on cross-border use of health care is qualitative. A finely measured geo-coded data at the individual level with information on health outcomes, alongside a set of relevant covariates, would have allowed for the use of spatial econometric models to estimate the effect of exposure to health facilities across borders on health outcomes. In essence, value will be added to the present study if a further microeconomic analysis of the effects of cross-border use of health facilities on health outcomes is carried out. However, this study limitation sheds light on the imperative for collecting individual level data on the use of health facilities across borders for all source countries in the SSA sub-region, and Nigeria in particular, as an agenda for future research.

Chapter 4 investigates the role of the domestic economy in influencing child health outcomes in Nigeria. I argue that asymmetric control over household resources, as reflected in the decision-making authority of spouses/partners, could be an important factor in explaining relative child health within the context of Nigeria. The current interest in the potential of demand-side policies through cash-based social protection schemes to improve child health outcomes in Nigeria is a motivation for the chapter. The results from the quantitative analysis indicate that, for child health outcomes in Nigeria, it matters if women have decision-making authority within the household. An important conclusion from the study is that the collective model describes the Nigerian household. By inference, with decision-making authority and more resources, women are likely to assert their innate preference for child well-being. Hence, it will matter in the context of child health outcomes whether demand-side financing options are gender sensitive in Nigeria.

Chapter 4 contributes to our understanding of the role of the domestic economy in explaining poor child health outcomes in Nigeria. The participation of women in household decision-making could influence the rate of utilization and uptake of interventions such as family planning, and maternal and child health services. The findings from this chapter provide a useful insight into how social policy could be administered to exert optimum impact in regard to child health outcomes. There is a multiplicity of social welfare programmes in Nigeria, such as the on-going national social-welfare programmes that give cash to the poorest citizens. Cash transfers from these programmes are not gendered. Results from this study are timely, especially in providing policy suggestions on how to improve child health outcomes for a country that substantially contributes to global under-five deaths. Though Nigeria is considered as an appealing case for such a study, given its heterogeneous society with autonomous communities having distinct cultural practices, our results could be generalizable to other developing countries with similar household structures.

To promote female participation in household decision-making in Nigeria, this study shows that media exposure, education, land ownership, and economic status are vital. From the results, while short-run policy prescriptions to promote female participation in decision making could include female financial empowerment (direct cash transfer and micro-credit), in the long run, promoting female school-age education, legislation to grant land ownership rights to women, and awareness campaigns through mass media, may be equally vital.

This study is limited in its inability to investigate dynamics between changing shares of female participation in household decision making, and the effect of this on child health outcomes. There have been media campaigns promoting women's rights and national legislation against domestic violence in Nigeria in the recent past. Investigating how these actions might have influenced women's rights within the household, and consequently child health outcomes, could be an important addition to this study. A further extension to this study could be an investigation of any potential gender patterns in the effect of the national social-welfare programme on child health outcomes.

Appendices

Appendix 1

Appendix 1A

Table 1A.1 - Description of Variables

Variable	Description	Source
U5MR	The probability per 1,000 that a new-born baby will die before reaching the age of five	World Bank
IMR	Number of infants dying before reaching one year of age, per 1,000 live births each year	World Bank
NMR	Number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year	World Bank
Ethnic_Frac	0 if all individuals are member of the same ethnic group, 1 if each individual belongs to his/her own ethnic group	HIEF, dataset
Corrupt_index	Ranges from -2.5 (weak) to 2.5(strong) governance performance.	WGI
Precipitation	Annual average series of rainfall dept in millimetres	UEA-CRU
Temperature	Annual average series of Temperature in Celsius	UEA-CRU
Inflation	changes in the cost to the average consumer of acquiring a basket of goods and services (CPI)	World Bank
GDP (PPP)	GDP to international dollars using purchasing power parity rates (in constant 2017)	World Bank
Conflict	1 if minor (conflict battle-related deaths is between 25 and 999), 2 is war if at least 1,000 battle-related deaths occurred in a given year	UCDP/PRIO

Table 1A.1 - Description of variables (continued).

Variable	Description	Source
Education	Female primary completion rate as % of relevant age group	UNESCO
Sanitation	The percentage of people using at least basic sanitation services that are not shared with other households	WHO/UNICEF
Safe water	The percentage of people using at least basic water services (collection time of Water is less than 30 minutes for a round trip	WHO/UNICEF
Immunization	The percentage of children ages 12-23 months that are immunized against Diphtheria, Pertussis, and tetanus (DPT) with three doses of vaccine	WHO/UNICEF
Labour Part	Percentage of female labour force participation (from total)	ILOSTAT
Urbanization	Percentage of urban population	UN Pop Div
PHE pc	Public expenditure on health from domestic sources per capita expressed in international dollars at purchasing power parity (PPP time series based on ICP 2011 PPP).	WHO/GHE database
PHE/THE	Share of public health expenditure of total health expenditure	WHO/GHE
GE/GDP	General government final consumption expenditure includes all government current expenditures for purchases of goods and services.	World Bank

Notes: PHE= Public health expenditure, THE=Total health expenditure, GE=General expenditure

Table 1A.2 - Summary statistics: Under-five, Infant and Neonatal mortality rates in SSA (1990-2015)

	U5MR			Infant			Neonates		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1990	159.17	16.6	328.6	96.02	14.3	174.7	42.49	11.1	66.7
	(68.72)			(36.73)			(13.58)		
1991	157.44	16	321.9	95.03	13.8	176	41.93	10.6	65.1
	(67.54)			(36.3)			(13.4)		
1992	155.81	15.5	313.6	94.08	13.3	175.2	41.42	10.2	63.6
	(66.02)			(35.65)			(13.21)		
1993	154.38	15	303.4	93.19	12.9	172.7	40.98	9.8	62.8
	(64.33)			(34.87)			(13.01)		
1994	154.64	14.6	291.6	92.47	12.6	168.5	40.61	9.4	62.2
	(65.15)			(34.19)			(12.8)		
1995	151.64	14.3	278.7	91.09	12.3	162.9	40.2	9.1	61.3
	(61.39)			(32.99)			(12.54)		
1996	148.07	14.1	266	89.62	12.1	156.4	39.74	8.9	60.6
	(57.86)			(31.88)			(12.25)		
1997	145.93	13.9	254.6	88.2	12	149.2	39.25	8.8	59.8
	(56.25)			(30.97)			(11.97)		
1998	143.31	13.8	244.4	86.53	11.9	147.2	38.67	8.7	58.8
	(54.9)			(30.13)			(11.69)		
1999	139.13	13.7	239.1	84.46	11.8	144.9	37.97	8.7	57.7
	(52.17)			(29.16)			(11.4)		
2000	135.13	13.7	234	82.28	11.8	142.4	37.21	8.6	56.6
	(50.22)			(28.31)			(11.16)		
2001	130.59	13.7	228.6	79.85	11.8	139.9	36.43	8.7	55.2
	(48.21)			(27.39)			(10.92)		
2002	125.82	13.7	222.9	77.27	11.8	137.2	35.67	8.7	54
	(46.22)			(26.48)			(10.73)		
2003	120.99	13.7	216.8	74.71	11.8	134.3	34.92	8.7	52.7
	(44.36)			(25.63)			(10.52)		
2004	116.15	13.7	210.3	72.13	11.8	131.2	34.2	8.7	51.5
	(42.7)			(24.89)			(10.33)		
2005	111.35	13.8	203.6	69.56	11.8	128	33.48	8.6	50.9
	(41.35)			(24.37)			(10.14)		
2006	106.75	13.8	196.4	67.24	11.9	124.5	32.8	8.6	50.1
	(40.17)			(23.8)			(9.95)		

Table 1A.2 - Summary Statistics: Under-five, infant and neonatal mortality rates 1990-2015 (continued).

	U5MR			Infant			Neonates		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
2007	102.24 (39)	13.9	188.6	65.01 (23.17)	11.9	120.8	32.13 (9.75)	8.6	49
2008	97.79 (37.89)	13.9	180.3	62.86 (22.66)	12	116.8	31.47 (9.55)	8.7	48.1
2009	93.43 (36.7)	14	171.7	60.78 (21.98)	12.1	112.6	30.82 (9.35)	8.7	47.5
2010	89.28 (35.56)	14.1	162.8	58.7 (21.45)	12.1	108.3	30.18 (9.16)	8.7	47
2011	85.56 (34.36)	14.2	153.9	56.77 (20.8)	12.2	103.9	29.52 (8.95)	8.8	46.3
2012	82.05 (33.27)	14.3	147.2	54.93 (20.27)	12.3	99.6	28.89 (8.78)	8.8	45.5
2013	78.79 (32.33)	14.5	142.3	53.23 (19.83)	12.5	95.6	28.29 (8.64)	8.7	44.8
2014	75.89 (31.42)	14.4	137.9	51.67 (19.36)	12.6	93	27.7 (8.51)	8.6	44.1
2015	73.25 (30.57)	14.3	133.4	50.21 (18.97)	12.5	90.7	27.11 (8.4)	8.5	43.3

Note: Standard deviation in parenthesis.

Source: World Bank Poverty Data Catalogue (2018)

Table 1A.3 - Achievement in the number of under-five mortality in the SSA (1990 and 2015)

Decrease				Increase			
Country	1990	2015	% Change	Country	1990	2015	% Change
Ethiopia	436220	210036	-51.85	Nigeria	853117	867269	1.66
Tanzania	176480	112345	-36.34	Congo, DR.	283090	307687	8.69
Uganda	149864	83902	-44.01	Cameroon	69421	72031	3.76
Mozambique	139655	83177	-40.44	Chad	60330	77430	28.34
Niger	137296	85193	-37.95	Somalia	59172	74974	26.71
Angola	125664	100834	-19.76	CAR	20570	21171	2.92
Sudan	106460	84321	-20.80	Mauritania	9236	11458	24.06
Kenya	105087	67718	-35.56	Congo, Rep	7804	9052	15.99
Malawi	98404	35022	-64.41	E. Guinea	3000	3683	22.77
Mali	91253	79876	-12.47	Botswana	2265	2288	1.02
Burkina-F	79362	60193	-24.15				
Madagascar	78017	45848	-41.23				
Cote d'Ivoire	76330	73918	-3.16				
Ghana	72650	45941	-36.76				
Guinea	68065	45073	-33.78				
South Africa	66361	45128	-32.00				
Zambia	65034	38027	-41.53				
South Sudan	63111	36947	-41.46				
Sierra Leone	49690	30108	-39.41				
Rwanda	49204	15010	-69.49				
Senegal	43054	25968	-39.69				
Benin	38370	38338	-0.08				
Zimbabwe	29833	25433	-14.75				
Liberia	24659	11829	-52.03				
Togo	22024	19016	-13.66				
Eritrea	13871	5067	-63.47				
Guinea-B	9816	5685	-42.08				
Gambia, The	6875	5176	-24.71				
Lesotho	5343	5260	-1.55				
Namibia	3842	3064	-20.25				
Gabon	3180	3130	-1.57				
Comoros	2132	1902	-10.79				
Cabo Verde	835	234	-71.98				
Mauritius	508	194	-61.81				
Sao Principe	498	229	-54.02				
Seychelles	28	24	-14.29				

Source: World Bank Poverty Data Catalogue (2018)

Note: Guinea-B=Guinea-Bissau, E.Guinea= Equatorial-Guinea, and Burkina-F=Burkina-Faso.

Table 1A.4 - MDG4 Country Performance in 2015

MDG4 Achievers		MDG4 Non-Achievers	
Country	U5MR	Country	U5MR
Malawi	59.2	Somalia	133.4
Tanzania	59.1	Chad	130.5
Madagascar	58.1	CAR	129.1
Congo, Rep.	54.9	Nigeria	125.4
Uganda	54.8	Sierra Leone	121.8
Ghana	54.7	Mali	109.1
Zimbabwe	54.3	Guinea	107.2
Gabon	51	Benin	99.9
Senegal	50.1	South Sudan	98.6
Eritrea	46.6	Congo, Dem. Rep.	97.4
Kenya	46.3	Niger	94.3
Namibia	44.9	Equatorial Guinea	94.2
Rwanda	41.3	Lesotho	92.5
Botswana	40.7	Guinea-Bissau	91.2
South Africa	37.7	Cote d'Ivoire	90
Sao Tome	35.1	Angola	88.1
Capo-Verde	21.5	Burkina Faso	86.8
Seychelles	14.7	Cameroon	85.8
Mauritius	14.3	Mauritania	83.5
		Mozambique	81.8
		Liberia	78.9
		Togo	76.8
		Comoros	74.9
		Sudan	66.3
		The Gambia	64.7

Source: World Bank Poverty Data Catalogue (2018)

Table 1A.5 - Progress to Meet MDG4 target

Country	1990	2015
Congo	90.2	54.9
Eritrea	152.5	46.6
Gabon	92.6	51
Ghana	127	52
Kenya	106	46.3
Madagascar	159.5	58.1
Malawi	238.7	59.2
Namibia	73.7	44.9
Rwanda	153.6	41.3
Senegal	139	50.1
Sao Tome	108.2	35.1
Tanzania	166.1	59.1
Uganda	184.7	54.8
Zimbabwe	80.5	54.3

Source: World Bank Poverty Data Catalogue (2018)

Table 1A.6 - ITS Regression results for SSA countries (Newey, OLS)

	1	2	3	4	5	6
	Without Controls			With controls		
	_t	_X	Post_MDGs	_t	_X	Post_MDGs
Botswana	2.722***	-15.86***	-2.068***	4.095	-5.149*	-6.121
	(0.297)	(5.092)	(0.502)	(4.227)	(2.585)	(4.070)
Eritrea	-7.173***	1.712	-2.556**	-6.690***	2.895**	-4.122**
	(0.195)	(1.689)	(0.151)	(0.304)	(1.157)	(0.140)
Cape Verde	-1.759***	-10.17***	-0.949**	-3.989***	-8.911**	-2.729***
	(0.337)	(2.955)	(0.115)	(1.262)	(4.076)	(0.881)
South Africa	1.492***	16.30**	-3.095***	7.760***	5.316*	2.874
	(0.300)	(6.392)	(0.55)	(1.028)	(2.866)	(1.668)
Seychelles	-0.273***	0.299	0.069**	-0.322***	0.566**	-0.017
	(0.0360)	(0.218)	(0.012)	(0.0421)	(0.226)	(0.0194)
Mauritius	-0.0570	-4.413***	-0.209**	-0.573*	-4.254***	-1.035***
	(0.104)	(0.997)	(0.057)	(0.277)	(0.790)	(0.346)
Sao Tome&P	-2.141***	-10.45***	-3.306***	-2.018***	-10.43***	-3.326***
	(0.401)	(3.235)	(0.207)	(0.446)	(3.334)	(0.211)
Lesotho	2.221***	10.60***	-1.369***	3.705***	6.212	2.0466
	(0.231)	(3.693)	(0.303)	(1.142)	(4.566)	(2.879)
Burkina Faso	-1.717***	-3.769*	-5.565***	-0.0915	-3.295*	-4.18**
	(0.293)	(2.055)	(0.151)	(0.618)	(1.805)	(0.544)
Senegal	-0.0721	-15.16***	-5.162***	-4.825**	-7.070**	-10.128**
	(0.204)	(4.153)	(0.417)	(2.009)	(3.292)	(2.408)
Ghana	-2.405***	-3.666***	-2.913***	-2.540***	-3.651***	-3.37***
	(0.119)	(0.903)	(0.047)	(0.157)	(1.125)	(0.468)
Malawi	-6.425***	-19.70***	-7.301***	-7.767***	-5.818*	-11.95**
	(0.202)	(6.393)	(0.594)	(0.499)	(2.870)	(0.77)
The Gambia	-5.581***	-2.004	-3.494***	-4.623***	-2.557*	-1.78**
	(0.0451)	(1.319)	(0.158)	(0.265)	(1.353)	(0.465)
Mozambique	-7.108***	-16.32***	-5.508***	-5.383***	-13.59***	-1.3166
	(0.623)	(5.225)	(0.327)	(1.171)	(3.705)	(1.59)
Madagascar	-5.018***	-4.979**	-3.217**	-7.379***	-2.166*	-7.954***
	(0.0459)	(1.791)	(0.195)	(0.215)	(1.017)	(0.378)
Ethiopia	-6.118***	-3.263*	-5.279***	-6.283***	0.801	-6.514***
	(0.0997)	(1.718)	(0.204)	(0.237)	(0.602)	(0.329)
Mauritania	-0.407***	5.018**	-2.121***	-1.151	3.658**	-1.043
	(0.129)	(1.855)	(0.169)	(1.502)	(1.469)	(1.465)
Benin	-3.635***	-1.088	-2.558***	-4.382***	-1.414**	-4.157***
	(0.0860)	(0.868)	(0.084)	(0.428)	(0.586)	(0.472)
Rwanda	7.426**	-77.58***	-9.32***	4.857*	-57.29**	3.062
	(3.006)	(22.64)	(0.822)	(2.348)	(21.85)	(2.65)
Cote d'Ivoire	-0.765***	-3.893***	-3.530***	-1.265**	-3.881***	-3.95***
	(0.216)	(1.362)	(0.034)	(0.462)	(1.237)	(0.25)
Gabon	-0.650***	0.275	-2.344**	-0.633***	-0.149	-1.98**
	(0.0224)	(0.476)	(0.045)	(0.0542)	(0.482)	(0.201)
Zambia	-2.465***	-17.80***	-5.554***	-11.42***	-8.945**	-17.031***
	(0.301)	(5.747)	(0.585)	(3.034)	(3.803)	(5.25)
Burundi	-1.549**	9.643**	-6.151***	-1.473	-7.289	-4.948
	(0.548)	(3.513)	(0.164)	(2.912)	(4.482)	(2.842)

Table 1A.6 – ITS Regression results for SSA countries (Newey, OLS) (continued).

