School of Public Health

Impact of Source of Health Funding on Under-Five, Infant, Neonatal and Maternal Mortality in sub-Saharan African Countries

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature: Date: 14 June 2020

Abstract

Background

While studies have shown that increased levels of health funding are linked to better health outcomes, there is little information about sources of health funding and relations to health outcomes. An average of 50% of health expenditure in sub-Saharan Africa come from government sources however the focus for health financing for the last 40 years was centered on increasing foreign resources for health. The primary aim of this work was to analyze the impact that the source of health expenditure has on health outcomes by analyzing existing data in sub-Saharan African countries between 2000 and 2014. The specific objectives of this work were (1) to compare sources of health expenditure and their effect on health outcomes (maternal, neonatal, infant and under-five mortality); (2) to compare sources of child health expenditure and their effect on neonatal, infant and under-five mortality in selected sub-Saharan African countries; and (3) provide a detailed analysis of health financing sources and health outcomes (maternal, neonatal, infant and under-five mortality) in two sub-Saharan African countries.

Methods

This work used a mixed-methods approach. Secondary panel data was used for objectives 1 and 2. Objective 1 included a sample of 43 sub-Saharan African countries while objective 2, 8 countries were purposively selected based on their availability of child health funding data. This quantative research used ordinary least squares, fixed effects, random effects and generalized method of moments estimation methods to predict point estimates. A qualitative analysis of two countries, Malawi and Mozambique, was used to supplement the quantitative findings under objectives 1 and 2. Malawi and Mozambique were selected because of similarities in characteristics (income level, region, total health expenditure) but differences in the sources of health funding.

Results

Government expenditure on health was associated with decreases in under-five and infant mortality when all countries were grouped together and in lower middle-income countries; and neonatal mortality in lower middle and upper middle-income countries.

Government expenditure on health was associated with decreases in maternal mortality in lower middle-income countries but increases in maternal mortality when all countries were grouped together and in low-income countries.

Development assistance for health was associated with decreases in under-five, infant, neonatal and maternal mortality in low-income countries.

Out of pocket expenditure on health was associated with decreases in neonatal mortality in upper middle-income countries model and with increases in under-five and infant mortality in lower middle-income countries. Out of pocket expenditure on health was associated with decreases in maternal mortality in low-income countries and increases in maternal mortality when all counties were grouped together.

When all countries were grouped together and in low-income countries, private expenditure on health was associated with decreases in under-five and infant mortality while in lower middle-income countries, it was associated with increases in under-five, infant and maternal mortality.

Private expenditure on health showed a larger effect on under-five, infant and neonatal mortality than government expenditure on health when all countries were grouped together. In low-income countries, development assistance for health had a larger effect in reducing under-five and infant mortality than private expenditure on health while in lower middle-income countries, government expenditure on health reduced under-five and infant mortality and out of pocket expenditure on health and private expenditure on health were associated with increases in under-five mortality. In upper middle-income countries, out of pocket expenditure on health had a larger effect on neonatal mortality than government expenditure on health.

For maternal mortality, development assistance for health reduced maternal mortality whereas government expenditure on health and out of pocket expenditure on health were associated with increases in maternal mortality when all countries were grouped together. In low-income countries, development assistance for health had a larger effect on reducing maternal mortality than out of pocket expenditure on health, as well as government expenditure on health which actually increased maternal mortality. In

lower middle-income countries, government expenditure on health was associated with reductions in maternal mortality while private expenditure on health were associated with increases in maternal mortality.

Under objective 2, none of the sources of child health expenditure showed statistically significant relationships with under-five, infant or neonatal mortality.

Under objective 3, despite relatively close starting points in terms of maternal and under-five, infant and neonatal mortality, these countries showed different rates of improvement with Malawi achieving the biggest improvement in under-five mortality with a reduction of 62% compared to Mozambique that saw a 51% reduction. In contrast, Mozambique showed its biggest improvement in maternal mortality with a 46% reduction whereas Malawi showed a 28%. Mozambique generated the majority of its health financing from development assistance for health whereas Malawi relied more heavily on government expenditure on health. There were noted differences in health governance, focus of expenditure and financial controls.

Conclusions

Government expenditure on health and development assistance for health appear to be associated with decreases in under-five, infant and neonatal mortality.

For maternal mortality, government expenditure on health showed mixed results, dependent on the country income classification, while development assistance for health appeared to be associated with decreases in maternal mortality.

The results for out of pocket expenditure on health and private expenditure on health were also mixed and dependent on the country income classification.

It appears that the most effective source of health expenditure for reducing under-five, infant, neonatal and maternal mortality changes with the country income classifications.

None of the sources of child health expenditure showed statistically significant relationships with under-five, infant or neonatal mortality.

The findings from this research are hopefully useful for fostering dialogue on investments made to the health sector and the functioning of the health system, specifically equitable use and provision of services, as well as quality and efficiency in service delivery.

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Abbreviations

2SLS	Two-Stage Least Squares Regression
AAAA	Addis Ababa Action Agenda
BPLM	Breusch Pagan Lagrange Multiplier
CAR	Central African Republic
CHAM	Christian Health Association of Malawi
CHERG	Child Health Epidemiology Reference Group
DAH	Development Assistance for Health
DAHPRTHE	Development Assistance for Health as a Per Cent of Total Health Expenditure
DHMT	District Health Management Team
DHO	District Health Offices
DHS	Demographic Health Survey
DPS	Direcção Provincial de Saúde
DRC	Democratic Republic of Congo
EDU	Mean number of years of schooling for females 25 years and older
EHP	Essential Health Package
FAO	Food and Agriculture Organization
FE	Fixed Effects
FOODSEC	Food security
GAVI	Global Alliance for Vaccines Initiative
GDP	Gross Domestic Product
GDPPRCAP	Gross Domestic Product per Capita
GHDx	Global Health Data Exchange
GHE(S)	Government Expenditure on Health (as Source)
GHEPRTHE	Government Health Expenditure as a Per Cent of Total Health Expenditure
GLSE	Generalized Least Squares Estimation
GMM	Generalized Method of Moments
GNI	Gross National Income
H2OSAFE	Proportion of the population with access to an improved water source
H2SLS	Heteroscedastic Two-Stage Least Squares Regression
HIVPREV	HIV Prevalence
HSA	Health Surveillance Assistants
IGME	United Nations Inter-Agency Group for Child Mortality Estimation
IHME	Institute for Health Metrics and Evaluation
IMR	Infant Mortality Rate
MDG	Millennium Development Goals
MMR	Maternal Mortality Rate
MOU	Memorandum of Understanding
MZB	Mozambique
NHA	National Health Account
NHS	National Health Service
NNMR	Neonatal Mortality Rate
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
OOP	Out of Pocket

OOPPRTHE	Out of Pocket Expenditure on Health as a Per Cent of Total Health Expenditure
OTTR	Observe, think, test, revise
PEPFAR	President's Emergency Plan for AIDS Relief
PHE	Private Expenditure on Health
PRVHETHE	Private Health Expenditure as a Per Cent of Total Health Expenditure
RE	Random Effects
SDGs	Sustainable Development Goals
SDSMAS	Serviços Distritais de Saúde, Mulher e Acção Social
SWAp	Sector-Wide Approach
TBA	Traditional Birth Attendants
THE	Total Health Expenditure
U5MR	UnderFive Mortality Rate
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
WDI	World Bank's World Development Indicators
WFP	World Food Programme
WHO	World Health Organization

Chapter 1: Introduction

1.1 Introduction

Governments are tasked with ensuring its citizens have access to essential health services. Governments use a mix of resources to finance the health care needs of their population including (1) government revenues; (2) foreign funds; and (3) private sources (Gutierrez & Ferrara, 2017, p. 3-4; and Gottret & Schieber, 2006, p. 251). The mix of resources chosen for each country is highly influenced by the political, economic, cultural, demographic and epidemiological context. Moreover, the mix is dependent on what financing the country can access and the trade-offs the country is willing to accept (WHO, 2010, p. 5; Gottret & Schieber, 2006, p.34; and Hsiao, 2000, p. 19 - 46).