	1	2	3	4	5	6
	Without Controls			With controls		
	_t	_X	Post_MDGs	_t	_X	Post_MDGs
Tanzania	-3.030***	-16.46***	-4.639***	-3.139**	-5.727**	-1.98*
	(0.341)	(4.404)	(0.357)	(1.330)	(2.266)	(1.090)
Mali	-3.899***	-6.968***	-5.244***	-4.161***	-2.509***	-5.317***
	(0.113)	(1.756)	(0.157)	(0.189)	(0.681)	(0.192)
Sudan	-2.619***	-3.962***	-2.483**	-2.738***	-2.658***	-2.731***
	(0.0726)	(1.186)	(0.110)	(0.126)	(0.913)	(0.244)
Uganda	-3.079***	-8.835***	-6.118***	-3.659***	-3.452***	-8.781***
	(0.124)	(2.819)	(0.312)	(0.409)	(1.101)	(0.464)
Niger	-11.05***	-4.264	-9.065**	-9.232***	-4.477	-9.32***
	(0.331)	(3.772)	(0.471)	(1.095)	(2.549)	(0.553)
Zimbabwe	2.181***	-12.00**	-1.930***	2.691***	-12.48***	-2.153***
	(0.454)	(4.672)	(0.503)	(0.438)	(3.387)	(0.178)
Kenya	0.139	-13.03***	-3.362***	-1.036	-7.848*	-5.582***
	(0.522)	(4.010)	(0.240)	(0.776)	(3.745)	(0.515)
Guinea-Bissau	-4.773***	-1.937**	-5.699***	-4.782***	-4.114	-5.915***
	(0.0584)	(0.920)	(0.137)	(0.327)	(3.458)	(0.117)
Chad	-2.553***	-0.0578	-3.766***	-2.828***	-0.357	-4.002***
	(0.0364)	(0.475)	(0.044)	(0.114)	(0.354)	(0.066)
Congo, Rep.	3.056***	-9.723***	-4.281***	3.744***	-6.899***	-5.915***
	(0.131)	(3.313)	(0.391)	(0.436)	(2.136)	(0.453)
CAR	-0.680***	3.697*	-2.877***	-2.130***	-0.102	-2.141***
	(0.0655)	(2.029)	(0.233)	(0.576)	(2.318)	(0.141)
Cameroon	1.314***	-5.478***	-3.616***	0.384	-1.829	-3.405***
	(0.272)	(1.852)	(0.095)	(0.298)	(1.082)	(0.218)
Nigeria	-2.242***	-12.97***	-3.803***	-4.705***	-6.011**	-6.542***
	(0.0459)	(1.791)	(0.195)	(0.793)	(2.610)	(1.502)
Angola	-1.280***	-6.726**	-8.193***	-1.525***	-4.754**	-8.094***
	(0.352)	(2.561)	(0.199)	(0.300)	(1.952)	(0.363)
E.Guinea	-1.808***	-5.317***	-4.250***	-1.669***	-3.327***	-4.081***
	(0.182)	(1.441)	(0.083)	(0.384)	(1.100)	(0.340)
Congo, DR.	-2.335***	-4.297***	-4.232***	0.0589	-4.886***	-2.061
	(0.108)	(1.126)	(0.094)	(1.219)	(1.218)	(1.256)
Somalia	-0.582**	10.56**	-2.6475**	-0.840*	11.36**	-2.4451***
	(0.239)	(4.135)	(0.417)	(0.419)	(4.133)	(0.395)
South Sudan	-6.680***	-14.41***	-5.913***	-6.582***	-8.968**	-6.276***
	(0.267)	(4.730)	(0.545)	(0.242)	(3.796)	(0.718)
Togo	-2.575***	-3.078***	-2.800***	-2.659***	-2.189**	-3.172**
	(0.0921)	(0.889)	(0.064)	(0.309)	(0.806)	(0.096)

Standard errors in parentheses ***p<0.01, **p<0.05, *p<0.1

Note: (i)_t is time since start of the study; _x is dummy variable representing the intervention period; _x_t is interaction of _x and _t.

(ii) Regressions results for Namibia, Liberia, Sierra Leone, and Guinea are omitted due to missing observations.

Table 1A.7 – ITS Regression results for Landlocked SSA countries (Newey, OLS)

	1	2	3	4	5	6
	Without Controls			With controls		
	_t	_X	Post_MDGs	_t	_X	Post_MDGs
Botswana	2.722***	-15.86***	-2.068***	4.095	-5.149*	-6.121
	(0.297)	(5.092)	(0.502)	(4.227)	(2.585)	(4.070)
Lesotho	2.221***	10.60***	-1.369***	3.705***	6.212	2.0466
	(0.231)	(3.693)	(0.303)	(1.142)	(4.566)	(2.879)
Burkina Faso	-1.717***	-3.769*	-5.565***	-0.0915	-3.295*	-4.18**
	(0.293)	(2.055)	(0.151)	(0.618)	(1.805)	(0.544)
Malawi	-6.425***	-19.70***	-7.301***	-7.767***	-5.818*	-11.95**
	(0.202)	(6.393)	(0.594)	(0.499)	(2.870)	(0.77)
Ethiopia	-6.118***	-3.263*	-5.279***	-6.283***	0.801	-6.514***
	(0.0997)	(1.718)	(0.204)	(0.237)	(0.602)	(0.329)
Rwanda	7.426**	-77.58***	-9.32***	4.857*	-57.29**	3.062
	(3.006)	(22.64)	(0.822)	(2.348)	(21.85)	(2.65)
Zambia	-2.465***	-17.80***	-5.554***	-11.42***	-8.945**	-17.031***
	(0.301)	(5.747)	(0.585)	(3.034)	(3.803)	(5.25)
Burundi	-1.549**	9.643**	-6.151***	-1.473	-7.289	-4.948
	(0.548)	(3.513)	(0.164)	(2.912)	(4.482)	(2.842)
Mali	-3.899***	-6.968***	-5.244***	-4.161***	-2.509***	-5.317***
	(0.113)	(1.756)	(0.157)	(0.189)	(0.681)	(0.192)
Uganda	-3.079***	-8.835***	-6.118***	-3.659***	-3.452***	-8.781***
	(0.124)	(2.819)	(0.312)	(0.409)	(1.101)	(0.464)
Niger	-11.05***	-4.264	-9.065**	-9.232***	-4.477	-9.32***
	(0.331)	(3.772)	(0.471)	(1.095)	(2.549)	(0.553)
Zimbabwe	2.181***	-12.00**	-1.930***	2.691***	-12.48***	-2.153***
	(0.454)	(4.672)	(0.503)	(0.438)	(3.387)	(0.178)
CAR	-0.680***	3.697*	-2.877***	-2.130***	-0.102	-2.141***
	(0.0655)	(2.029)	(0.233)	(0.576)	(2.318)	(0.141)
South Sudan	-6.680***	-14.41***	-5.913***	-6.582***	-8.968**	-6.276***
	(0.267)	(4.730)	(0.545)	(0.242)	(3.796)	(0.718)

Standard errors in parentheses ***p<0.01, **p<0.05, *p<0.1

Note: _t is time since start of the study; _x is dummy variable representing the intervention period; _x_t is interaction of _x and _t. * countries with missing observations on covariates

Table 1A.8 - Regression results for quality institutions (Newey, OLS)

	1	2	3	4	5	6
	Without Controls			With controls		
	_t	_X	Post_MDGs	_t	_X	Post_MDGs
Botswana	2.722***	-15.86***	-2.068***	4.095	-5.149*	-6.121
	(0.297)	(5.092)	(0.502)	(4.227)	(2.585)	(4.070)
Eritrea	-7.173***	1.712	-2.556**	-6.690***	2.895**	-4.122**
	(0.195)	(1.689)	(0.151)	(0.304)	(1.157)	(0.140)
Cape Verde	-1.759***	-10.17***	-0.949**	-3.989***	-8.911**	-2.729***
	(0.337)	(2.955)	(0.115)	(1.262)	(4.076)	(0.881)
South Africa	1.492***	16.30**	-3.095***	7.760***	5.316*	2.874
	(0.300)	(6.392)	(0.55)	(1.028)	(2.866)	(1.668)
Seychelles	-0.273***	0.299	0.069**	-0.322***	0.566**	-0.017
	(0.0360)	(0.218)	(0.012)	(0.0421)	(0.226)	(0.0194)
Mauritius	-0.0570	-4.413***	-0.209**	-0.573*	-4.254***	-1.035***
	(0.104)	(0.997)	(0.057)	(0.277)	(0.790)	(0.346)
Sao Tome&Prin	-2.141***	-10.45***	-3.306***	-2.018***	-10.43***	-3.326***
	(0.401)	(3.235)	(0.207)	(0.446)	(3.334)	(0.211)

Standard errors in parentheses ***p<0.01, **p<0.05, *p<0.1

Note: _t is time since start of the study; _x is dummy variable representing the intervention period; _x_t is interaction of _x and _t. * countries with missing observations on covariates

Table 1A.9 – ITS Regression results for Least Ethnic Fractionalized countries (Newey, OLS)

	1	2	3	4	5	6
	Without Controls			With controls		
	_t	_X	Post_MDGs	_t	_X	Post_MDGs
Botswana	2.722***	-15.86***	-2.068***	4.095	-5.149*	-6.121
	(0.297)	(5.092)	(0.502)	(4.227)	(2.585)	(4.070)
Lesotho	2.221***	10.60***	-1.369***	3.705***	6.212	2.0466
	(0.231)	(3.693)	(0.303)	(1.142)	(4.566)	(2.879)
Rwanda	7.426**	-77.58***	-9.32***	4.857*	-57.29**	3.062
	(3.006)	(22.64)	(0.822)	(2.348)	(21.85)	(2.65)
Zimbabwe	2.181***	-12.00**	-1.930***	2.691***	-12.48***	-2.153***
	(0.454)	(4.672)	(0.503)	(0.438)	(3.387)	(0.178)
Cape Verde	-1.759***	-10.17***	-0.949**	-3.989***	-8.911**	-2.729***
	(0.337)	(2.955)	(0.115)	(1.262)	(4.076)	(0.881)
Mauritius	-0.0570	-4.413***	-0.209**	-0.573*	-4.254***	-1.035***
	(0.104)	(0.997)	(0.057)	(0.277)	(0.790)	(0.346)
Madagascar	-5.018***	-4.979**	-3.217**	-7.379***	-2.166*	-7.954***
	(0.0459)	(1.791)	(0.195)	(0.215)	(1.017)	(0.378)

Standard errors in parentheses ***p<0.01, **p<0.05, *p<0.1

Note: _t is time since start of the study; _x is dummy variable representing the intervention period; _x_t is interaction of _x and _t. * countries with missing observations on covariates

Table 1A.10 – ITS Regression results—Multiple-design

Country	_t	_x1990	_x_t1990	_x2000	_x_t2000
Angola	-1.675***	6.253***	0.395	-6.726**	-6.914***
	(0.203)	(2.253)	(0.385)	(2.581)	(0.418)
Benin	-3.868***	-1.468**	0.234***	-1.088	1.076***
	-0.0182	(0.540)	(0.0847)	(0.874)	(0.130)
Botswana	-2.901***	7.522***	5.623***	-15.86***	-4.791***
	(0.198)	(2.076)	(0.341)	(5.131)	(0.549)
Burkina Faso	-4.330***	7.650***	2.613***	-3.769*	-3.848***
	(0.179)	(2.150)	(0.314)	(2.071)	(0.339)
Burundi	-6.155***	24.94***	4.606***	-9.644**	-4.602***
	(1.016)	(7.913)	(1.056)	(3.540)	(0.574)
CAR	-0.978***	3.860***	0.298*	3.697*	-2.198***
	(0.157)	(1.114)	(0.156)	(2.044)	(0.252)
Cameroon	-5.070***	11.80***	6.384***	-5.478***	-4.931***
	(0.356)	(3.041)	(0.418)	(1.866)	(0.303)
Cape Verde	-3.007***	-0.0461	1.247***	-10.17***	0.811**
	(0.243)	(1.941)	(0.434)	(2.978)	(0.329)
Chad	-2.725***	-0.960**	0.172**	-0.0578	-1.213***
	(0.0553)	(0.362)	(0.0631)	(0.479)	(0.0635)
Comoros	-5.135***	0.401	2.516***	8.379***	0.577**
	(0.138)	(1.347)	(0.302)	(2.413)	(0.263)
Congo Rep	-2.259***	4.582***	5.315***	-9.723***	-7.337***
	(0.230)	(1.528)	(0.289)	(3.339)	(0.406)
Congo, DR	-2.647***	1.718**	0.312**	-4.297***	-1.897***
	(0.0916)	(0.726)	(0.137)	(1.134)	(0.136)
Cote d'Ivoire	-1.755***	6.915***	0.989***	-3.893***	-2.765***
	(0.312)	(2.336)	(0.353)	(1.373)	(0.223)
E_Guinea	-2.702***	4.176**	0.895***	-5.317***	-2.442***
	(0.229)	(1.527)	(0.274)	(1.461)	(0.197)
Eritrea	-3.647***	-6.073***	-3.527***	1.712	4.617***
	(0.210)	(1.699)	(0.275)	(1.701)	(0.274)
Ethiopia	-3.867***	0.489	-2.250***	-3.263*	0.838***
	(0.0850)	(0.695)	(0.140)	(1.731)	(0.228)
G_Bissua	-4.230***	0.937**	-0.543***	-1.937*	-0.927***
	(0.0278)	(0.369)	(0.0594)	(0.942)	(0.151)
Gabon	-2.775***	3.730**	2.125***	0.275	-1.694***
	(0.226)	(1.363)	(0.230)	(0.480)	(0.0560)
Gambia	-6.633***	0.813***	1.052***	-2.004	2.086***
	(0.0326)	(0.263)	(0.0604)	(1.329)	(0.174)
Ghana	-3.871***	-6.485**	1.465***	-3.666***	-0.508***
	(0.414)	(2.763)	(0.407)	(0.910)	(0.122)
Guinea	-4.555***	-0.0364	-2.182***	-8.006**	3.090***
	(0.0210)	(0.409)	(0.0783)	(3.070)	(0.330)
Madagascar	-1.050	-10.68**	-3.967***	-4.979***	1.800***
	(0.643)	(3.979)	(0.648)	(1.805)	(0.195)
Kenya	-1.377***	13.24***	1.516**	-13.03***	-3.501***
	(0.406)	(4.199)	(0.603)	(4.041)	(0.554)

Table 1A.10 – ITS Regression results—Multiple-design (continued)