Some of these trade-offs may be the ability and willingness of the population to take on more taxation; the ability of the government to establish and manage a social insurance programme; the ability of the government to access loans or foreign aid, and the conditions that may be attached to those types of funding; what private providers are in the market and how much of the population they target; and the risk of high out-of-pocket payments for citizens. The mix of health resources used will affect coverage of health services, the costs of health services, sustainability, health outcomes and the financial protection of the population from catastrophic health expenditures.

Health financing is the "function of a health system concerned with the mobilization, accumulation and allocation of money to cover the health needs of the people, individually and collectively, in the health system." It states that the "purpose of health financing is to make funding available, as well as to set the right financial incentives to providers, to ensure that all individuals have access to effective public health and personal health care" (WHO, 2007, p. vi; and WHO, 2000, p. 95).

In 2013, the Organization for Economic Co-operation and Development (OECD) showed that on average, industrialized nations sourced almost 75 per cent of total health expenditure from public sources (government revenues or social health

insurance) (OECD, 2015, p. 4). Even the United States, which has a market-based health system, sourced 48% of total health expenditure from government resources. In sub-Saharan Africa, average government expenditure on health was 50% but there were large differences between countries. Seven countries (Cameroon, Cote D'Ivoire, Guinea-Bissau, Mali, Nigeria, Sierra Leone and Uganda) financed less than 30% of total health expenditures from domestic resources while six countries (Cabo Verde, Congo, Equatorial Guinea, Lesotho, Seychelles and Swaziland) financed over 70% of total health expenditures from domestic sources (WHO, 2016, p. 88-89). In low- and middle-income countries, options for mobilizing domestic resources are limited largely due to low levels of income, a large informal sector and poorly developed administrative structures which make it difficult to generate revenue through taxation. This often requires a greater burden of health expenditure on private financing, particularly out-of-pocket expenditures (Gottret & Schieber, 2006, p. 48-51 and 213).

In sub-Saharan Africa, private spending accounts for almost 50 per cent of total health expenditure with the majority financed from out-of-pocket (OOP) expenditure (WHO, 2016, p. 88-89). Sub-Saharan African countries have an average of 32% of total health expenditure sourced from OOP with 6 countries (Cameroon, Cote d'Ivoire, Eritrea, Nigeria, Sierra Leone and South Sudan) having more than 50% of the total health expenditure sourced from OOP and 5 countries sourced less than 10% (Botswana, Mozambique, Namibia, Seychelles and South Africa) (WHO, 2016, p. 88-89). Conversely, OECD countries have an average of 19% of total health expenditure from OOP. While transferring the financing responsibility to the household reduces government costs, household OOP for health has significant consequences, including difficulty in accessing services and the risk that catastrophic health expenses could put the household further into poverty (Gottret & Schieber, 2006, p. 227).

Many developing countries rely heavily on external sources to finance their health systems. While OECD countries have no significant financing from external resources (OECD countries source less than 1.1% of their health financing from external sources, except for Luxemburg) (OECD data accessed on 12 Nov 2017), sub-Saharan African countries sourced an average of 24% of total health expenditure from external resources with 8 countries sourcing more than 45% (Burundi, Central African Republic, Gambia, Lesotho, Liberia, Malawi, Mozambique and Rwanda) and 7

countries (Angola, Congo, Equatorial Guinea, Gabon, Mauritius, Seychelles and South Africa) sourcing less than 5% (WHO, 2016, p. 88-89).

1.2 Motivation for this Research

While there have been numerous political declarations to urge increases in both domestic and donor health resources, there has been little agreement about how much should be invested, by whom and how the investments should be made in order to achieve universal access to health care (UN, 2015, p. xiii-xv; WHO, 2011, p. 3-4; Taskforce on Innovative International Financing for Health Systems, 2009; Govender et al., 2008, p. 3; OAU, 2001, p. 4-6; UN, 2000, MDG8; World Bank, 1987, p. 25-46; and WHO, 1978, p. 2).

The focus for health financing has been primarily centred on increasing foreign resources for health including official development assistance (ODA). This was evident in the Millennium Declaration which highlighted the need for global partnerships for development (UN, 2000, p. 1), which generated momentum for new health financing mechanisms including the Global Fund to Fight HIV, Tuberculosis and Malaria; and The Global Alliance for Vaccines Initiative (GAVI). Such efforts contributed to the 25% per year increase in external resources for health in low-income countries between 2001 and 2011 (WHO, 2014, p. 9). Moreover, there is some evidence that these resources have contributed to declines in mortality, especially since malaria and vaccine preventable diseases are amongst the largest killers for children under-five (Jaupart et al, 2019; World Malaria Report, 2019; Jakubowski et al, 2017; USAID, 2016; and Akachi & Atun, 2011).

However, other sources of health financing, particularly domestic resources and private/out of pocket expenditure on health, which account for large portions of health expenditure, were ignored by the Millennium Declaration. In the African region, approximately 80% of health expenditure is sourced from domestic (30%) and private (50%) sources of which 71% was from out-of-pocket payments by households (WHO, 2016, p. 88-89). Under the framework of the 2030 Development Agenda "Transforming our world: the 2030 Agenda for Sustainable Development", a new

financing paradigm was agreed that recognizes all contributions for development financing including domestic, foreign and private investments.

While the 2030 Agenda continues to advocate for universal health coverage, it goes further to focus on ensuring personal financial protection from catastrophic out of pocket expenditure on health. The Millennium Project report to the UN Secretary General, chaired by Jeffrey Sachs, recommends the decreasing reliance on out of pocket expenses to be financed by increased domestic and donor resources for health (Millennium Project, 2005, p. 26). Generating additional resources for health is complicated: necessitating not only fiscal space but also advocacy, informed by evidence. Unfortunately, there are many unanswered questions that would shape advocacy efforts, particularly around the effectiveness of different sources of financing to produce health outcomes. Presently, there is no in-depth study comparing the effects of different sources of health financing (government, donor and out of pocket expenditures) on health outcomes. By understanding the effects of different sources of health financing, advocacy and health financing policies can be shaped and/or improved.

This research will focus on sub-Saharan Africa given the large disparities in the distribution of health resources. With a global investment of US$6.9 trillion in health in 2011 (WHO, 2014, p. 3), sub-Saharan Africa accounts for only 1% of global health expenditure yet 15% of the global population and 24% of the world's disease burden including almost half of the world's under-five deaths and one-third of global maternal mortality (UN, 2015(b), p. 33 and 29; WHO, 2014, p. 7; and World Bank, 2008, p. iii).

It is hoped that this work inspires further data generation on health financing, particularly child health financing, and encourages dialogue on investments in child and maternal health, especially in sub-Saharan Africa.

1.3 Objectives of this Research

The aim of this research is to fill the gap in knowledge regarding the impact that the source of funding has on health outcomes (maternal, neonatal, infant and under-five

mortality) by analyzing existing data from 2000-2014. The specific objectives of this research are as follows:

Objective 1: This research compares sources of health expenditure and their effect on health outcomes (maternal, neonatal, infant and under-five mortality) in sub-Saharan African countries between 2000 and 2014.

It was expected that all sources of health financing will be associated with decreases in under-five, infant, neonatal and maternal mortality. This was in line with available research on government expenditure on health (Gottret & Schieber, 2006; Bokhari et al., 2007; and Achoki & Chansa, 2013); and development assistance for health (Akachi & Atun, 2011; Bendavid & Bhattacharya, 2009; and Mishra & Newhouse, 2009). While results have been mixed for private and out of pocket expenditures on health, private expenditures seem to be related to decreases in mortality rates (Novignon and Lawanson, 2017; Novignon et al., 2012; and Issa and Ouattara, 2005) while out of pocket expenditure on health may be related to income level of the country (Fofack & Sarpong, 2019; Keats et al., 2018; Akinci et al., 2014; Plumper & Neumayer, 2012; and Muldoon et al., 2011).

It was expected that domestic resources will show a higher impact on health outcomes than donor funding as governments can control the resources, enabling the government to plan for long term health investments for the population; direct funding to the areas of greatest need; and ensure sustainability of financing for priority health programmes. The expectation that domestic resources will show a higher impact on health outcomes is aligned with available literature (Gottret & Schieber, 2006; Bokhari et al., 2007; and Achoki & Chansa, 2013). It is recognized that the allocation of government budget to health is subject to political influences. Governments will make judgments about the importance of health spending relative to other demands for public sector spending. Donor funding may supplement, or even replace government financing (Farag et al., 2009 and Lu et al., 2010). Donor funding tends to be project-based, focused on donor priorities, and are subject to the political influences from the donor country which effects sustainability of the resources. If this research shows improved health outcomes with government

resources, this research could be used to advocate for increased government investment in health.

Objective 2: This research compares sources of child health expenditure on under-five, infant and neonatal mortality in selected sub-Saharan African countries between 2000 and 2014.

While available literature examines child health outcomes, none look at the financing for child health. Most national health accounts have not included coding for child health investments making research on child health outcomes in relation to child health financing challenging. Existing data available on government and external resources for child health for sub-Saharan African countries are examined in relation to government and external resources for health on child health outcomes. It is hypothesized that government expenditure on child health will produce better child health outcomes than donor funding. If this research shows improved child health outcomes with government child health funding, this research could be used to advocate for increased government investment in child health.

Objective 3: This research will provide a detailed analysis of health financing sources and health outcomes (maternal, neonatal, infant and under-five mortality) in two sub-Saharan African countries.

Illustrative case studies are used to look in-depth at the relationships between health financing sources and health outcomes. The case studies are used to triangulate and cross-verify the qualitative data. In this research, two countries have been purposively selected for the case study. Mozambique had the second highest development assistance for health as a per cent of total health expenditure at 66.65%, after Liberia, and Malawi had the highest government expenditure on health as a per cent of total health expenditure (39.84%) for a low-income country from the Southern Africa region, third highest of all the countries included in this research after Ghana and Mauritania. Mozambique and Malawi had the lowest combined amounts of private and out of pocket expenditure on health as percentages of THE so they rely more on government and development assistance for health and thus the effects of government and development assistance for health may be easier to

identify. Moreover, they had similar mean total health expenditure ranking 26th and 28th highest out of the countries included in this research; neither experienced conflicts during the period included in this research; both are classified as low-income countries; and are from the same region, thus they have some common ecological, geographical, social, linguistic and cultural characteristics as many ethnic groups are shared, particularly for the northern part of Mozambique.

1.4 Health Financing Systems

Successful structures for health financing follow three basic principles:

> "Principle 1. Raise enough revenue to provide individuals with a basic package of essential services and financial protection against catastrophic medical expenses caused by illness and injury in an equitable, efficient, and sustainable manner.
>
> Principle 2. Manage these revenues to pool health risks equitably and efficiently.
>
> Principle 3. Ensure the purchase of health services in ways that are allocatively and technically efficient" (Gottret & Schieber, 2006, p. 2).

Health financing systems differ greatly between countries largely due to different populations, disease burdens and civil/economic pressures. Low- and middle-income countries (LMIC) tend to rely on a combination of government resources, external/donor funding and household contributions (Lagarde & Palmer, 2006, p. 2). "The mix of these sources has many implications for health systems, particularly in terms of access, equity, efficiency, and financial sustainability" (Gottret & Schieber, 2006, p. 34).

The potential of a country to collect revenue depends on various factors including income, distribution of income, availability of natural resources, effectiveness of tax systems, structure of the labour market (i.e. formal versus informal sectors), population

size as well as the global and domestic economy. Unfortunately, many developing countries do not have an efficient taxation system or a sizable tax base as much of the business transactions are done in the informal sector, thereby limiting their ability to generate significant revenue (Stenberg et al. 2010, p. 8 and 21). In addition, weak regulatory environments enable mismanagement of funds and/or corruption which further diminishes the ability of the government to pay for social services (Hsiao, 2000, p. 21).

In order to meet some of the demand, LMIC often supplement their financing needs by borrowing (internal or external) or printing more money, noting that borrowed funds would then have to be repaid from future government revenues (WHO, 2010, p. 32; Gottret & Schieber, 2006, p. 6, 46, 63, 218-221; WHO, 2001, p. 132; and Hsiao, 2000, p. 21 and 66). If a country is not able to generate enough resources, it may look for external assistance in the form of loans and/or grants (Foster & Leavy, 2001, p. 2-6). External funding can be earmarked for specific expenditures related to a discrete set of activities for which objectives and outputs are clearly defined and set to be achieved within a short timeframe. This tends to be preferred by development partners and donors however it is often critiqued as it is considered to (1) be unstable; (2) be set according to the preferences of the donors rather than national priorities; (3) typically have high transaction costs; and (4) have sustainability issues when the donor funding ends (Antunes et al., 2008, p. 4-7; and Foster & Leavy, 2001, p. 7-9 and 16).

External funding can also be provided to a government who will then allocate the funds based on national priorities and managed using national procedures (i.e. channelled through the national treasury). Typically, this funding focuses on outcome level results and thus requires a longer term of support. This type of support focuses on ownership of the programmes by recipient countries, which addresses one of the weaknesses of the project support model (Antunes et al., 2008, p. 4-7).