Country	_t	_x1990	_x_t1990	_x2000	_x_t2000
Lesotho	-4.158***	4.015*	6.379***	10.60***	-3.591***
	(0.357)	(2.227)	(0.469)	(3.721)	(0.358)
Liberia	1.767**	22.25**	-8.948***	-33.73***	0.959
	(0.771)	(8.608)	(1.211)	(10.83)	(1.301)
Malawi	0.379	-11.71***	-6.805***	-19.70***	-0.876
	(0.564)	(3.235)	(0.580)	(6.442)	(0.641)
Mali	-7.267***	4.654***	3.367***	-6.968***	-1.345***
	(0.210)	(1.429)	(0.239)	(1.770)	(0.175)
Mauritania	-5.117***	1.973**	4.710***	5.018**	-1.715***
	(0.0877)	(0.853)	(0.179)	(1.870)	(0.204)
Mauritius	-1.499***	-0.790	1.442***	-4.413***	-0.152
	(0.253)	(1.307)	(0.278)	(1.005)	(0.107)
Mozambique	-2.318***	4.005	-4.790***	-16.32***	1.599**
	(0.213)	(3.269)	(0.690)	(5.265)	(0.662)
Namibia	-3.099***	-2.352	3.647***	3.174	-2.808***
	(0.122)	(1.605)	(0.271)	(2.181)	(0.304)
Niger	2.253***	-8.016**	-13.30***	-4.264	1.985***
	(0.425)	(3.244)	(0.625)	(3.801)	(0.583)
Nigeria	0.00242	4.398*	-2.245***	-12.97***	-1.561***
	(0.268)	(2.349)	(0.430)	(3.901)	(0.448)
Rwanda	-7.653***	38.61*	15.08***	-77.58***	-16.75***
	(1.199)	(21.58)	(3.149)	(22.82)	(3.009)
S_Sudan	-3.935***	0.820	-2.745***	-14.41***	0.767
	(0.104)	(1.367)	(0.308)	(4.766)	(0.582)
Safrica	-3.656***	-0.315	5.147***	16.30**	-4.587***
	(0.166)	(1.778)	(0.376)	(6.441)	(0.595)
SeirraLeone	-2.782***	4.781***	-0.150	-4.070*	-3.642***
	(0.125)	(1.689)	(0.276)	(2.002)	(0.366)
Senegal	-7.069***	2.795**	6.997***	-15.16***	-5.090***
	(0.127)	(1.089)	(0.245)	(4.185)	(0.436)
Seychelles	-1.456***	1.834**	1.183***	0.299	0.342***
	(0.159)	(0.864)	(0.168)	(0.219)	(0.0402)
SoaTomeP	1.869***	2.933	-4.010***	-10.45***	-1.166**
	(0.0514)	(2.119)	(0.415)	(3.260)	(0.430)
Somalia	-2.018***	-4.731***	1.435***	10.56**	-2.065***
	(0.0584)	(1.564)	(0.242)	(4.192)	(0.469)
Sudan	-1.436***	-0.979	-1.183***	-3.962***	0.136
	(0.0915)	(0.599)	(0.127)	(1.195)	(0.123)
Tanzania	-0.993***	-1.583	-2.036***	-16.46***	-1.610***
	(0.234)	(1.930)	(0.442)	(4.438)	(0.446)
Togo	-3.295***	3.105***	0.720***	-3.078***	-0.226**
	(0.122)	(0.975)	(0.140)	(0.895)	(0.104)
Uganda	-3.890***	1.348	0.811***	-8.835***	-3.040***
	(0.228)	(1.591)	(0.282)	(2.841)	(0.330)
Zambia	2.722***	2.015	-5.187***	-17.80***	-3.089***
	(0.179)	(1.941)	(0.350)	(5.791)	(0.629)
Zimbabwe	-4.058***	15.49***	6.239***	-2.002	-4.111***
	(0.454)	(4.237)	(0.589)	(4.707)	(0.721)

Table 1A.11 – The Millennium Development Goals (MDGs)

Goals and Targets	Indicators for Monitoring Progress
Goal 1: Eradicate extreme poverty and hunger Target 1A: Halve between 1990 and 2015, the proportion of people whose income is less than one dollar a day	1.1 Proportion of population below $1 (PPP) per day
	1.2 Poverty gap ratio
	1.3 Share of poorest quintile in national consumption
Target 1B: Achieve full and productive employment and decent work for all including women and young people	1.4 Growth rate of GDP per person employed
	1.5 Employment-to-population ratio
	1.6 Proportion of employed people living below $1 (PPP) per day
	1.7 Proportion of own-account and contributing family workers in total employment
Target 1C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	1.8 Prevalence of underweight children under-five years of age
	1.9 Proportion of population below minimum level of dietary energy consumption
Goal 2: Achieve universal primary education Target 2.A: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	2.1 Net enrolment ratio in primary education
	2.2 Proportion of pupils starting grade 1 who reach last grade of primary
	2.3 Literacy rate of 15-24-year-olds, women and men
Goal 3: Promote gender equality and empower women Target 3.A: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education on later than 2015	3.1 Ratios of girls to boys in primary, secondary and tertiary education
	3.2 Share of women in wage employment in the non-agricultural sector
	3.3 Proportion of seats held by women in national parliament
Goal 4: Reduce child mortality Target 4.A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	4.1 Under-five mortality rate
	4.2 Infant mortality rate
	4.3 Proportion of 1-year children immunized against measles
Goal 5: Improve maternal health Target 5.A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio Target 5.B: Achieve, by 2015, universal access to reproductive health	5.1 Maternal Mortality ratio
	5.2 Proportion of births attended by skilled health personnel
	5.3 Contraceptive prevalence rate
	5.4 Adolescent birth rate
	5.5 Antenatal care coverage (at least one visit and at least four visits)
	5.6 Unmet need for family planning

Source: Adapted from the Millennium Declaration (http://www.un.org/millennium/declaration/ares552e.htm)

Table 1A.11 – The Millennium Development Goals (MDGs)…Continued (2)

Goal 6: Combat HIV/AIDS, malaria and other diseases Target 6A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS	6.1 HIV prevalence among population aged 15-24 years
	6.3 Condom use at last high-risk sex
	6.3 Proportion of population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS
	6.4 Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14 years
Target 6B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it	6.5 Proportion of population with advanced HIV infection with access to antiretroviral drugs
Target 6C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	6.6 Incidence and death rates associated with malaria
	6.7 Proportion of children under-five sleeping under insecticide—treated bednets
	6.8 Proportion of children under-five with fever who are treated with appropriate antimalarial drugs
	6.9 Incidence, prevalence, and death rates associated with tuberculosis
	6.10 Proportion of tuberculosis cases detected and cured under directly observed treatment short course
Goal 7: Ensure environmental sustainability Target 7A: Integrate the principle of sustainable development into country policies and programmes and reverse the loss of environmental resources	7.1 Proportion of land area covered by forest
	7.2 CO2 emissions, total, per capita, and per $1 GDP (PPP)
	7.3 Consumption of ozone-depleting substances
	7.4 Proportion of fish stocks within safe biological limits
	7.5 Proportion of total water resources used
Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	7.6 Proportion of terrestrial and marine areas protected
	7.7 Proportion of species threatened with extinction
Target 7C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	7.8 Proportion of population using an improved drinking water source
	7.9 Proportion of population using an improved sanitation facility
Target 7D: By 2020, to have achieved a significant improvement in the lives of at least 100n million slum dwellers	7.10 Proportion of urban population living in slum
Goal 8: Develop a global partnership for development Target 8A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system includes a commitment to good governance, development and poverty reduction -both nationally and internationally	8.1 Net Official Development Assistance (ODA), total and to the least developed countries, as percentage of OECD/DAC donors' gross national income
	8.2 Proportion of total bilateral, sector-allocable ODA of OECD/DAC donor to basic social services (basic education, primary health care, nutrition, safe water and sanitation)

Table 1A.11 - The Millennium Development Goals (MDGs)……End.

Goals and Targets	Indicators for monitoring progress
Target 8.B: Address the special needs of the least developed countries Includes: tariff and quota free access for the least developed countries' exports; enhanced programme of debt relief for heavily indebted poor countries (HIPC) and cancellation of official bilateral debt; and more generous ODA for countries committed to poverty reduction	8.3 Proportion of bilateral official development assistance of OECD/DAC donors that is untied
	8.4 ODA received in landlocked developing countries as a proportion of their gross national incomes
	8.5 ODA received in small island developing states as a proportion of their gross national incomes
Target 8.C: Address the special needs of landlocked developing countries and small island developing States (through the Programme of Action for the Sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly) Target 8.D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term	8.6 Proportion of total developed country imports (by value and excluding arms) from developing countries and least developed countries, admitted free of duty
	8.7 Average tariffs imposed by developed countries on agricultural products and textiles and clothing from developing countries
	8.8 Agricultural support estimate for OECD countries as a percentage of their gross domestic product
	8.9 Proportion of ODA provided to help reached their HIPC decision points
	8.10 Total number of countries that have reached their HIPC decision points and number that have reached their HIPC completion points (cumulative)
	8.11 Debt relief committed under HIPC and MDRI initiatives
	8.12 Debt service as a percentage of exports of goods and services
Target 8E: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries	8.13 Proportion of population with access to affordable essential drugs on a sustainable basis
Target 8F: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	8.14 Telephone lines per 100 population
	8.15 Cellular subscribers per 100 population
	8.16 Internet users per 100 population

Source: Adapted from the Millennium Declaration (http://www.un.org/millennium/declaration/ares552e.htm)