In most countries, private sources are a major contributing source of health expenditure. Private health financing refers to "funds paid directly to health care providers from private sources, including direct household expenditures such as out-of-pocket payments, expenditures through private insurance plans and employers' direct payments for health services" (WHO Global Health Expenditure database). In

this research, pre-paid private spending in the form of private insurance plans have been differentiated from out-of-pocket payments given the very different nature of these private payments.

Designing a health financing system for many countries, particularly low-income countries, is challenging because of the following:

- A low tax base from which to generate domestic revenue.
- A heavy reliance on donor financing.
- The predominance of out of pocket spending by households to finance their healthcare needs.
- A number of different healthcare providers in the public and private sectors.
- A reliance on private providers or nongovernmental organizations to scale up service delivery rapidly (Mills, 2014, p. 553-556; Atim et al., 2008, p. 17-30; Gottret & Schieber, 2006, p. 50; and Lagarde & Palmer, 2006, p. 2).

1.5 Definitions

For the purposes of this research, commitments or the promise of future payments are differentiated from both disbursements and expenditures. *Commitments* represent intentions and may not be realized, which could potentially inflate financial contributions (OECD, 2014, p. 11 and 21; and WHO, 2009, p. 155). *Disbursements* are the funds released or transferred but not necessarily spent (OECD, 2014, p. 11 and 21; and WHO, 2009, p. 155). *Expenditures* are funds that have been utilized or spent. It is noted that the value of commitments will be higher than disbursements as not all the funding may be released by the donor. In addition, the value of disbursements will be higher than expenditures due to limited absorption rates in some countries (OECD, 2014, p. 11 and 21). This research focuses on expenditure as it denotes the funds were planned for and utilized.

Public expenditure on health "refers to expenditure on health care incurred by public funds. Public funds are state, regional and local government bodies and social security schemes." (OECD 2001 https://stats.oecd.org/glossary/detail.asp?ID=2198).

Private health expenditure includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations (WHO, 2015c, p. 24).

Out-of-pocket (OOP) expenditure on health comprise "expenditure paid directly by private households, irrespective of whether the contact with the health care system was established on referral or on the patient's own initiative" (OECD 2001 https://stats.oecd.org/glossary/detail.asp?ID=2198). For this research, OOP has been separated from other private health expenditure given its size and the ability to obtain data.

Government expenditure on health (GHE) refers to the "expenditures incurred by central, state/regional and local government authorities" that is sourced from domestic funds (WHO, 2015c, p. 6).

External resources for health are "funds or services in-kind that are provided by entities not part of the country in question", including donations, loans, in cash and in-kind resources. "The resources may come from international organizations, other countries through bilateral arrangements, or foreign nongovernmental organizations. These resources are part of total health expenditure" (WHO, 2015c, p. 3).

It is noted that funds for health-related activities may be provided to other sectors (i.e. education, water and sanitation, infrastructure and humanitarian assistance) and that improvements in these other sectors are likely to influence health outcomes. The models used in this work try to account for some of this influence but not all could be factored in.

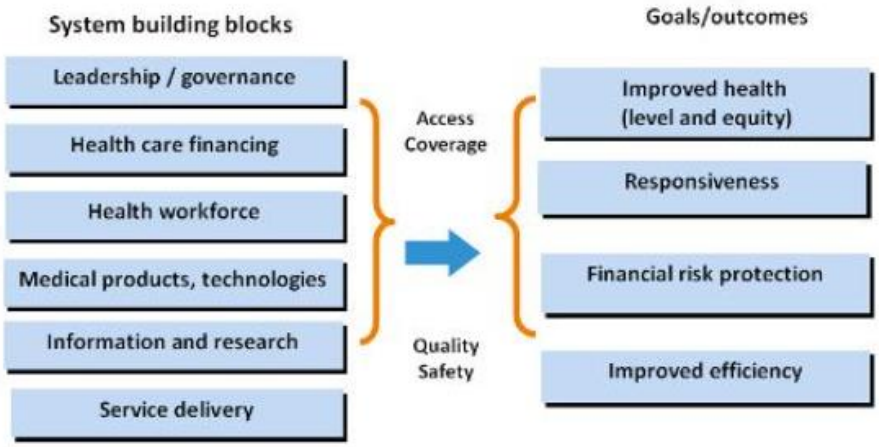
1.6 Conceptual Frameworks

As health systems and health financing are complex, conceptual frameworks can be used to help to guide research. Conceptual frameworks provide a basis for the development of hypotheses, the methodology for data collection and the interpretation of results (Hort et al., 2010, p. 4-6).

A common framework for health systems is from WHO (2007). The framework focuses on six operational "building blocks": service delivery, health workforce, information, medical products and technologies, financing and leadership and governance. These building blocks would have intermediate goals of access, coverage, quality and safety and would have end goals of improved health, responsiveness, financial risk protection and improved efficiency.

Figure 1

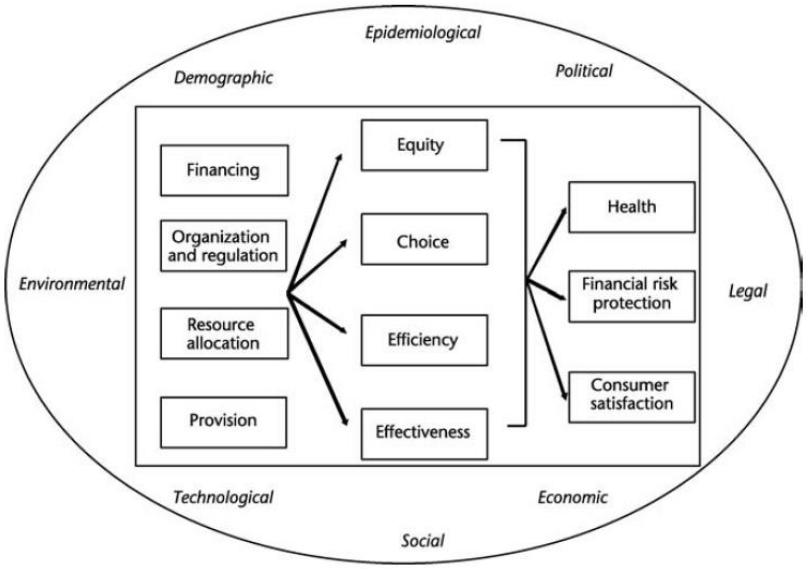
WHO Health System Framework (2007)



Atun & Menabde (2008, p. 132) further expanded the framework "to take into account the context within which the health system functions, namely, the demographic, economic, political, regulatory, epidemiological, socio-demographic and technological contexts" and showing the complex interactions between health system elements and the contextual factors. Under this framework, four levers were identified as being available to policy-makers when managing the health system: stewardship and organizational arrangements (policy environment and regulatory environment, structural arrangements for purchasers, providers and market regulators), financing, resource allocation and provider payment systems and service provision. Modification of these levers enables policy-makers to achieve different intermediate objectives and goals. The intermediate objectives are equity, efficiency, effectiveness and choice and the goals are health, financial risk protection and consumer satisfaction.