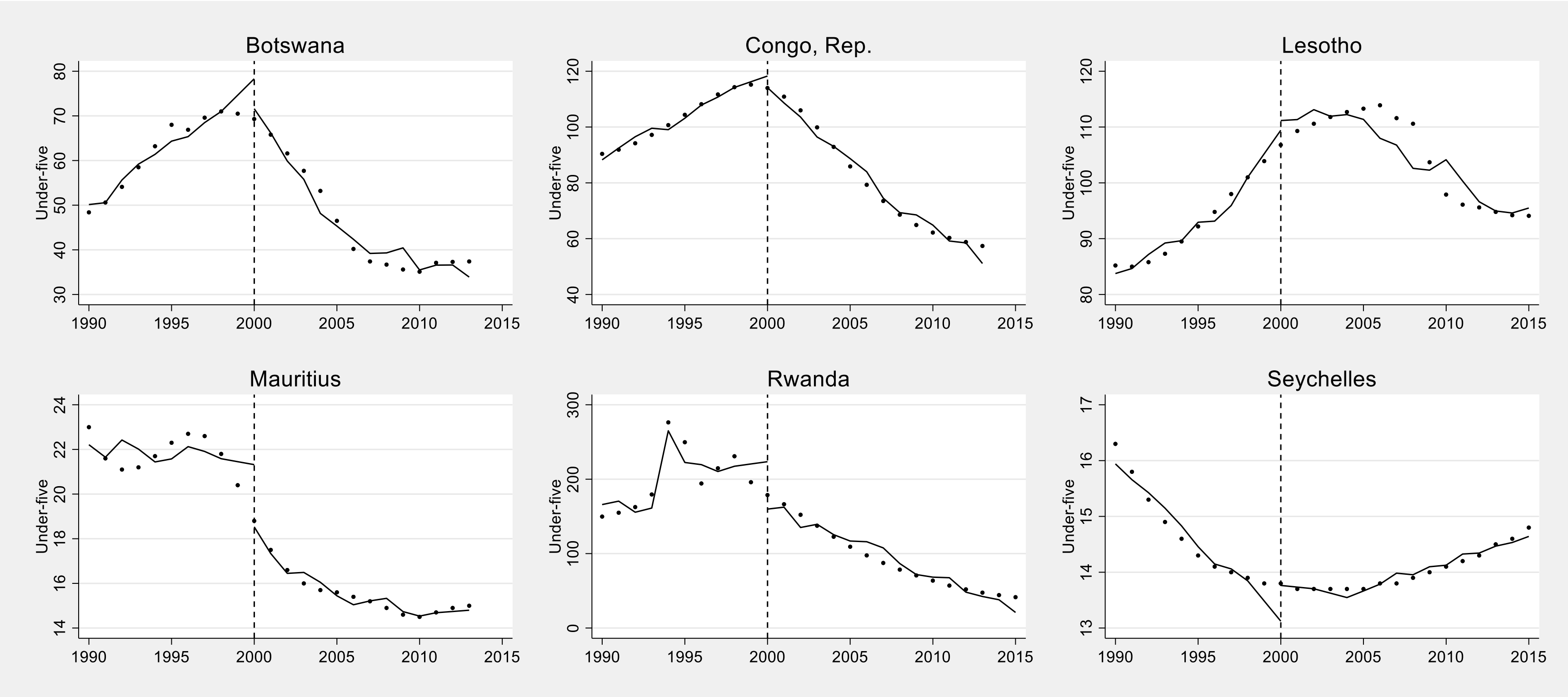

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

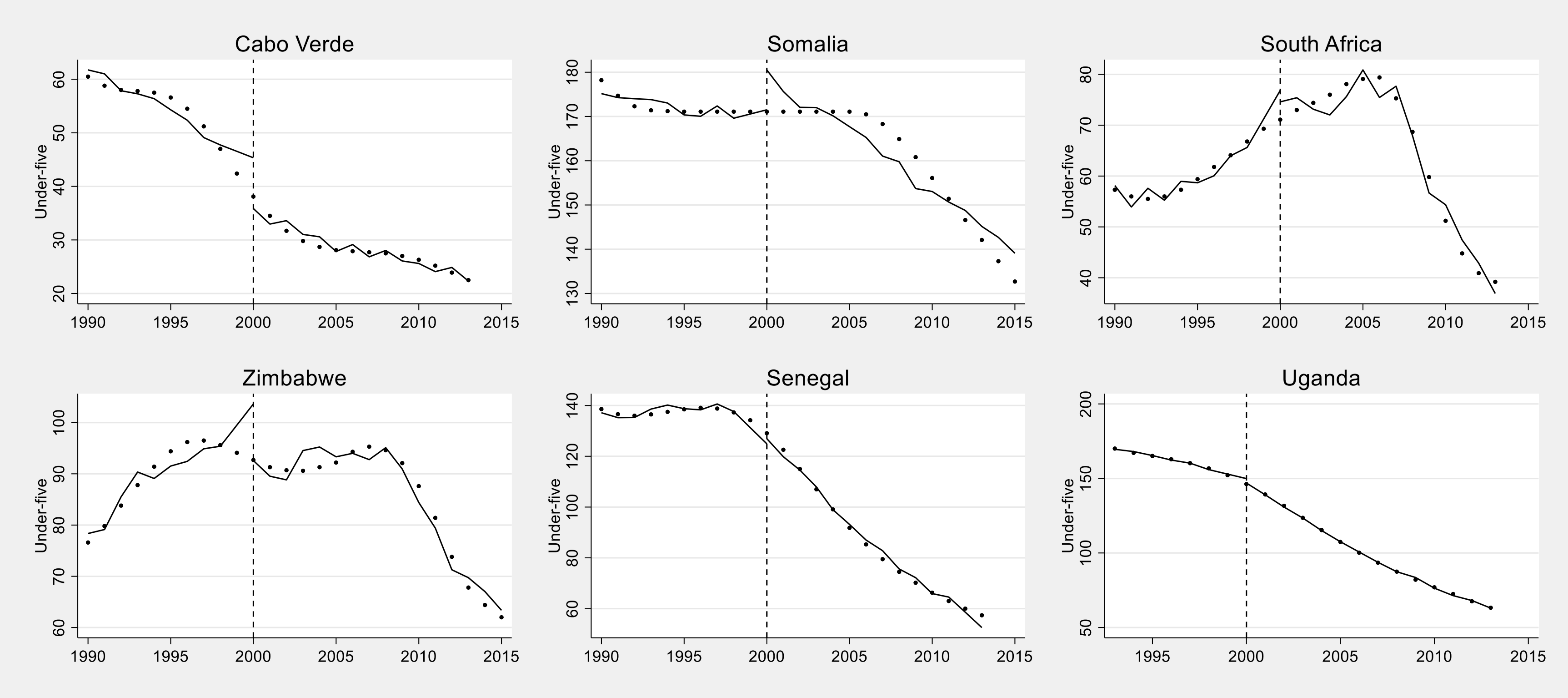

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

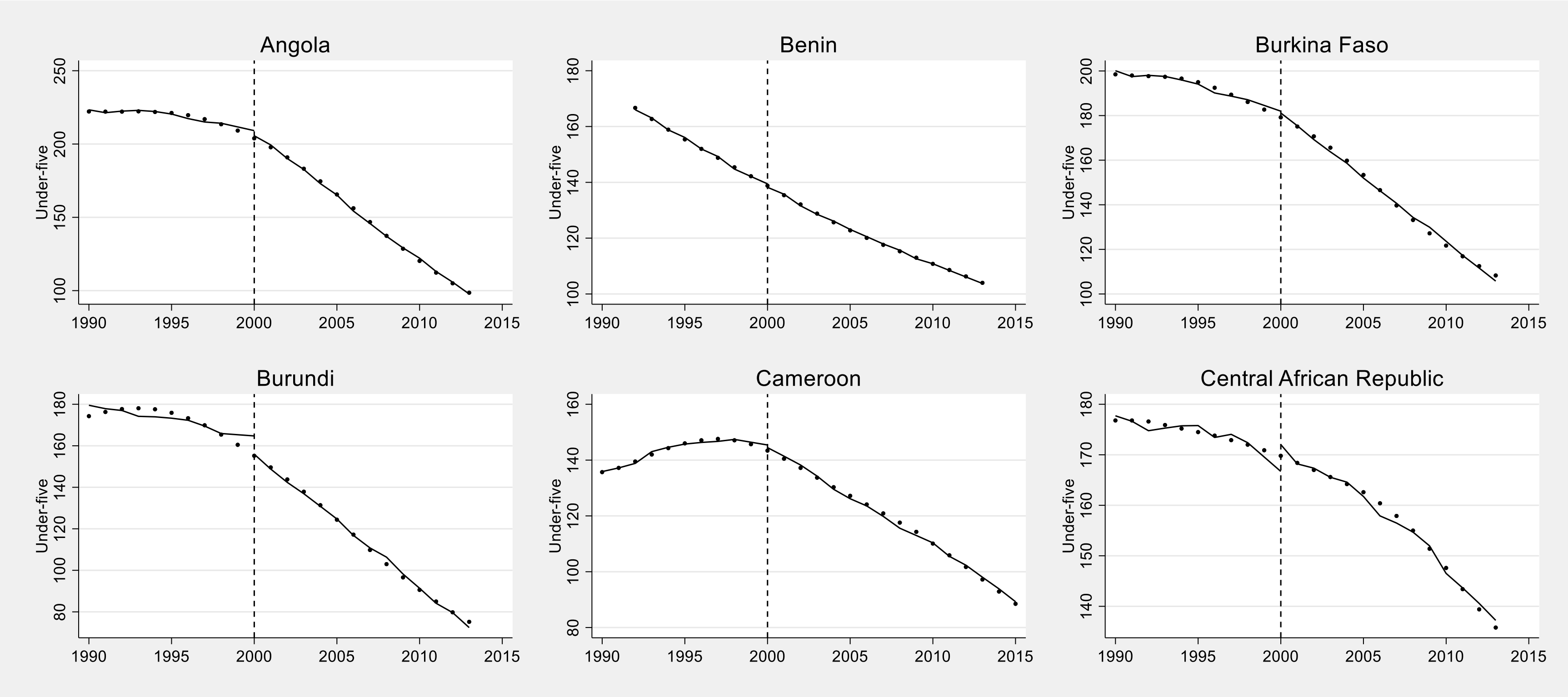

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

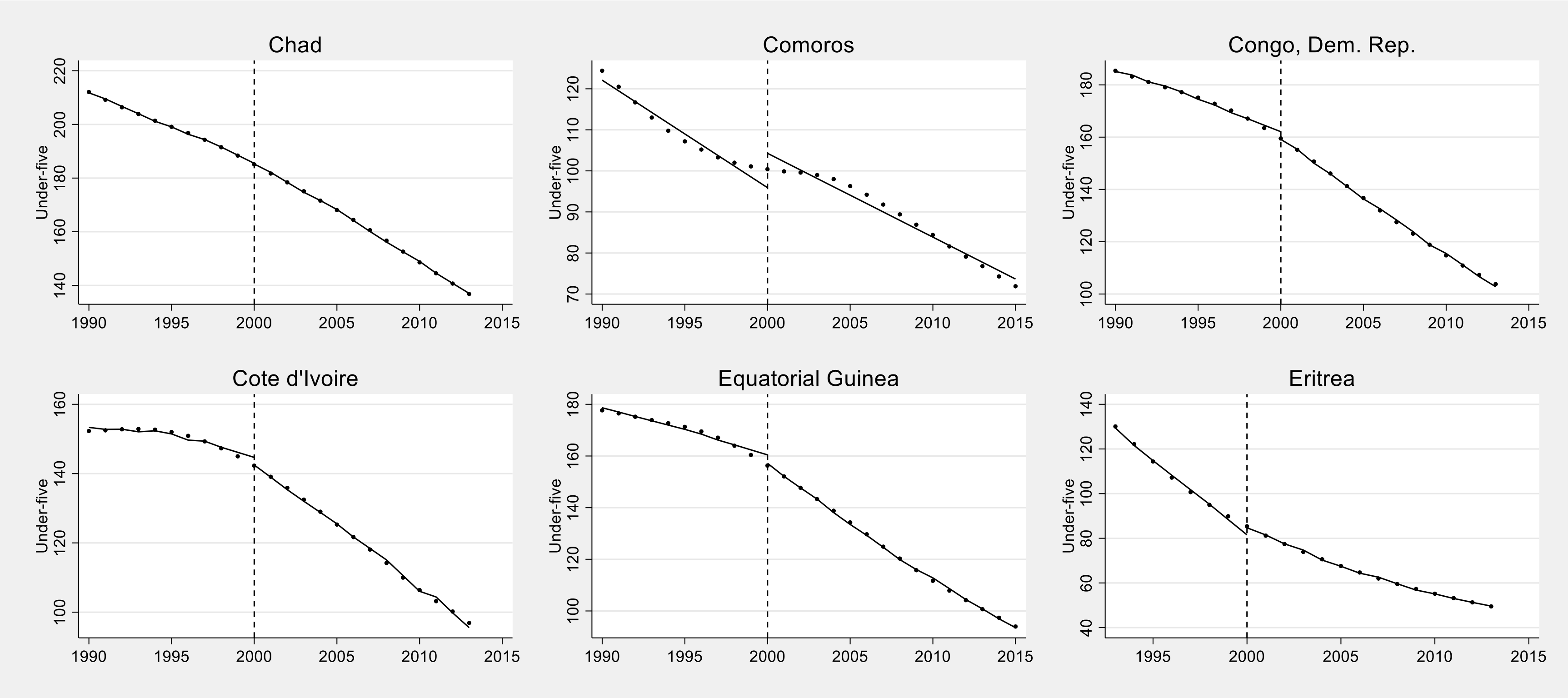

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

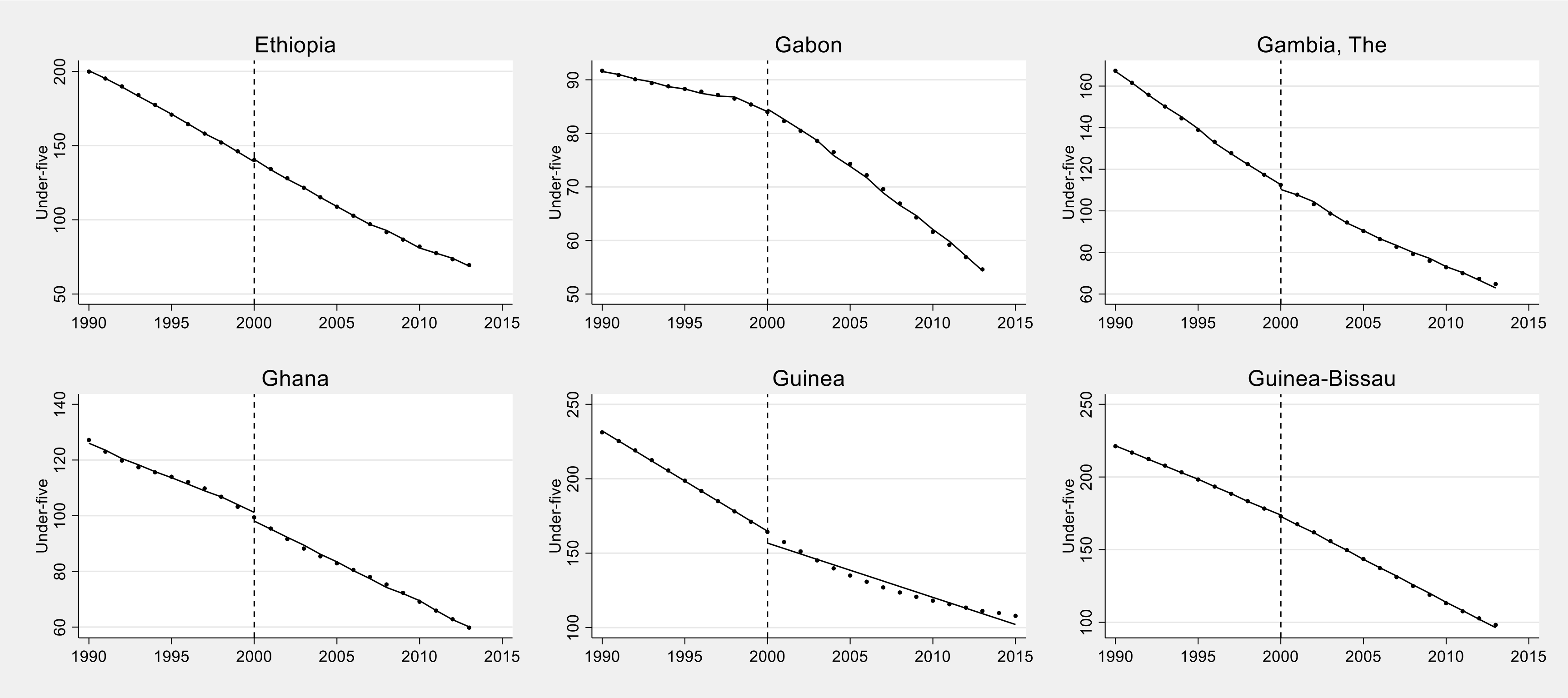

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

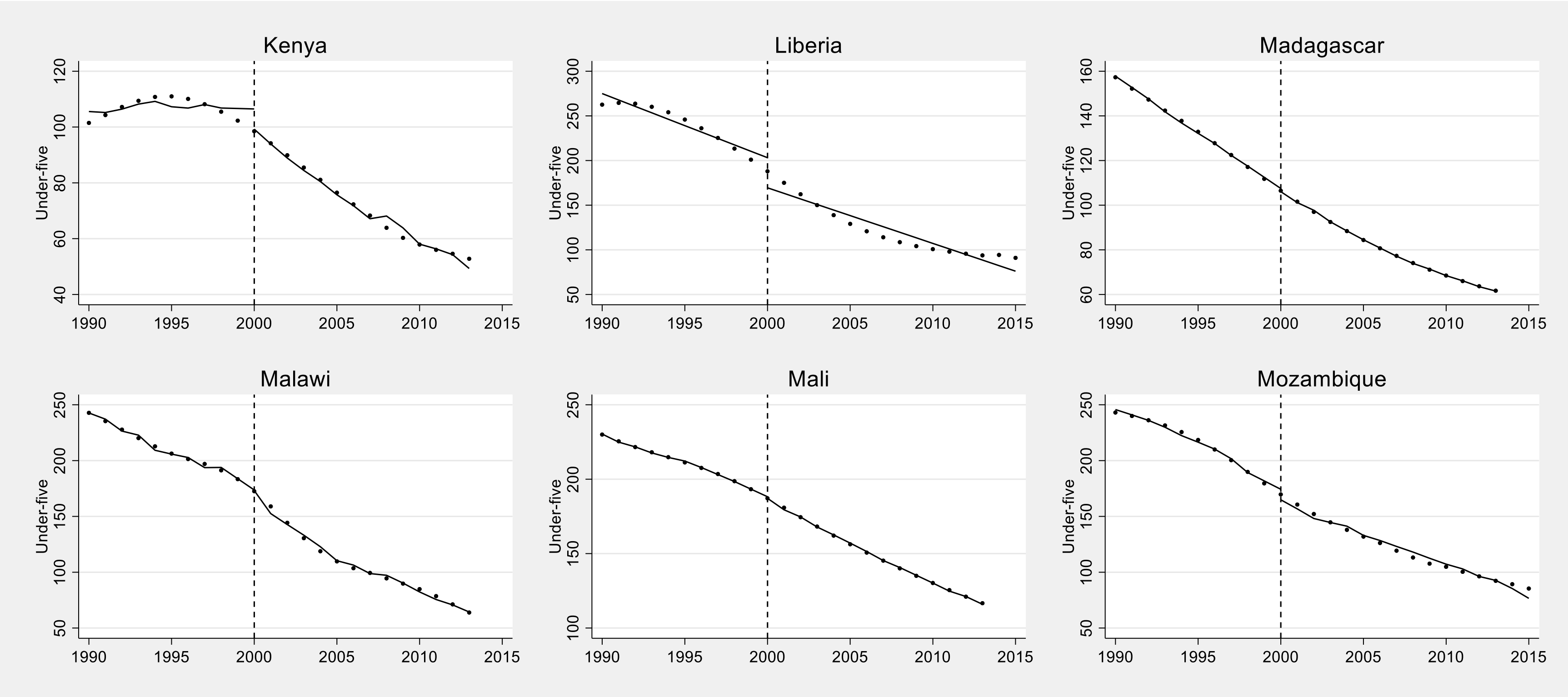

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

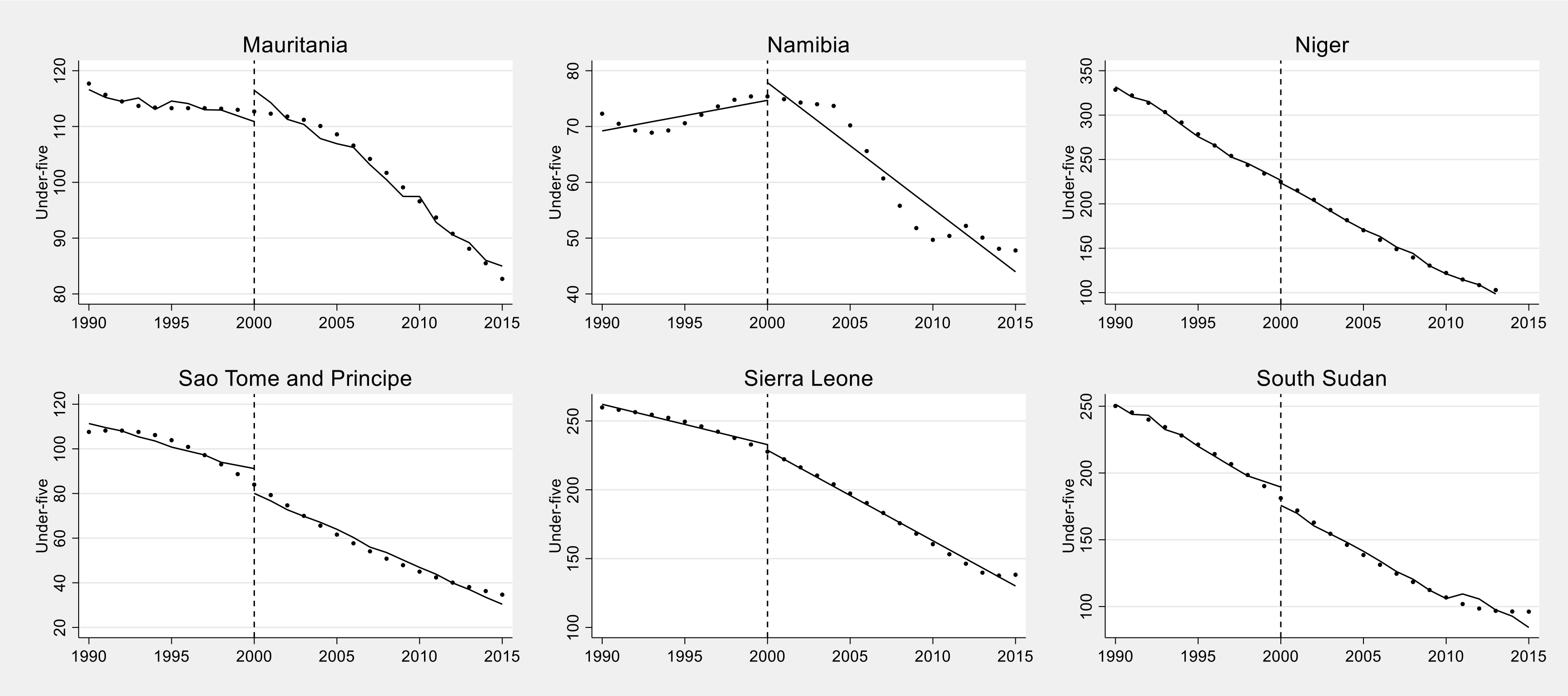

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

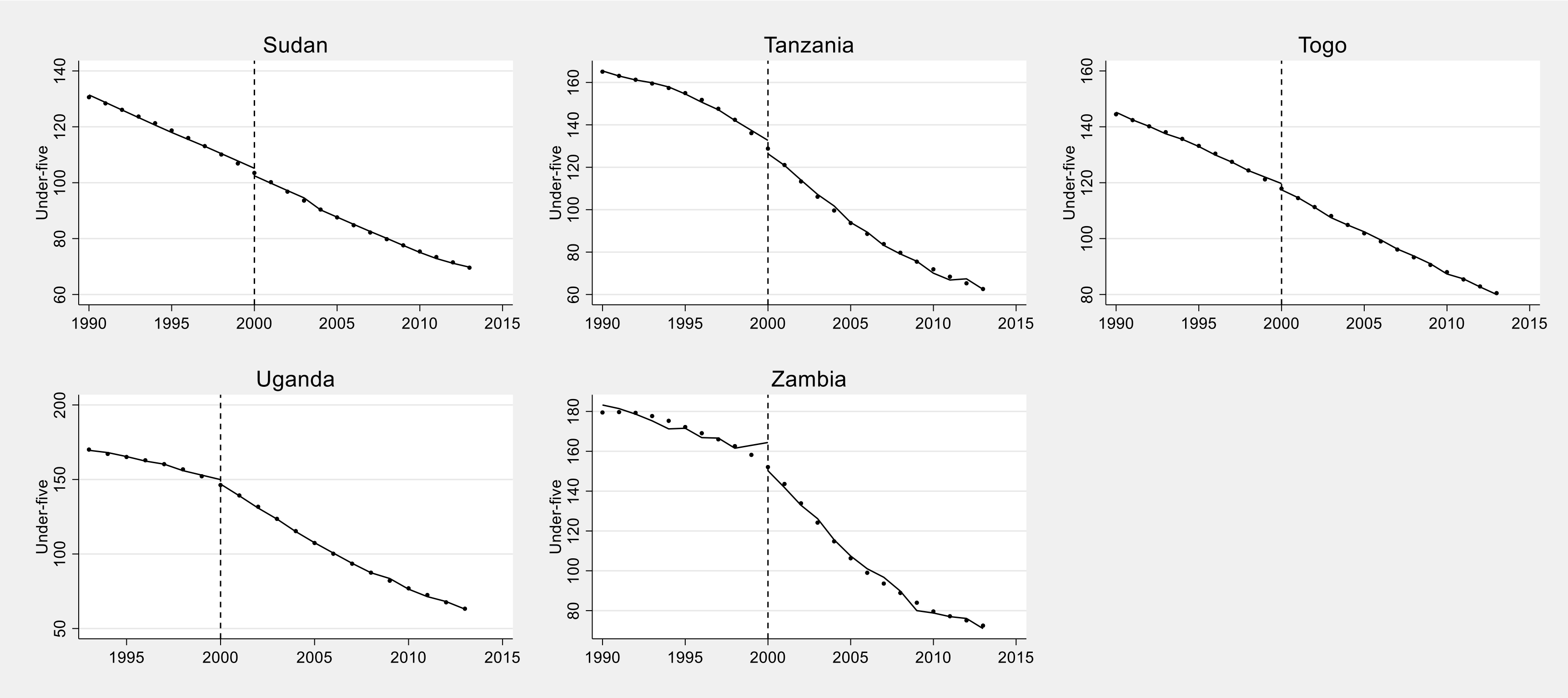

Figure 1A.1 - Single-group ITSA for SSA countries using year 2000 as intervention start year.

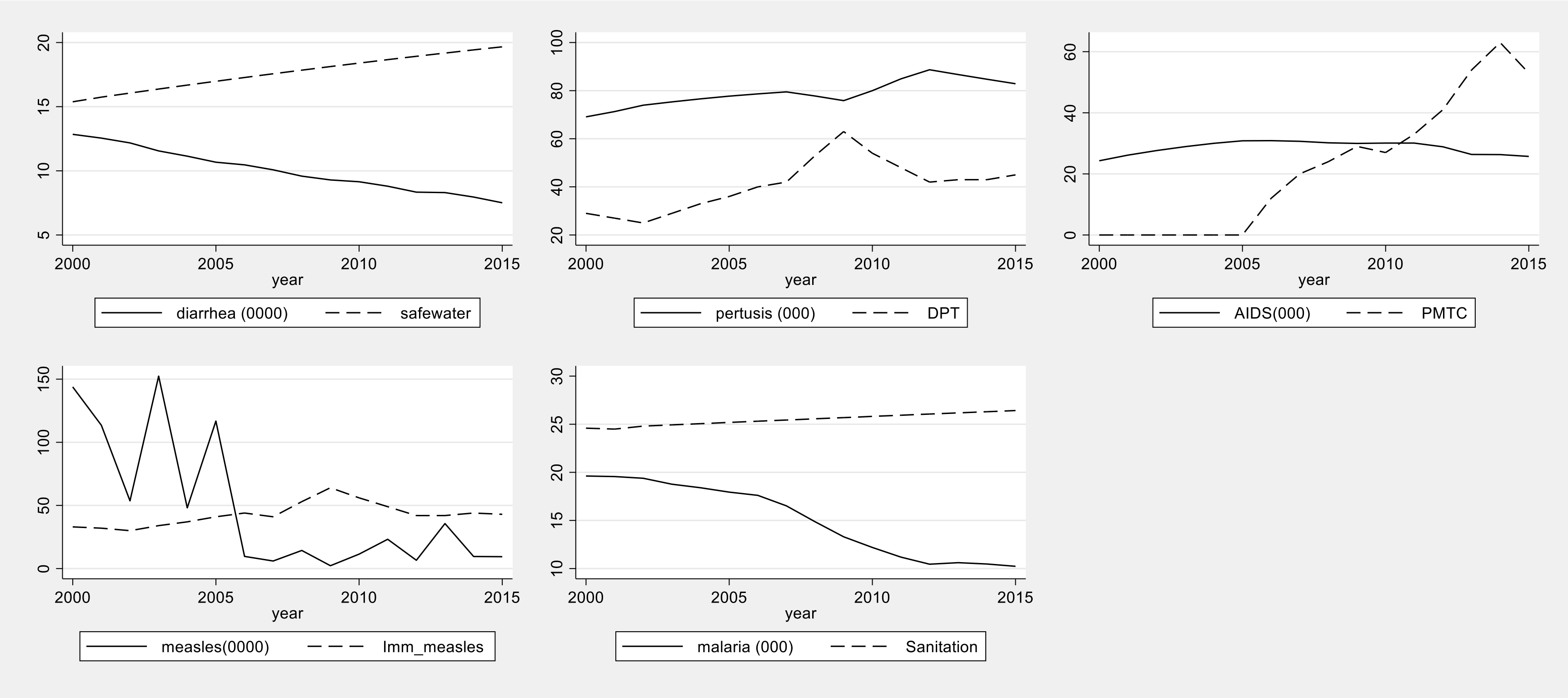

Figure 1A.2 - Trends in public health programme coverages and number of related under-five deaths

Appendix 2

Appendix 2A

Table 2A.1 - Structural break in the effect of economic growth on child mortality

	(1)	(2)	(3)	(4)
	Two-System AB estimation		LSDV	
VARIABLES	PreMDGs	PostMDGs	PreMDGs	PreMDGs
L1_lnU5MR	1.091***	0.945***	0.987***	0.985***
	(0.135)	(0.0724)	(0.0475)	(0.0176)
lnGDPpc	-0.292**	-0.124	-0.114**	0.0182
	(0.118)	(0.554)	(0.0492)	(0.0440)
L1_lnGDPpc	-0.0526	0.0161	-0.00776	0.00756
	(0.942)	(0.513)	(0.0577)	(0.0428)
Literacy	-0.0290	-0.00240	-0.00313**	-0.000365
	(0.0377)	(0.00329)	(0.00144)	(0.000674)
L1_Literacy	0.00703	-0.000265	-0.000150	0.00127*
	(0.00803)	(0.00306)	(0.00122)	(0.000746)
Sanitation	-0.0278	-0.00129	-0.00479**	-0.000236
	(0.0409)	(0.00238)	(0.00213)	(0.000768)
Safe water	0.00439	0.00256	-0.00536**	-0.00179**
	(0.00746)	(0.00523)	(0.00229)	(0.000748)
Immunization	-0.00106	-0.000527	-0.000296	-0.000109
	(0.00333)	(0.00110)	(0.000263)	(0.000264)
Rainfall	-0.0652	-0.00280	-0.00322	0.00120
	(0.0842)	(0.0108)	(0.00350)	(0.00305)
Ethnic	0.792	0.327	0.703	0.0224
	(1.433)	(0.354)	(1.082)	(0.336)
Conflict	0.00410	0.0245	0.00715	0.119*
	(0.223)	(0.0264)	(0.00663)	(0.0666)
Temperature	-0.0162	0.00722	0.00598	0.00682*
	(0.0459)	(0.0155)	(0.00453)	(0.00359)
Pol regime	-0.0419	-0.00722	-0.000158	-0.00129
	(0.0565)	(0.0112)	(0.00157)	(0.00131)
Constant	0.305	0.637	4.513	6.060
	(0.518)	(0.906)	(6.155)	(4.888)
Observations	81	200	81	200
R-squared			0.705	0.892
Number of country2	25	30		
AR(1)	0.346	0.667		
AR(2)	0.587	0.363		
Spec test (p-value)				
Hansen J-test	0.201	0.316		
Number of Instruments	58	84		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Results in all columns use the GMM of Arellano and Bond (1991), with robust standard errors. The dependent variable is under-five mortality. Year dummies are included in all regression. The AR(1 &2) tests and the Hansen J test indicate that there is no serial correlation, and the overidentifying restrictions are not rejected.

Table 2A.2 - Structural break in the effect of economic growth: Resource-rich versus resource-poor countries

	(1)	(2)	(3)	(4)	(5)	(6)
		Resource-Rich			Resource-Poor	
VARIABLES	Full	PreMDGs	PostMDGs	Full	PreMDGs	PostMDGs
L1_lnU5MR	0.977***	0.916***	1.052***	0.891***	0.756***	0.928***
	(0.0336)	(0.0730)	(0.0477)	(0.0298)	(0.0656)	(0.0395)
lnGDPpc	-0.00209	-0.0173	-0.119	-0.0488**	-0.122*	-0.0994
	(0.0577)	(0.0353)	(0.0887)	(0.0020)	(0.0621)	(0.0811)
L1_lnGDPpc	0.0572	0.0543	0.0116	0.0928	-0.0417	-0.0521
	(0.0526)	(0.0779)	(0.0673)	(0.0670)	(0.0750)	(0.0800)
Literacy	-0.00105	-0.00452	-0.00378	-0.00200*	-0.00157	-0.000511
	(0.00110)	(0.00983)	(0.0131)	(0.00111)	(0.00173)	(0.000887)
L1_Literacy	-0.000777	-0.00116	-0.00163	0.00304***	0.00788***	0.00177*
	(0.00134)	(0.000891)	(0.00184)	(0.00105)	(0.00187)	(0.00105)
Sanitation	-0.00813***	-0.000636	-0.00995***	-0.00187*	-0.00847**	-0.000133
	(0.00145)	(0.00452)	(0.00280)	(0.00104)	(0.00331)	(0.00213)
Safe water	-0.00905***	-1.48e-05	0.0122***	-0.00186*	-0.00829***	-0.000327
	(0.00154)	(0.00279)	(0.00308)	(0.000985)	(0.00182)	(0.00106)
Immunization	-6.93e-05	0.000106	-7.19e-05	-0.00618**	0.000456	-0.000724
	(0.000305)	(0.000300)	(0.000389)	(0.00300)	(0.000301)	(0.000577)
Rainfall	-0.00254	-0.00116	-0.00124	-0.00928**	0.00127	0.00457
	(0.00447)	(0.00293)	(0.00556)	(0.00405)	(0.00465)	(0.00359)
Ethnic	0.917	3.357**	4.844**	4.640***	8.303***	1.220
	(0.845)	(1.470)	(1.821)	(1.007)	(2.157)	(1.461)
Conflict	0.00614	0.00221	0.00110	0.0120*	0.00396	0.00466
	(0.00551)	(0.00697)	(0.00608)	(0.00665)	(0.00986)	(0.00581)
Temperature	0.00524	-0.00581	0.00666	0.00519	0.000542	0.00424
	(0.00587)	(0.00408)	(0.00721)	(0.00486)	(0.00588)	(0.00399)
Pol regime	-0.00193	-0.00115	1.51e-05	0.0950***	-0.0145**	-0.00207
	(0.00172)	(0.00156)	(0.00201)	(0.00213)	(0.00211)	(0.00287)
Year	-0.00503**	-0.00566	0.00215	-0.00428*	-0.0146***	-0.00506*
	(0.00229)	(0.00442)	(0.00358)	(0.00252)	(0.00427)	(0.00282)
Constant	10.31**	8.563	-0.0595	10.61**	34.90***	10.38*
	(4.322)	(7.862)	(6.861)	(5.224)	(9.050)	(5.961)
Observations	107	46	70	132	50	92
R-squared	0.999	1.000	0.999	1.000	1.000	1.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2A.3 - Economic growth, under-five, and infant mortality

	(1)	(2)	(3)	(4)
	AB-GMM		LSDV	
VARIABLES	lnU5MR	lnIMRT	PreMDGs	PreMDGs
L1_lnIMRT		0.826**	1.016***	0.947***
		(0.360)	(0.0555)	(0.0175)
lnGDPpc	-0.0974*	-0.0655**	-0.0557	-0.0309
	(0.081)	(0.0269)	(0.404)	(0.0337)
L1_lnGDPpc	-0.262	-0.158	-0.0333	-0.0173
	(0.669)	(1.690)	(0.0554)	(0.0324)
Literacy	-0.0058**	-0.00539	-0.00217	-0.000166
	(0.0020)	(0.00992)	(0.00139)	(0.000515)
L1_Literacy	0.0104	0.00610	0.000338	0.000335
	(0.0137)		(0.00117)	(0.000568)
Sanitation	-0.0209***	-0.00824***	-0.00377*	-0.000234
	(0.00651)	(0.00125)	(0.00201)	(0.000590)
Safe water	-0.00646	-0.000773	-0.00603***	0\-.000707
	(0.0140)	(0.0151)	(0.00216)	(0.000577)
Immunization	-0.000571	-0.000229	-0.000348	-0.000292
	(0.00316)	(0.00532)	(0.000252)	(0.000201)
Rainfall	0.00563	0.0118	0.00168	0.000612
	(0.00779)	(0.0427)	(0.00332)	(0.00232)
Ethnic	0.447	0.198	1.551	0.225
	(0.601)	(0.244)	(1.040)	(0.261)
Conflict	0.0734*	0.0657	0.00415	0.00173
	(0.0384)	(0.200)	(0.00634)	(0.00307)
Temperature	0.0275	0.0182	0.00445	0.00407
	(0.0411)	(0.0141)	(0.00434)	(0.00274)
Pol Regime	-0.0317*	-0.0200**	-0.000333	-0.000920
	(0.0264)	(0.0047)	(0.00150)	(0.000999)
Year			0.00123	-0.00177
			(0.00302)	(0.00186)
L1_lnU5MR	0.922*			
	(0.497)			
GDP_Squared	0.0326	0.0219		
	(0.117)	(0.0594)		
Constant	1.513	1.487	-0.713	3.751
	(9.464)	(4.226)	(6.058)	(3.705)
Observations	262	262	81	200
R-squared			1.000	1.000
Number of country2	30	30		
AR(1)	0.513	0.435		
AR(2)	0.896	0.933		
Spec test (p-value)				
Hansen J-test	0.207	0.4771		
Number of Instruments	87	87		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Results in all columns use the GMM of Arellano and Bond (1991), with robust standard errors. The dependent variable is under-five mortality. Year dummies are included in all regression. The AR(1 &2) tests and the Hansen J test indicate that there is no serial correlation, and the overidentifying restrictions are not rejected.