Figure 2

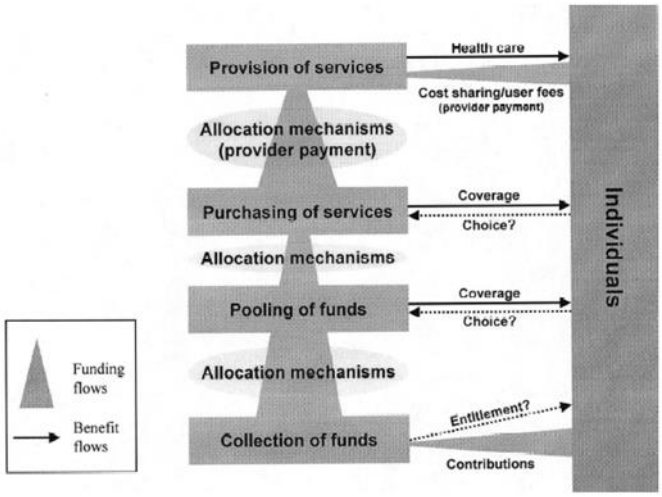
Conceptual framework for analyzing health systems (Atun & Menabde, 2008)



In contrast, the Kutzin and Hsiao frameworks take a more focused look at health financing. The Kutzin framework (Kutzin, 2001, p. 174) is a descriptive analysis of a country's health system with respect to the flow of funds (Figure 3). It describes health care financing and resource allocation including collection of funds, pooling of funds, purchasing of services and provision of services. The framework focuses on the elements of the financing system and does not provide analyses on the relationship between financing and the broader health system.

Figure 3

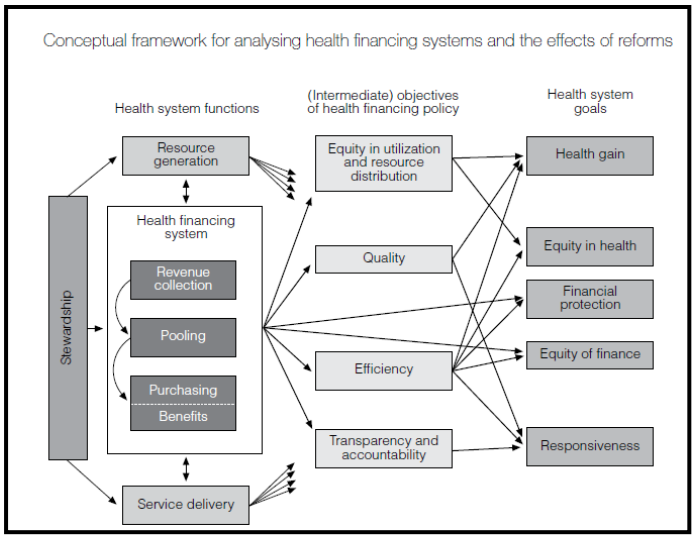
Kutzin Framework (2001)



Kutzin revised the framework (Kutzin, 2008, p. 3-24) to further detail the relationship between the health financing role and the overall health system functioning. Among broader health system goals, Kutzin described an important role for health financing in promoting equitable use and provision of services relative to need and promoting quality and efficiency in service delivery; and improving efficiency in administration of financing (Figure 4).

Figure 4

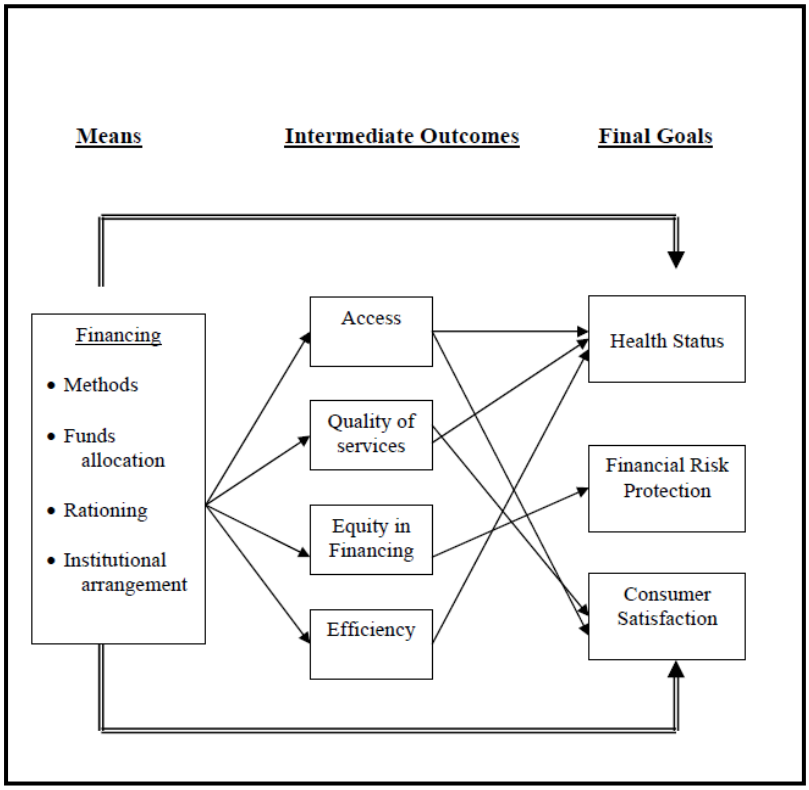
Kutzin's conceptual framework for analysing health financing systems and the effects of reforms



The Hsiao framework (Hsiao, 2003, p. 30) focuses on the major components of the health system to explain aggregate outcomes. The framework describes the different health financing functions in terms of causal links rather than through the flow of funds (Figure 5). Although there is less reference in this framework to contextual factors, there is greater recognition of "multiple, potentially competing, objectives and of the need to balance the impact on different objectives in policy making" (Hort et al., 2010, p. 6).

Figure 5

The Hsiao framework



Both the Kutzin and Hsiao frameworks illustrate general principles and are accepted frameworks in health financing research (Hort et al., 2010, p. 6).

Kutzin's updated model (2008) distinguishes the health financing role in the overall health system in terms of the objectives of the health system, the functions and policies of health financing and contextual factors including fiscal constraints. For this research, the Kutzin (2008) model provides a more appropriate conceptual framework.

1.7 Summary

In this chapter, it was noted that there are still many unanswered questions around source of health financing and health outcomes. The aim of this research is to fill the gap in knowledge regarding the relationship between the source of funding and health outcomes by analyzing existing data from 2000-2014. The specific objectives are as follows:

> Objective 1: To compare sources of health expenditure and their effect on under-five, infant, neonatal and maternal mortality in sub-Saharan African countries between 2000 and 2014.
>
> Objective 2: To compare sources of child health expenditure on under-five, infant and neonatal mortality in selected sub-Saharan African countries between 2000 and 2014.
>
> Objective 3: To provide a detailed analysis of health financing sources and health outcomes (maternal, neonatal, infant and under-five mortality) in two sub-Saharan African countries.

Common definitions of key terms were detailed and conceptual models on health financing were compared. Given the scope of research, it was determined that Kutzin's updated model (2008) is the more appropriate conceptual framework since it distinguishes the health financing role in the overall health system in terms of the objectives of the health system, the functions and policies of health financing and contextual factors including fiscal constraints.