Appendix 3

Table 3A.1 - Partitioned Ethnicity for Nigeria and Neighbours

No	Ethnicity Name	% of Homeland	Country name	No. of Partitions
1	Bargu	0.77	Benin	4
	Bargu	0.03	Niger	4
	Bargu	0.19	Nigeria	4
	Bargu	0.02	B/F	4
2	Bata	0.29	Cameroon	2
	Bata	0.71	Nigeria	2
3	Boki	0.22	Cameroon	2
	Boki	0.78	Nigeria	2
4	Busa	0.14	Benin	2
	Busa	0.86	Nigeria	2
5	Egba	0.41	Benin	3
	Egba	0.52	Nigeria	3
	Egba	0.07	Togo	3
6	Ekoi	0.38	Cameroon	2
	Ekoi	0.62	Nigeria	2
7	Fungon	0.81	Cameroon	2
	Fungon	0.19	Nigeria	2
8	Gude	0.83	Cameroon	2
	Gude	0.17	Nigeria	2
9	Gun	0.48	Benin	2
	Gun	0.52	Nigeria	2
10	Hausa	0.14	Niger	2
	Hausa	0.86	Nigeria	2
11	Ibibio	0.11	Cameroon	2
	Ibibio	0.89	Nigeria	2
12	Kanembu	0.73	Chad	3
	Kanembu	0.25	Niger	3
	Kanembu	0.02	Nigeria	3
13	Kapsiki	0.65	Cameroon	2
	Kapsiki	0.35	Nigeria	2
14	Mambila	0.57	Cameroon	2
	Mambila	0.43	Nigeria	2
15	Mandara	0.35	Cameroon	2
	Mandara	0.65	Nigeria	2
16	Manga	0.6	Cameroon	2
	Manga	0.4	Nigeria	2
17	Matakam	0.7	Cameroon	2
	Matakam	0.3	Nigeria	2
18	Nsunli	0.78	Cameroon	2
	Nsunli	0.22	Nigeria	2

Table 3A.1 - Partitioned Ethnicities for Nigeria and Neighbours (continued)

No	Ethnicity Name	% of Homeland	Country name	No. of Partitions
19	Shuwa	0.62	Chad	3
	Shuwa	0.17	Cameroon	3
	Shuwa	0.21	Nigeria	3
20	Tienga	0.22	Niger	3
	Tienga	0.78	Nigeria	3
21	Tigon	0.32	Cameroon	2
	Tigon	0.68	Nigeria	2
22	Wakura	0.28	Cameroon	2
	Wakura	0.72	Nigeria	2
23	Wum	0.88	Cameroon	2
	Wum	0.12	Nigeria	2

Table 3A.2 - The effect of extreme weather events and conflict on source country public health spending spill over.

VARIABLES	(1) Flood	(2) drought	(3) epidemic	(4) conflict
n_GHEpc	-0.492**	-0.492*	-0.703**	-0.493*
	(0.229)	(0.233)	(0.287)	(0.239)
GHEpc	0.356*	0.350	0.335	0.195
	(0.200)	(0.204)	(0.222)	(0.158)
GHEpc_flood	-0.0718			
	(0.127)			
GHEpc_drought		-0.133		
		(0.0913)		
GHEpc_epidemic			0.273**	
			(0.104)	
GHEpc_conflict				-0.158
				(0.251)
Constant	534.3***	525.8***	570.9***	518.7***
	(158.2)	(159.3)	(154.8)	(172.8)
Observations	172	172	172	200
R-squared	0.535	0.537	0.554	0.576
Number of country1	17	17	17	17
Control	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3A.3 - Spill-over effect of public health spending on infant and under-five mortality using the GMM estimator.

	FE		GMM	
VARIABLES	Imrt	Ghe/ge	u5mr	imrt
n_GHEpc	-0.247*		-0.0157	-0.000318
	(0.120)		(0.0250)	(0.0186)
GHEpc	0.0805		-0.326	-0.0716
	(0.0616)		(0.302)	(0.0746)
LnGDP	-17.17*	-35.61	-0.852	-0.112
	(9.141)	(24.41)	(0.748)	(0.403)
Literacy	-0.702***	-1.387***	-0.192	-0.0306
	(0.0961)	(0.239)	(0.440)	(0.227)
L1_u5mr			1.003***	
			(0.0439)	
L1_GHEpc			0.285	0.0664
			(0.263)	(0.0697)
L1_lnGDPpc			-0.808	-0.401
			(0.667)	(0.367)
L1_Literacy			0.363	0.0348
			(0.559)	(0.234)
Year			-0.00336	0.000226
			(0.00355)	(0.00102)
n_GHE/GE		-0.592		
		(0.949)		
GHE/GE		-0.393		
		(0.470)		
L1_imrt				0.970***
				(0.0199)
Constant	225.7***	428.7**	0	0
	(68.94)	(193.2)	(0)	(0)
Observations	200	200	163	163
R-squared	0.634	0.562		
Number of country1	17	17	16	16
Control	YES	YES		
Country FE	YES	YES		
AR(1)			0.124	0.297
AR(2)			0.356	0.634
Hansen			1	1
Sargan			6.22e-09	6.69e-07
Number of Instruments			26	26

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 Notes: (i) Results in all columns use the GMM of Arellano and Bond (1991), with robust standard errors. The dependent variable is under-five mortality. Year dummies are included in all regression. The AR(1 &2) tests and the Hansen J test indicate that there is no serial correlation, and the overidentifying restrictions are not rejected (ii) GHE/GE is Government health expenditure as a percentage of total government expenditure.

Table 3A.4 - Estimate of Euclidean distances: Health facilities in Nigeria and cross-border settlements (sample results).

InputID	TargetID	Distance (M)	Distance (Km)
Alaari Health Centre	Aro	663.6298	0.66363
Alaari Health Centre	Alari	663.676	0.663676
Alaari Health Centre	Abule Alari	663.676	0.663676
Ajegunle Health Centre	Agosa	1105.875	1.105875
Chikanda Basic Health Centre	Chikanda	1166.127	1.166127
Ilase Health Centre	Ilashe	1274.674	1.274674
Ilase Health Centre	Ilase	1274.674	1.274674
Ilase Health Centre	Iiashe	1274.674	1.274674
Bode Ase Health Centre	Idosa	1506.261	1.506261
Bode Ase Health Centre	Dosa	1506.261	1.506261
Idiroko Health Centre	Aitedjou	1527.31	1.52731
Idiroko Health Centre	Ayetedjoun	1527.31	1.52731
Igbokofi Comprehensive Health Centre	Osubi	1588.566	1.588566
Igbokofi Comprehensive Health Centre	Aitedjou	1869.171	1.869171
Idiroko General Hospital	Ayetedjoun	1869.171	1.869171
Agosasa Health Centre	IgidiRiver	2066.731	2.066731
Agosasa Health Centre	AfaRiver	2066.731	2.066731
Agosasa Health Centre	Iguidi	2066.731	2.066731
Bode Ase Health Centre	Bloblo	2168.439	2.168439
Bode Ase Health Centre	Gblogblo	2168.439	2.168439
Ijofin Health Centre	Ijofin	2339.177	2.339177
Teu Health Clinic	Bibikparo	2471.67	2.47167
Igbokofi Comprehensive Health Centre	Digbo	2547.117	2.547117
Ipatefin Health Centre	Akadja	2729.423	2.729423
Idiroko Health Centre	Dangban	2783.267	2.783267
Farasime Model Health Centre	Adjaran	3110.102	3.110102
Farasime Model Health Centre	Ajarra	3110.102	3.110102
Farasime Model Health Centre	Ajara	3110.102	3.110102
Farasime Model Health Centre	Adjira	3110.102	3.110102
Farasime Model Health Centre	AjarraRiver	3110.102	3.110102
Ajegunle Health Centre	Ilashe	3249.05	3.24905
Ajegunle Health Centre	Ilase	3249.05	3.24905
Ajegunle Health Centre	Iiashe	3249.05	3.24905
Igbokofi Comprehensive Health Centre	Orisada	3378.148	3.378148
Igbokofi Comprehensive Health Centre	Orishada	3378.148	3.378148
Ipatefin Health Centre	IgidiRiver	3472.226	3.472226
Ipatefin Health Centre	AfaRiver	3472.226	3.472226
Ipatefin Health Centre	Iguidi	3472.226	3.472226
Atan Ota Health Centre	Aro	3906.617	3.906617

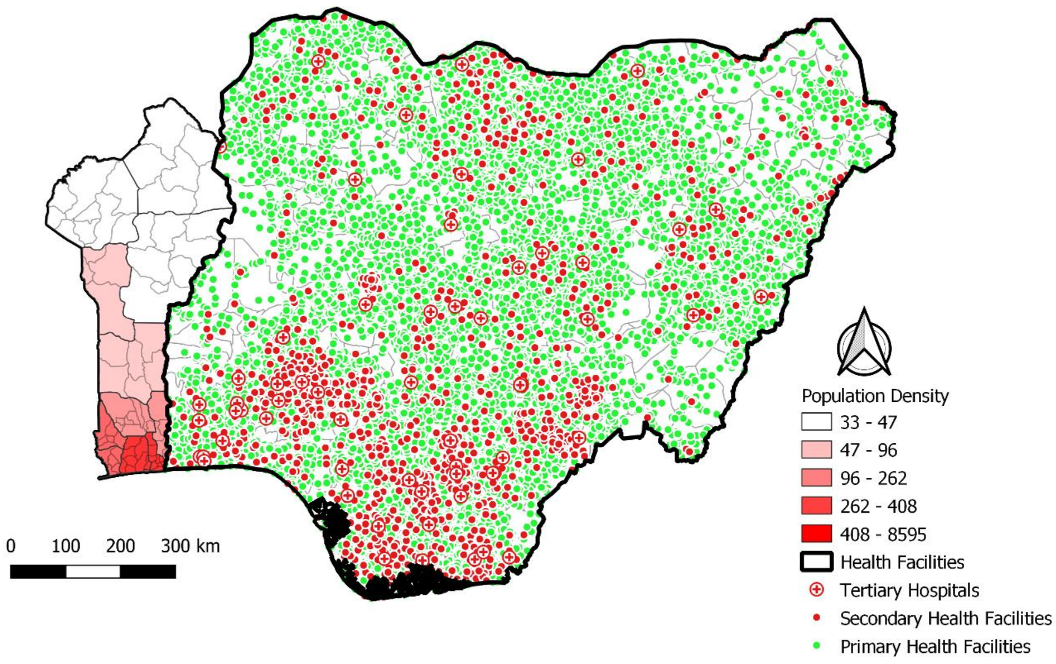

Figure 3A.1 - Distribution of geo-coded public health facilities in Nigeria and population density in Benin**.**

Note: Health facilities and population densities are mapped on the Map Library for Africa Administrative district level boundaries.

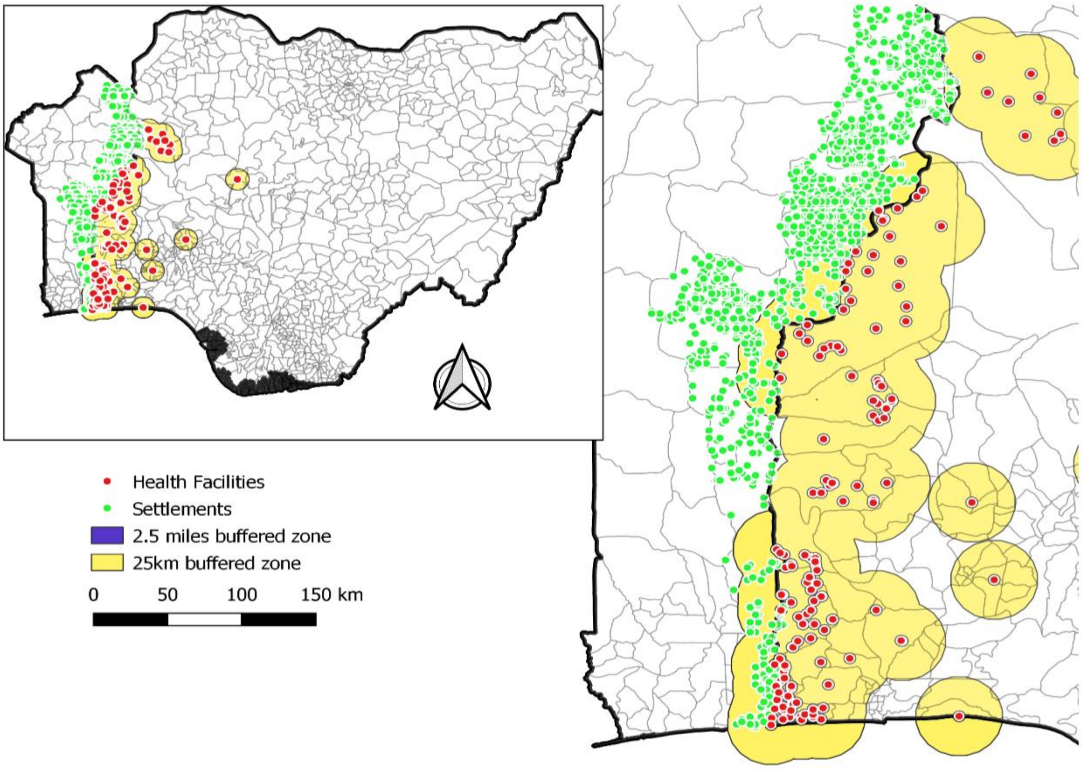

Figure 3A.2 - Distribution of health facilities and settlements along the Benin Republic and Nigeria international borderland (Administrative district level boundaries).

Note: Twenty-five kilometre and 2.5 miles buffered zones are centred on health facilities in Nigeria (Nigeria-Benin map inset).

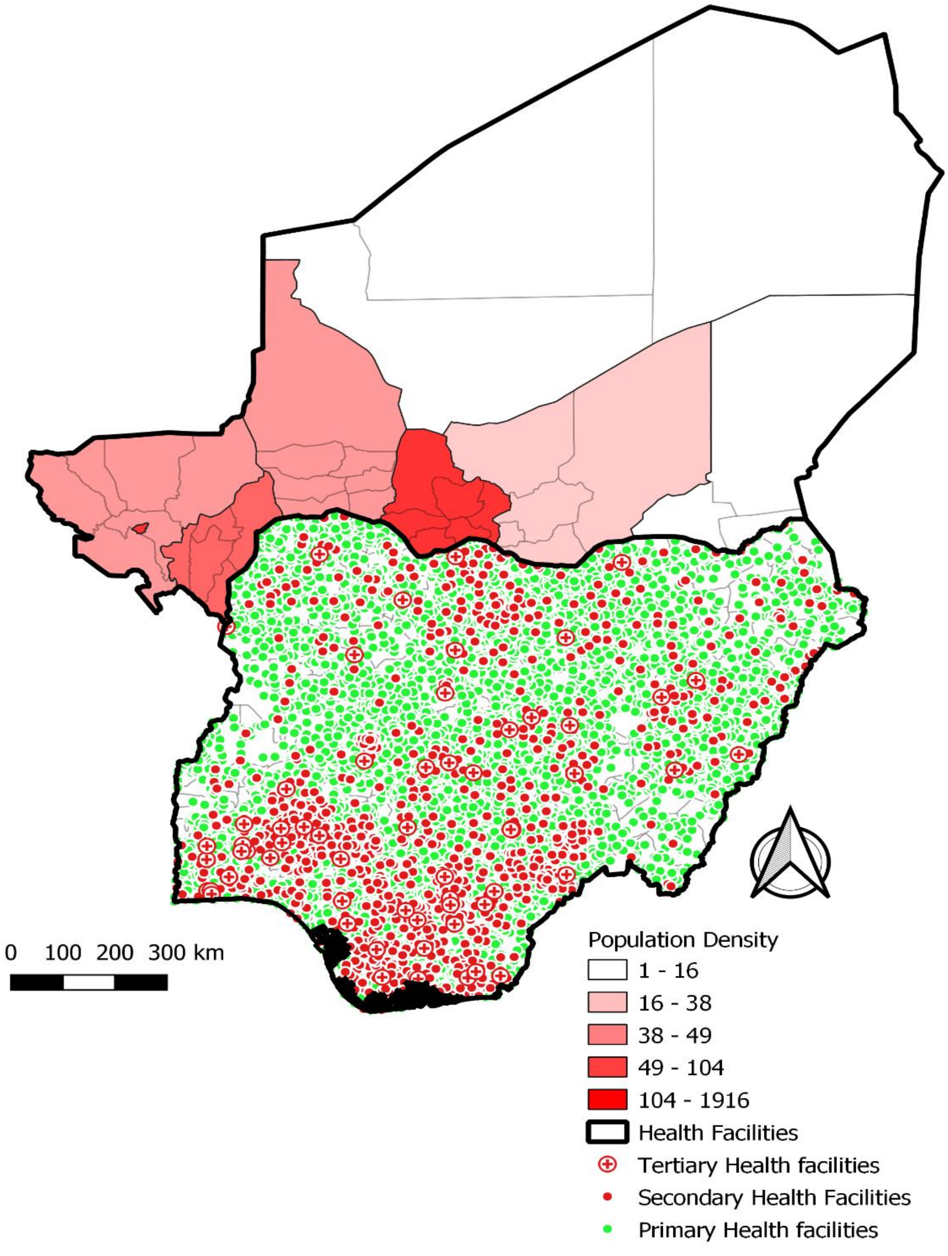

Figure 3A.3 - The distribution of public health facilities in Nigeria and population density in Niger Republic.