This research is comprised of nine chapters. While this first chapter introduced the subject matter, the subsequent chapter provides the background and context for this research. A literature review is presented in Chapter 3 and provides details on the methodological aspects of the studies which informed this research. The research design and methodology are outlined in Chapter 4. Chapter 5 describes the data and analyses for Objective 1 (relationship between health expenditure and health outcomes) and Objective 2 (relationship between child health expenditure and child

health outcomes) are contained within Chapter 6 and Chapter 7 respectively. Two cases studies are presented in Chapter 8 as a means of providing a more in-depth understanding of the relationship between health financing and health outcomes. The thesis concludes with a discussion of the main findings under each of the objectives of the research along with recommendations for policy-makers and future work to inform health financing decision-making.

Chapter 2: Background and Context

2.1 Introduction

In the 1880's, European countries began establishing health insurance systems through legislative acts. Germany was the first country to establish a national health insurance system with the Sickness Insurance Law (1883) where employers were required to provide insurance for injury and illness for low-wage workers with funds generated through deductions in worker's wages and employer contributions. Other countries soon began to follow (Austria, 1887, Denmark, 1892, Belgium, 1894, Switzerland, 1911, United Kingdom, 1911, Japan, 1927) (Saltman et al., 2004, p. 21-26). However, the main component of the insurance was not the provision of treatment but income insurance for those unable to work due to poor health.

Medical breakthroughs changed the focus from income coverage to diagnosis, treatment and prevention of illness. Following World War II, publicly funded health care started in the United Kingdom (1948), followed by Sweden (1955); Iceland (1956); Norway (1956); Denmark (1961); Japan (1961); Finland (1964); Canada (1968); and Australia (1975).

While these changes were happening in Europe, North America, Japan and Australia, access to health services for people in other regions/countries remained limited. In the 1960s and 1970s, many developing countries were focused on establishing and/or continuing tertiary health services (Hall & Taylor, 2003, p. 17). These tertiary services consumed much of the country's health care budget, perpetuating issues with access to services for the predominately rural populations. Meanwhile, simple interventions such as oral rehydration solutions and vaccines, as part of a basic health service administered by caregivers and/or village volunteers, were showing significant improvements in health outcomes across China, Tanzania, Sudan and Venezuela (Hall & Taylor, 2003, p. 17). These successes, coupled with the rise in awareness about the widespread inequities in health, greatly influenced the development of a political framework in 1978 in which world leaders agreed on the priority for "health for all"

(Hall & Taylor, 2003, p. 17). Since then, the prioritization of health has been reiterated in numerous political frameworks which are detailed in this chapter.

One of the biggest limiting factors for the achievement of health for all was the ability of countries to adequately finance health services. Most of the early political frameworks on health were vague about how the health services would be financed. In recent years, there has been greater emphasis on health financing strategies. This chapter explores the evolution of global health financing strategies, the corresponding trends in health financing and health financing today.

2.2 Political Frameworks on Health

Health financing systems are heavily influenced by political frameworks for health. These frameworks often influence the investment priorities and the amount of financing generated in the country and/or from external donors.

Alma-Ata Declaration (1978)

In 1978, 134 Heads of State signed the Alma-Ata Declaration to affirm governmental responsibility for the health of their people. It was the first international declaration underlining the importance of "Health for All by 2000". The Alma-Ata Declaration generated numerous criticisms and reactions worldwide with many arguing that it was not possible to have "Health for All by 2000" (Hall & Taylor, 2003, p. 17; and Tarimo & Webster, 1994, p 88). In addition, there were no clear targets, and some felt it was too broad (Cueto, 2004, p. 1868).

In terms of financing, the Alma-Ata Declaration asserted that the cost of health care should be at a cost the community and country can afford. With the recognition that resources must increase to achieve universal access to health care, the Alma-Ata Declaration encouraged political will to mobilize more resources nationally and internationally and it urged better use of these resources (WHO, 1978). However, the Declaration did not go so far as to indicate how much should be invested, by whom and how the investments should be made to achieve universal access to health care.

World Health Assembly's Global Strategy for Health for All (1981)

Shortly after the adoption of the Alma-Ata Declaration, the World Health Assembly agreed to the Global Strategy for Health for All where the main target was "to ensure that all people in all countries have at least such a level of health that they are capable of working productively and of participating actively in the social life of the community in which they live" (WHO, 1981, p. 15). Evaluations of progress in implementing the Global Strategy for Health for All by the year 2000 showed improvements in access to health care and health status of many people following the approval of the strategy (WHO, 1998 and WHO, 1988). However, there was a noted disparity in health outcomes between developed and developing countries, with billions of people lacking access to primary health care (WHO, 1988). Moreover, health data were not comprehensive with many countries not reporting at all or not reporting on all indicators (WHO, 1998). Critics of the strategy noted concerns about the resource requirements for health given the growing costs of health services which largely went unaddressed (WHO, 1998).

United Nation's Millennium Declaration and the Millennium Development Goals (2000)

With the lessons learned from Health for All and recognition of the link between health and poverty reduction, there was a push to have more concrete and defined goals which could lead towards not only improved access to health care but also poverty alleviation (WHO, 2001). World leaders came together at the United Nations to commit their countries to a new global partnership to reduce extreme poverty, in their various forms, and to set out a series of time-bound targets. The partnership resulted in the signing of the Millennium Declaration in September 2000 which established eight goals, termed the Millennium Development Goals (MDGs), to be reached by 2015. Three of the goals focused on health (Goal 4: reduce child mortality (MDG4); Goal 5: improve maternal health (MDG5); and Goal 6: combat HIV/AIDS, malaria and other diseases (MDG6)), and two more were strongly related to health (Goal 1: eradicate poverty and hunger; and Goal 7: ensure environmental sustainability). The MDGs were considered revolutionary as they galvanized participation across a variety of actors and provided a common language to reach global agreement. The eight MDGs were considered by

many researchers to be realistic and easy to communicate, with a clear measurement/monitoring mechanism (Rippen, 2013, p. 34; Hulme, 2010, p. 15; Dodd and Cassels, 2006, p. 379-380; and Vandemoortele, 2008, p. 221). Overall, the MDGs brought about unprecedented attention to some of the world's most pressing development issues (Langford et al., 2013, p. 27; Lawn et al., 2007, p. 551; and Dodd & Cassels., 2006, p. 380).

Conversely, the MDGs were heavily criticized for failing to consider the holistic nature of development and the root causes of issues such as poverty. The MDGs did not address many key aspects including human rights (Cecchini & Notti, 2011, p. 121–133; Ziai, 2011, p. 27-43; and Deneulin & Shahani, 2009, p. 66), inequalities (Vandemoortele, 2011, p. 9-25; Vandemoortele, 2010, p. 1-2; Gwatkin, 2005, p. 813-7; Reidpath et al., 2009, p. 1-2) and did not specifically address economic development (Oya, 2011, p. 27; and Curtis & Poon, 2009, p. 837-848).

The years following the adoption of the MDGs, dramatic results were shown particularly in terms of realizing the goal of halving extreme poverty (UN, 2015, p. 4, 14-23). While there was significant progress under the health-related indicators, there was significant variation between regions and countries (UN, 2015, p. 32-37). This highlighted a further issue of translating global MDG targets to country-level targets. Targets were "translated in a very superficial manner to national and sub-national contexts" (Oya, 2011, p. 24) negating starting points. This was particularly problematic for African countries, who were behind the baselines for the MDG indicators than other regions and constraints on financing and capacity made it near impossible to achieve the MDG targets (United Nations Economic Commission for Africa et al., 2015, p. xvi). Only a third of African countries either met or came close to meeting the target to reduce child mortality and only four African countries (Cape Verde, Equatorial Guinea, Eritrea and Rwanda) met the target of reducing maternal mortality by two-thirds (United Nations Economic Commission for Africa et al., 2015, p. xiii-xv). There were mixed results for combatting HIV, malaria and other diseases with reductions in HIV incidence, malaria cases and malaria deaths (United Nations Economic Commission for Africa et al., 2015, p. 39-44).

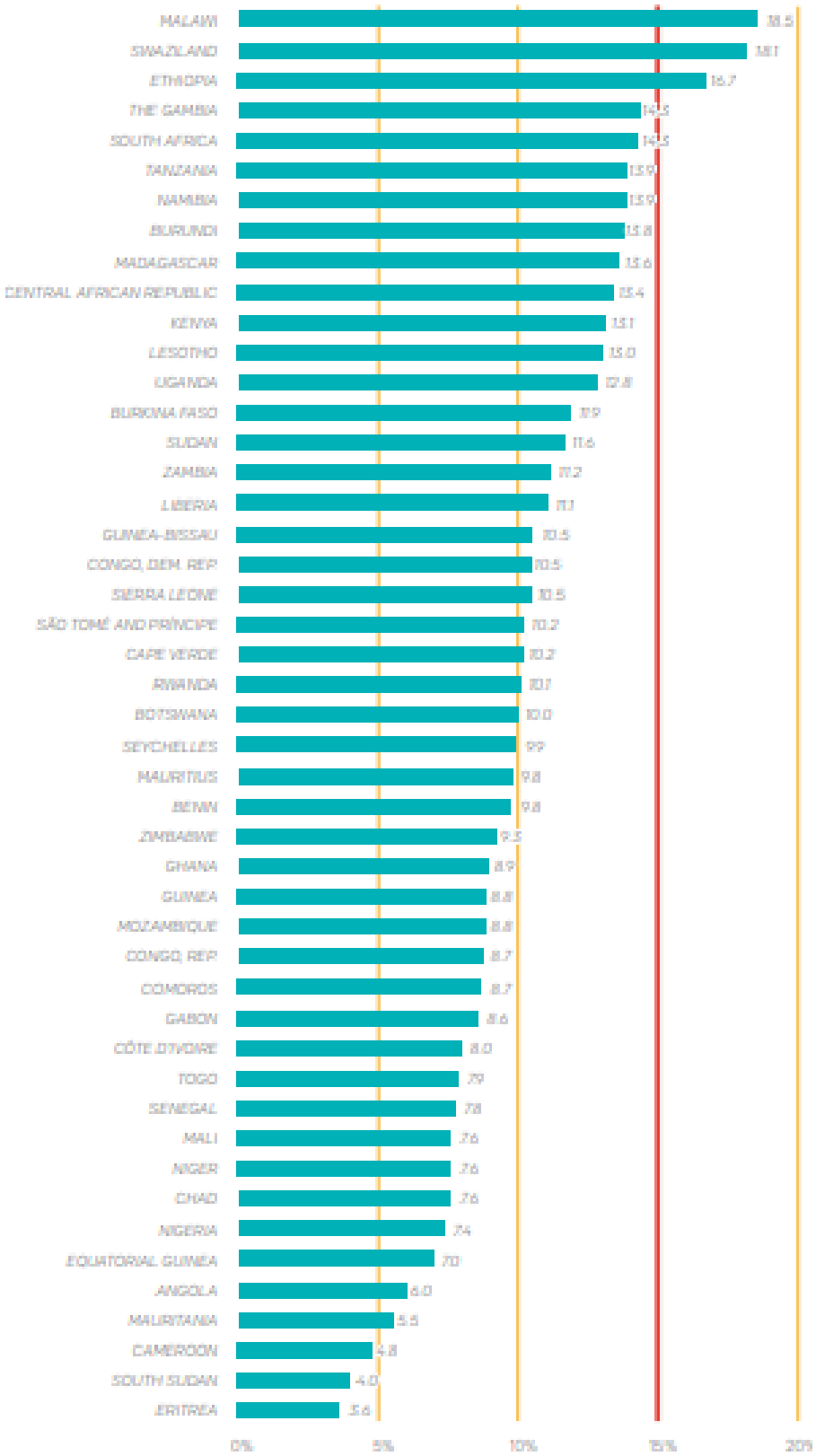
The MDGs were considered a global framework document which, in theory, applied to all countries. In reality, the MDGs were considered targets for poor countries to achieve, whereas wealthy states were considered as the financiers to achieve the targets (Saith, 2006, p. 1167-1199). The focus for health financing under the MDGs were centered on increasing external resources for health including ODA. MDG8 highlighted the need for global partnerships for development and while this helped to generate momentum for new health financing mechanisms (The Global Fund for HIV, Tuberculosis and Malaria; and The Global Alliance for Vaccines Initiative (GAVI)), it fell short by ignoring the importance of domestic resources in health financing (UN System Task Team on the Post-2015 UN Development Agenda, 2013, p. 5).

African Union's Abuja Declaration (2001)

In line with MDG6, combatting HIV/AIDS, malaria and other diseases, African leaders met to discuss the serious consequences these diseases have had on the health of their people and the corresponding impact on their health systems. Under the Abuja Declaration, not only did African leaders politically commit to responding to these diseases, they committed to ensuring that the necessary resources from all sources were made available for health (WHO, 2001). The Declaration requested donors to increase funding but it also set a very clear target for African governments: 15 per cent of the annual government budget was to be allocated to health. By 2014, only three African countries (Ethiopia, Malawi, and Swaziland (now called Eswatini)) achieved the Abuja target (refer to Figure 6), although South Africa and The Gambia came close. However, both ONE and WHO noted changes every year in which countries met the target, noting that fewer than half of the African countries met the Abuja target in any given year (ONE, 2016, p. 3; and WHO, 2011, p. 3).

Figure 6

General Government Health Expenditure as a % of General Government Expenditure 2012-14 Average (from ONE, 2016, p. 5)



Rio+20 Conference on Sustainable Development (2012)

As the end of the MDGs neared, there was much focus on what the post-2015 development agenda would look like. In 2012, heads of state from 192 governments came together at the Rio+20 Conference on sustainable development and produced a working paper titled "The Future We Want" (UN, 2012). It was in this working paper that the MDGs begin to be transformed to address all three dimensions of sustainable development (environment, economics and society) and their interlinkages for the post-2015 development agenda (UN, 2012).

United Nation's 2030 Agenda for Sustainable Development and the Sustainable Development Goals (2015)

To pick up where the MDGs left off and to consider some of the lessons learned under the MDGs, a large consultation process took place to develop and agree upon the set of goals for the post-2015 development agenda. In September 2015, the UN General Assembly adopted the 2030 Development Agenda "Transforming our world: the 2030 Agenda for Sustainable Development". Under this agenda, the Sustainable Development Goals (SDGs), a set of seventeen aspirational global goals, were outlined. While only one of the seventeen goals is directly related to health, termed SDG3, the goal is to ensure healthy lives and promote well-being for all at all ages. However, all the SDGs are considered to be interrelated and contribute the health of a population.