Note: Health facilities and population densities are mapped on the Map Library for Africa Administrative district level boundaries.

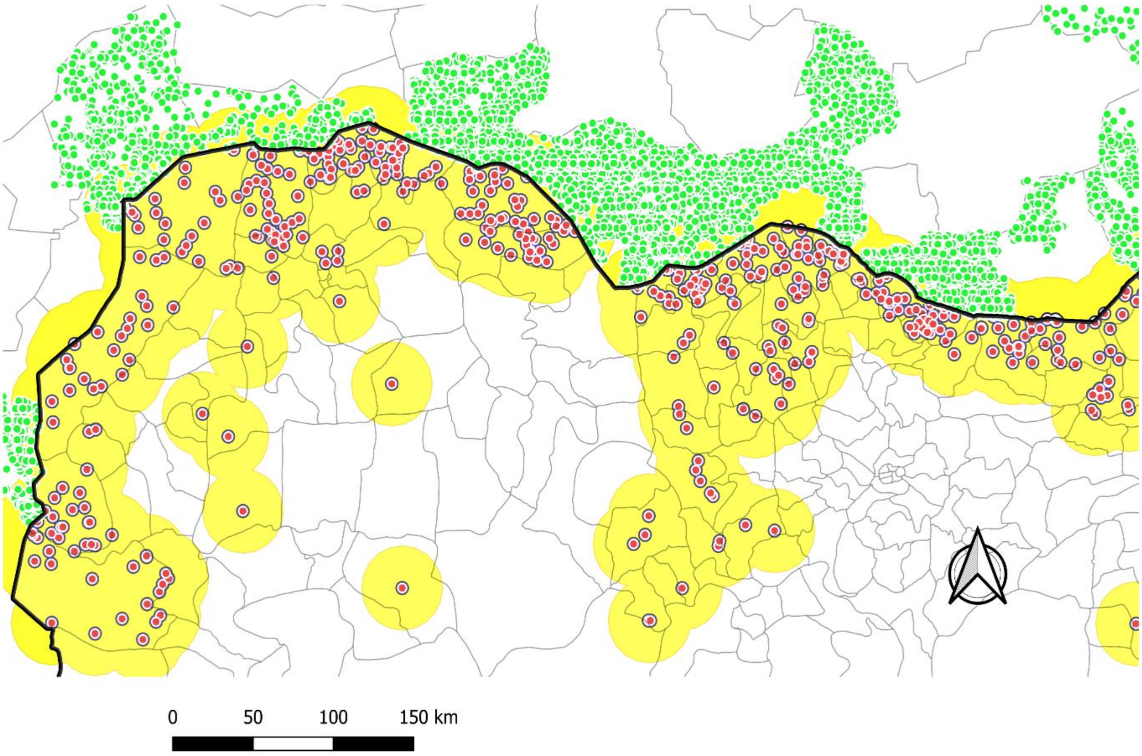

Figure 3A.4 - Distribution of health facilities and settlements along the Niger Republic and Nigerian international borderland (Administrative district level boundaries).

Note: Twenty-five kilometre and 2.5 miles buffered zones are centred on health facilities in Nigeria.

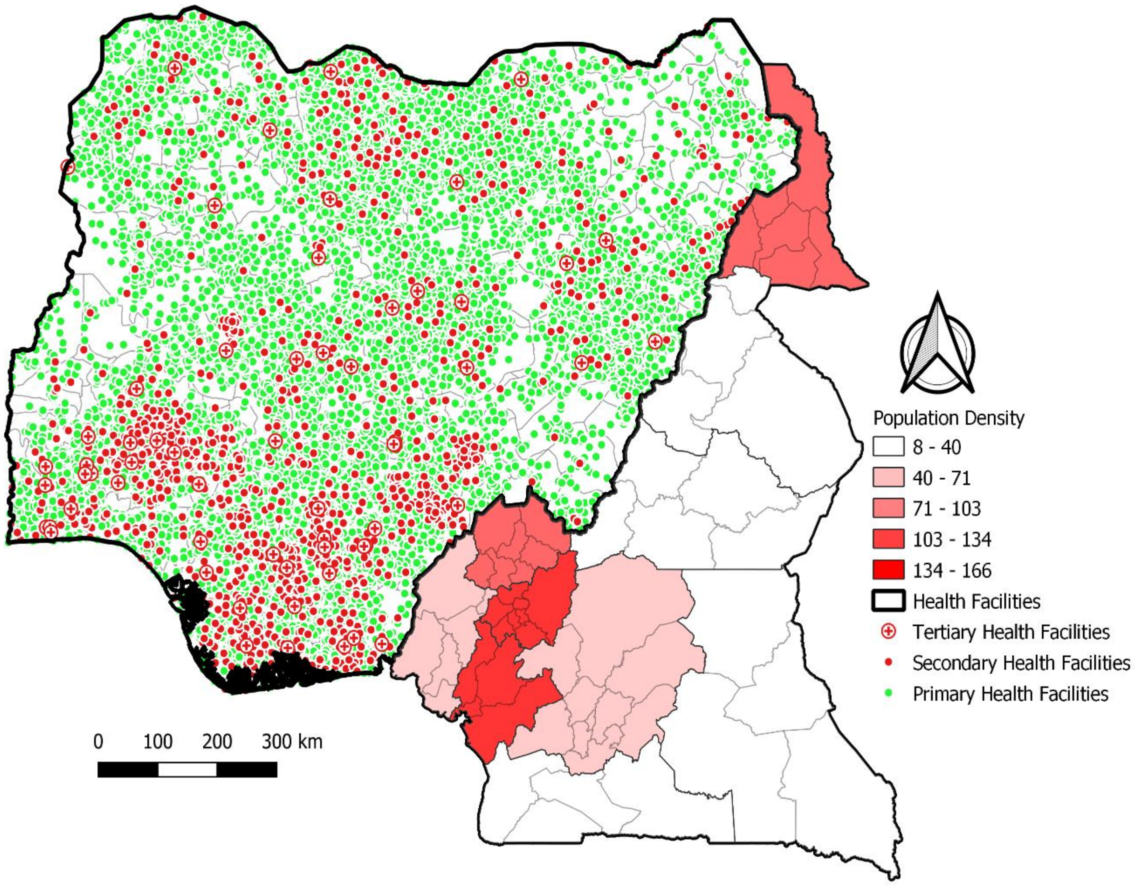

Figure 3A.5 - The distribution of geo-coded public health facilities in Nigeria and population density in Cameroon.

Note: Health facilities and population densities are mapped on the Map Library for Africa Administrative district level boundaries.

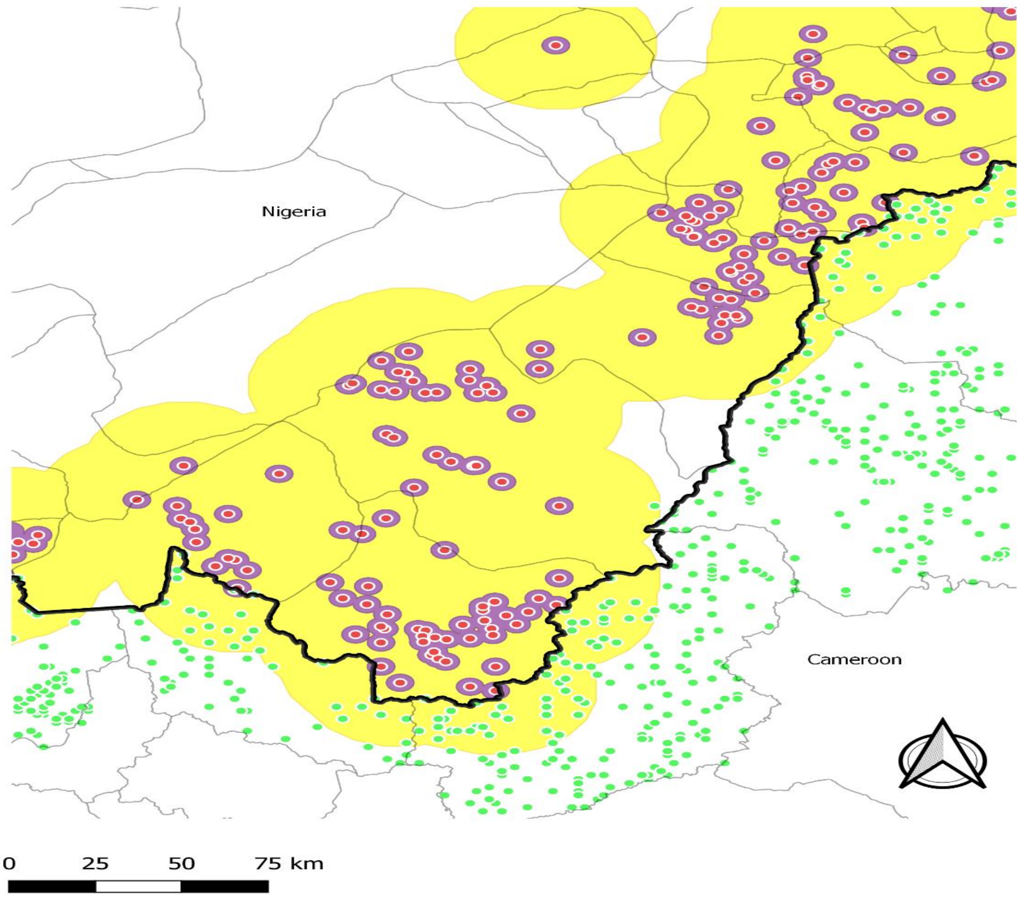

Figure 3A.6 - Distribution of health facilities and settlements along the Cameroonian and Nigerian international borderland (Administrative district level boundaries).

Notes: Twenty-five kilometre and 2.5 miles buffered zones are centred on health facilities in Nigeria.

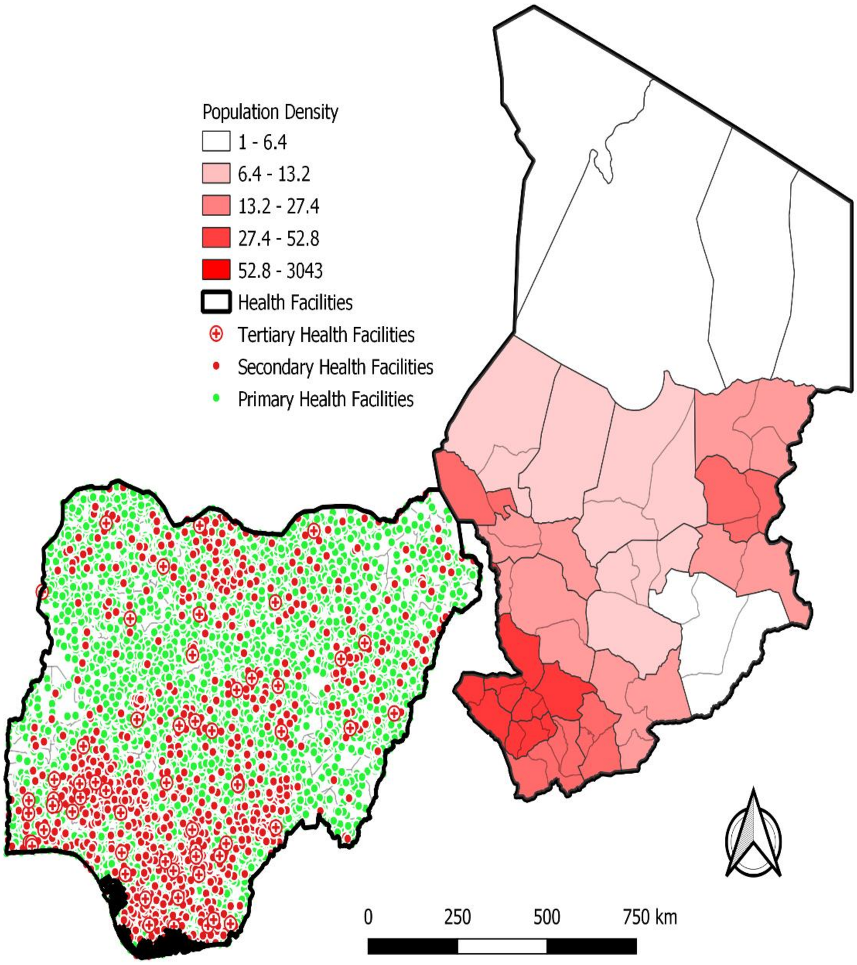

Figure 3A.7 - The distribution of geo-coded public health facilities in Nigeria and population density in Chad Republic.

Note: Health facilities and population densities are mapped on the Map Library for Africa Administrative district level boundaries.

Appendix 4

Table 4A.1 - Effects of decision-making rights on stunting outcome

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Decision Right Index		Decision HH Expenses		Decision Health		Decision Visits	
Decision Right	-0.145***	-0.0316***	-0.146***	-0.0224**	-0.135***	-0.0170*	-0.134***	-0.0249***
	(0.0101)	(0.00957)	(0.0102)	(0.0101)	(0.0102)	(0.00977)	(0.0102)	(0.00956)
Child sex		0.0411***		0.0410***		0.0409***		0.0409***
		(0.00688)		(0.00689)		(0.00688)		(0.00687)
Child Age		0.0200***		0.0200***		0.0200***		0.0200***
		(0.000938)		(0.000940)		(0.000938)		(0.000942)
Child AgeSq		-0.000281***		-0.000282***		-0.000281***		-0.000281***
		(1.48e-05)		(1.48e-05)		(1.48e-05)		(1.49e-05)
Land Ownership		-0.0628***		-0.0636***		-0.0638***		-0.0633***
		(0.0110)		(0.0110)		(0.0110)		(0.0110)
Women Employ		-0.0127		-0.0144		-0.0158		-0.0152
		(0.00986)		(0.00990)		(0.00989)		(0.00987)
HH head sex		-0.0187		-0.0199		-0.0197		-0.0193
		(0.0138)		(0.0138)		(0.0139)		(0.0138)
Locality		0.00593		0.00584		0.00547		0.00487
		(0.0127)		(0.0128)		(0.0128)		(0.0127)
Wife Edu (in Yrs)		-0.00945***		-0.00966***		-0.00983***		-0.00955***
		(0.00132)		(0.00133)		(0.00132)		(0.00131)
Hus Edu (in Yrs)		-0.00316***		-0.00319***		-0.00319***		-0.00322***
		(0.00107)		(0.00107)		(0.00107)		(0.00107)
Observations	23,414	23,100	23,359	23,045	23,370	23,056	23,375	23,061

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4A.1 - Effects of decision-making rights on stunting outcome (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Decision Right Index		Decision HH Expenses		Decision Health		Decision Visits	
HH size		0.00328***		0.00339***		0.00343***		0.00336***
		(0.00123)		(0.00125)		(0.00124)		(0.00123)
Quintile 2		-0.0437***		-0.0431***		-0.0444***		-0.0439***
		(0.0155)		(0.0155)		(0.0155)		(0.0155)
Quintile 3		-0.0990***		-0.0997***		-0.101***		-0.102***
		(0.0190)		(0.0190)		(0.0190)		(0.0191)
Quintile 4		-0.151***		-0.152***		-0.154***		-0.154***
		(0.0199)		(0.0199)		(0.0200)		(0.0199)
Quintile 5		-0.193***		-0.195***		-0.197***		-0.196***
		(0.0233)		(0.0233)		(0.0234)		(0.0233)
Observations	23,414	23,100	23,359	23,045	23,370	23,056	23,375	23,061

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4A.2 - Effects of decision-making rights on wasting outcome

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Decision Right Index		Decision HH Expenses		Decision Health		Decision Visits	
Decision Right	-0.0750***	-0.0437***	-0.0713***	-0.0320***	-0.0670***	-0.0309***	-0.0686***	-0.0385***
	(0.00777)	(0.00869)	(0.00790)	(0.00857)	(0.00790)	(0.00883)	(0.00774)	(0.00819)
Child sex		0.0208***		0.0212***		0.0211***		0.0209***
		(0.00576)		(0.00577)		(0.00579)		(0.00578)
Child Age		-0.00419***		-0.00419***		-0.00418***		-0.00419***
		(0.000756)		(0.000758)		(0.000757)		(0.000758)
Child AgeSq		1.95e-05		1.96e-05		1.93e-05		1.92e-05
		(1.29e-05)		(1.29e-05)		(1.29e-05)		(1.29e-05)
Land Ownership		-0.0281***		-0.0285***		-0.0285***		-0.0295***
		(0.00957)		(0.00959)		(0.00960)		(0.00957)
Women Employ		-0.00344		-0.00574		-0.00623		-0.00550
		(0.00802)		(0.00806)		(0.00806)		(0.00803)
HH head sex		-0.0142		-0.0161		-0.0159		-0.0149
		(0.0123)		(0.0125)		(0.0124)		(0.0123)
Locality		-0.0449***		-0.0452***		-0.0454***		-0.0451***
		(0.0124)		(0.0125)		(0.0125)		(0.0125)
Wife Edu (in Yrs)		-0.00493***		-0.00523***		-0.00532***		-0.00505***
		(0.00119)		(0.00120)		(0.00120)		(0.00118)
Hus Edu (in Yrs)		-0.00300***		-0.00299***		-0.00301***		-0.00306***
		(0.000950)		(0.000952)		(0.000952)		(0.000950)
Observations	23,414	23,100	23,359	23,045	23,370	23,056	23,375	23,061

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4A.2 - Effects of decision-making rights on wasting outcome (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Decision Right Index		Decision HH Expenses		Decision Health		Decision Visits	
HH size		0.00137		0.00140		0.00144		0.00144
		(0.000929)		(0.000956)		(0.000950)		(0.000942)
Quintile 2		-0.00325		-0.00344		-0.00356		-0.00364
		(0.0122)		(0.0123)		(0.0123)		(0.0123)
Quintile 3		-0.0133		-0.0148		-0.0146		-0.0144
		(0.0161)		(0.0162)		(0.0162)		(0.0162)
Quintile 4		-0.00527		-0.00712		-0.00679		-0.00722
		(0.0165)		(0.0167)		(0.0167)		(0.0165)
Quintile 5		-0.0118		-0.0155		-0.0143		-0.0132
		(0.0200)		(0.0202)		(0.0203)		(0.0202)
Observations	23,414	23,100	23,359	23,045	23,370	23,056	23,375	23,061

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4A.3 - Effects of decision-making rights on underweight outcome

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Decision Right Index		Decision HH Expenses		Decision Health		Decision Visits	
Decision Right	-0.149***	-0.0668***	-0.146***	-0.0516***	-0.146***	-0.0516***	-0.140***	-0.0601***
	(0.00940)	(0.0103)	(0.00988)	(0.0104)	(0.00988)	(0.0104)	(0.00949)	(0.00984)
Child sex		0.0351***		0.0354***		0.0353***		0.0352***
		(0.00668)		(0.00671)		(0.00669)		(0.00670)
Child Age		0.00784***		0.00786***		0.00784***		0.00783***
		(0.000812)		(0.000816)		(0.000812)		(0.000814)
Child AgeSq		-0.000124***		-0.000125***		-0.000124***		-0.000125***
		(1.32e-05)		(1.32e-05)		(1.32e-05)		(1.32e-05)
Land Ownership		-0.0611***		-0.0613***		-0.0624***		-0.0627***
		(0.0103)		(0.0104)		(0.0104)		(0.0103)
Women Employ		0.0109		0.00785		0.00673		0.00797
		(0.00941)		(0.00943)		(0.00945)		(0.00935)
HH head sex		-0.0131		-0.0163		-0.0155		-0.0140
		(0.0157)		(0.0160)		(0.0160)		(0.0158)
Locality		-0.0467***		-0.0470***		-0.0472***		-0.0478***
		(0.0137)		(0.0139)		(0.0138)		(0.0138)
Wife Edu (in Yrs)		-0.00986***		-0.0103***		-0.0105***		-0.0101***
		(0.00151)		(0.00151)		(0.00152)		(0.00150)
Hus Edu (in Yrs)		-0.00445***		-0.00446***		-0.00446***		-0.00450***
		(0.00108)		(0.00108)		(0.00108)		(0.00108)
Observations	23,414	23,100	23,359	23,045	23,370	23,056	23,375	23,061

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4A.3 - Effects of decision-making rights on underweight outcome (continued)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7	(8) Model 8
HH size		0.00389***		0.00390***		0.00404***		0.00402***
		(0.00112)		(0.00116)		(0.00114)		(0.00113)
Quintile 2		-0.0311**		-0.0319**		-0.0320**		-0.0317**
		(0.0141)		(0.0142)		(0.0142)		(0.0142)
Quintile 3		-0.0765***		-0.0789***		-0.0789***		-0.0789***
		(0.0192)		(0.0195)		(0.0194)		(0.0193)
Quintile 4		-0.0872***		-0.0903***		-0.0902***		-0.0902***
		(0.0196)		(0.0199)		(0.0199)		(0.0197)
Quintile 5		-0.111***		-0.116***		-0.115***		-0.114***
		(0.0245)		(0.0249)		(0.0249)		(0.0247)
Observations	23,414	23,100	23,359	23,045	23,370	23,056	23,375	23,061

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4A.4 - Does the Effect of Decision-making Rights depend on Women's Locality of Residence, Education, and Land Ownership Status?

Variables	(1) Education	(2) Locality	(3) Land
No Decision Right* No Wife Education	2.282***		
	(0.0943)		
No Decision Right*Wife Education	0.970***		
	(0.0580)		
Decision Right* No Wife Education	1.760***		
	(0.0953)		
Decision Right*Wife Education	0.547***		
	(0.0195)		
No Decision Right*Urban		1.426***	
		(0.108)	
No Decision Right*Rural		1.999***	
		(0.0793)	
No Decision Right*Urban		0.577***	
		(0.0265)	
Decision Right*Rural		1.133***	
		(0.0453)	
No Decision Right*No Land own			1.942***
			(0.0731)
No Decision Right*Land own			1.277***
			(0.0930)
Decision Right*No Land own			0.928***
			(0.0324)
Decision Right*Land own			0.563***
			(0.0326)
Observations	23,111	23,100	23,100

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: All covariates in the basic specifications are controlled for in the above.

Table 4A.5 - Factors that explains women decision-making rights in Nigeria.

Variables	(1) DMR Index	(2) HH_E	(3) HH_H	(4) HH_V
Mass Media (No)	Ref	Ref	Ref	Ref
	(.)	(.)	(.)	(.)
Irregular Mass Media	0.0512***	0.0199	0.0274	0.0288
	(0.0187)	(0.0169)	(0.0174)	(0.0188)
Regular Mass Media	0.0426**	0.0121	0.0375**	0.0464***
	(0.0173)	(0.0157)	(0.0161)	(0.0178)
Wife Educ (in Yrs)	0.0264***	0.0246***	0.0238***	0.0253***
	(0.00145)	(0.00124)	(0.00138)	(0.00141)
Land Ownership	0.0324**	0.0456***	0.0369**	0.0114
	(0.0165)	(0.0151)	(0.0145)	(0.0162)
Poverty	0.0851***	0.124***	0.102***	0.0803***
	(0.0186)	(0.0159)	(0.0176)	(0.0191)
Women Employ	0.231	0.288*	0.319*	0.214
	(0.184)	(0.173)	(0.178)	(0.192)
No of sons	-0.0206***	-0.0163***	-0.0150***	-0.0166***
	(0.00441)	(0.00423)	(0.00412)	(0.00441)
Wife Earn More	-0.292***	-0.283***	-0.274***	-0.257***
	(0.0192)	(0.0174)	(0.0164)	(0.0179)
Other wives in HH	0.000883	0.000197	-8.76e-05	0.000663
	(0.000695)	(0.000643)	(0.000693)	(0.000637)
Religion	0.00121	0.00186**	0.00140**	0.00136*
	(0.000791)	(0.000738)	(0.000670)	(0.000799)
Observations	47,619	47,548	47,557	47,539

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: DMR_index= Decision Making Right index, HH_E= Decision on Household Expenses, HH_E =Decision on wife's health, HH_V=Decision on Visits, wife_eduYrs=Wife's education in years

Table 4A. 6 - Standardized Differences from Propensity Score Analysis

	Balance SD:Raw	SD:Matched	Ratio:Raw	Ratio:Matched
Own Land	0.28	0.00	1.66	1.00
Employ	0.49	-0.01	0.61	1.01
HH head (sex)	0.25	0.03	2.20	1.09
HH size	-0.30	0.01	0.69	1.07
Poverty	0.68	-0.01	0.85	1.01
Education (Secondary)	0.52	-0.00	1.80	1.00
Education (Higher)	0.30	0.00	3.39	1.01

Notes: HH=Household; SD= Standardized Difference.

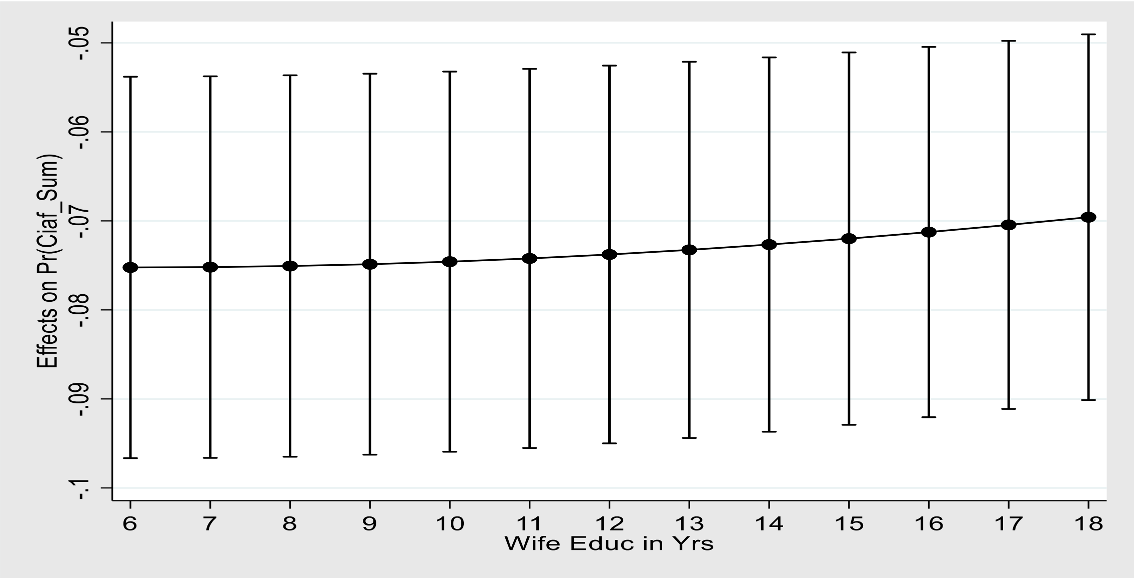

Figure 4A. 1 -Average marginal effects of decision right over education with 95% CIs

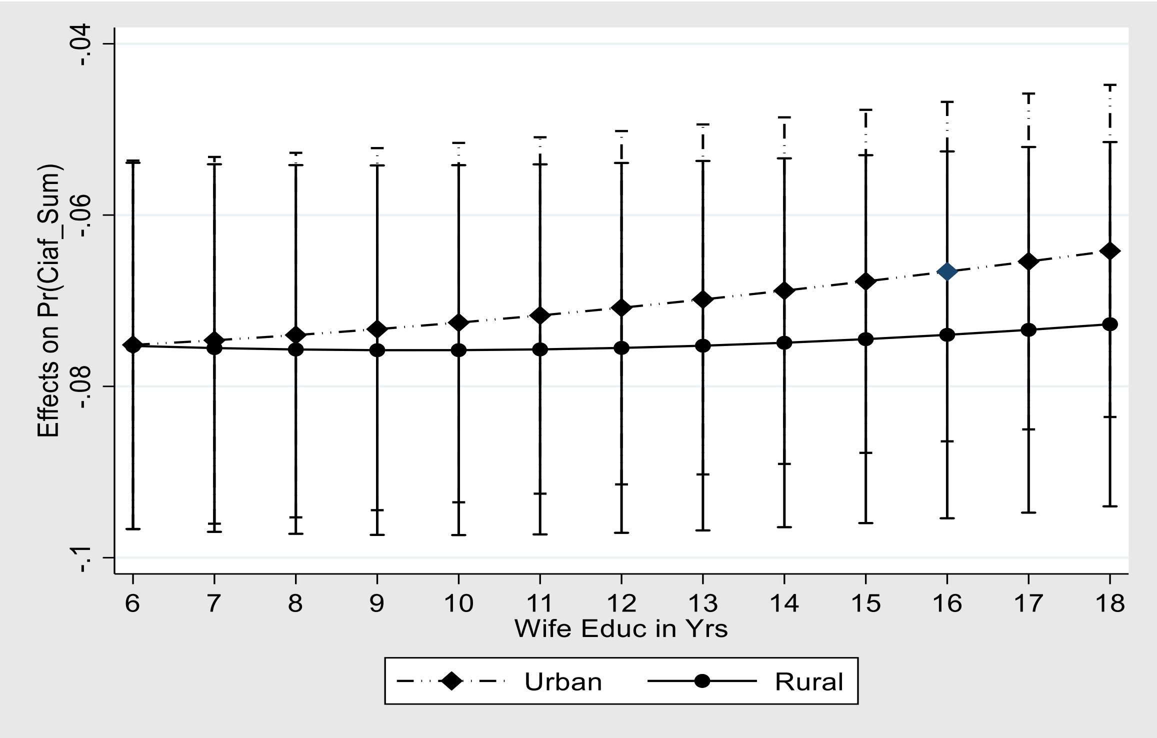

Figure 4A. 2- Average marginal effects of decision right over education and locality with 95% CIs

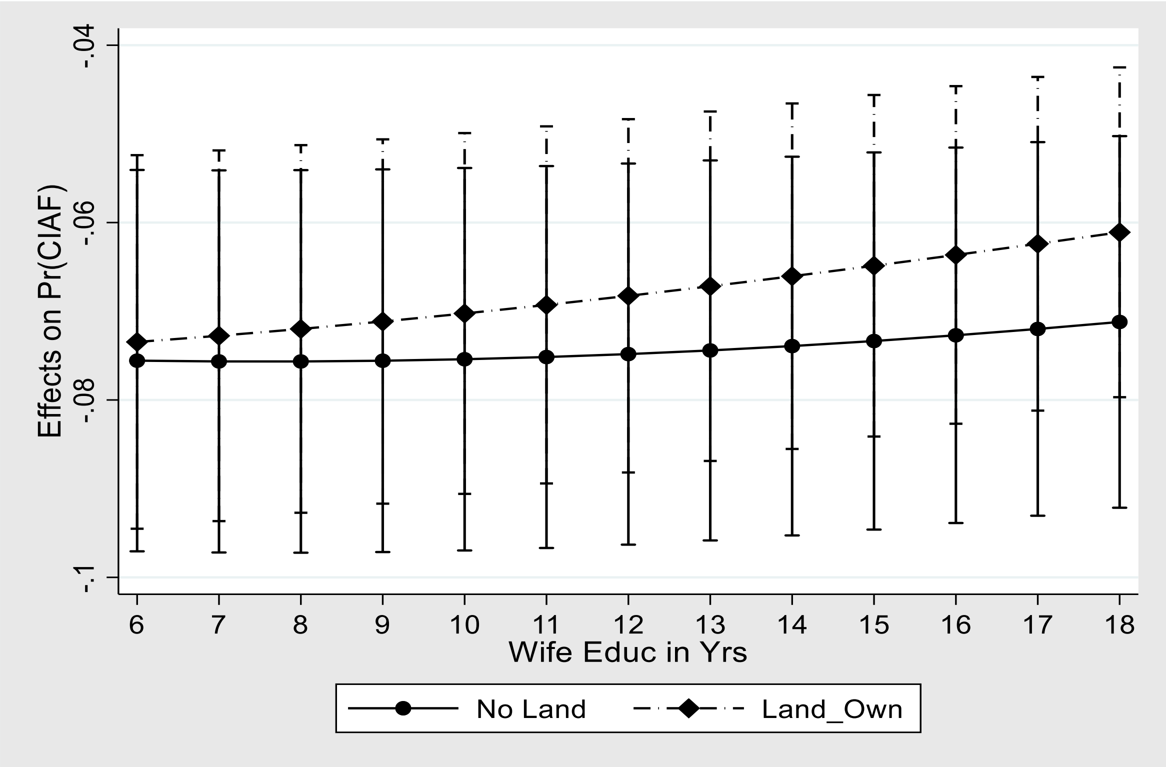

Figure 4A. 3- Average marginal effects of decision right over education and land ownership with 95% CIs

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