As a whole, the SDGs are considered to be ambitious and inclusive of the entire global community. However, critics fear that there is less focus under the SDGs with over 169 targets, many of which are vague; and with a low level of obligation of the signatories, there is doubt whether the SDGs will achieve what it has set out to (Persson et al., 2016, p. 59-68). Furthermore, it is estimated that the SDGs will require a global investment of US$ 5-7 trillion per annum and in developing countries investments of US$3.3-4.5 trillion per annum for the next 15 years (UNCTAD, 2014, p. xi), making the achievement of the SDGs questionable.

2.3 Global Health Financing Strategies

The political frameworks on health, defined in section 2.2, are often vague about the financing for health and fail to indicate how much should be invested, by whom and how the investments should be made. Moreover, some political frameworks overemphasized external resources for health and often ignored the domestic inputs into financing health.

By 2002, there was increasing demand for a new "aid architecture". The first International Conference on Financing for Development highlighted six key areas of focus in what was termed the Monterrey Consensus (2002):

1. Mobilizing domestic financial resources for development.
2. Mobilizing international resources for development: foreign direct investment and other private flows.
3. Increasing international trade.
4. Increasing international financial and technical cooperation.
5. Reducing external debt.
6. Addressing systemic issues: enhancing the coherence and consistency of the international monetary, financial and trading systems in support of development (OECD, 2002).

The following year, at the first International Forum on Financing for Development, the focus reverted to external resources, specifically on how to make aid more effective. Under what is termed the Rome Declaration (2003) the following key priority actions agreed:

- Development assistance be delivered based on the priorities and timing of the countries receiving it;
- Donor efforts concentrate on delegating co-operation and increasing the flexibility; and
- Good practice be encouraged and monitored (OECD, 2003).

Building on the Rome Declaration, the second International Forum on Financing for Development focused on agreeing additional principles about aid/external resources. The Paris Declaration on Aid Effectiveness (2005) encouraged greater country

ownership, harmonization of support measures, better alignment to national systems, and a commitment to mutual accountability. Further emphasis was placed on these principles at the third International Forum on Financing for Development, where the Accra Agenda for Action was agreed. The principles set out in the Paris Declaration and Accra Agenda for Action changed the mechanisms of financing for development with aid recipient countries maintaining ownership by forging their own national development strategies, including detailing budgetary gaps; donors supporting and aligning to these plans; harmonization; goal setting that could be monitored; and joint responsibility for achieving the goals (OECD, 2008).

These principles have also served as the foundation for other commitments: the Bogota Statement which concentrated on effective aid principles in south-south cooperation, a term used to describe the transfer of resources, technology and knowledge between developing countries; Istanbul Principles which outlined the role of civil society in financing; and the Dili Declaration which concentrated on effective aid in fragile and conflict-affected states (OECD, 2008).

In 2008, amid the global financial crisis, the second International Conference on Financing for Development was held to encourage donor countries to maintain their financial commitments. The Doha Declaration encouraged:

1. Maintenance of ODA
2. National ownership of development strategies
3. The need for strong policies on good governance, accountability, gender equality and human development
4. Increasing international trade
5. Consideration for debt restructuring mechanisms
6. Review of existing global economic governance arrangements, with a view of comprehensive reforms to the international financial system and institutions (OECD, 2008).

Although there had been increased foreign aid investments, there were still significant gaps in reaching the targets set out in the MDGs. At the Fourth International Forum on Financing for Development, the focus was again on aid and how to maximize its

impact, termed the Busan Partnership for Effective Development Co-operation (OECD, 2011).

By 2015, there was a recognition that there was an overreliance on ODA and it undermined the economic sustainability of interventions as ODA rose and fell with the economic health of the donor countries and/or political changes in the respective countries (MDG Report, 2015, p. 62-3 & 68). With this recognition and the launch of the SDGs, there was an increasing demand to diversify funding sources and for public policies and regulatory frameworks to set the right incentives for investments. This formed the guidance of how the SDGs should be financed at the third UN Financing for Development Conference. In what was termed the Addis Ababa Action Agenda (AAAA), the focus was on domestic resource mobilization including widening the revenue base, improving tax collection and combatting tax evasion; and it detailed all sources of finance that will contribute to meeting the SDGs including ODA, south-south cooperation and private investment (UN, 2015c).

2.4 Historical Trends in Health Financing

Through the 1960s to the 1980s, development theory focused on meeting individuals' basic needs, particularly in family planning, nutrition, health and education (Ruger, 2005, p. 60). However, by the 1980s, economic crisis, sharp reductions in public health spending, political instability, and emerging disease, led to an almost a total collapse of health systems in many LMIC and reducing the coverage and quality of remaining health services (Waiswa, 2012, p. 1; and ODI, 1982, p. 4-5).

Many countries had to increasingly borrow funds to pay for public services and many were carrying large budget deficits. From 1970 to 1980, "the external debt of sub-Saharan African countries increased from 14.6% of the region's gross domestic product (GDP) to 28.7%" (Siebrits & Calitz, 2006, p. 8). In an effort to minimize the deficits and to meet the demands of creditors towards the late 1980s, many countries, at the direction of creditors, reduced publicly funded health services in favour of cost recovery programs (World Bank, 1987, p. 1-7). Many countries introduced user fees to cover the cost of health services. Issues were soon raised about the negative impacts

of these cuts to the public health service as out of pocket payment for services were often catastrophic and further plunged families into poverty (Gilson et al., 1997).

In the 1990s, the focus returned to strengthening public health services and ownership over health programs largely returned to governments with the support of development partners. The number of development partners increased dramatically during this period. By the late 1990s, there was heavy scrutiny of development partner modalities due to issues regarding lack of coordination and creation of parallel structures, which overburdened the recipient government administration and increased transaction costs (Fernandes Antunes et al., 2008, p. 6).

Following the adoption of the MDGs, the 2000s marked a growing movement for increasing external resources for health including ODA. This helped to generate momentum for new global health financing mechanisms (The Global Fund for HIV, Tuberculosis and Malaria; and The Global Alliance for Vaccines Initiative (GAVI)) which combined donor and private sector finances across the world and awarded grants to recipient countries in an effort to more efficiently provide resources to the countries in most urgent need (GAVI & Global Fund, 2013, p. 3-4).

This period also marked a change in the way development assistance was viewed with increasing demand for a new “aid architecture”. Efforts were made to encourage greater country ownership, harmonization of support measures, better alignment to national systems, and a commitment to mutual accountability. By the 2010s, there was a recognition that there was an overreliance on ODA (UN, 2015b, p. 68). With this recognition and the launch of the SDGs, there was an increasing demand to diversify funding sources, particularly to increase domestic financing, and to invest more effectively and efficiently (UN, 2015d, p. 1). Despite progress in generating additional resources for health, particularly external funding, there continued to be a large gap between disease burden and the resources required to address health needs (UNCTAD, 2014, p. xi).

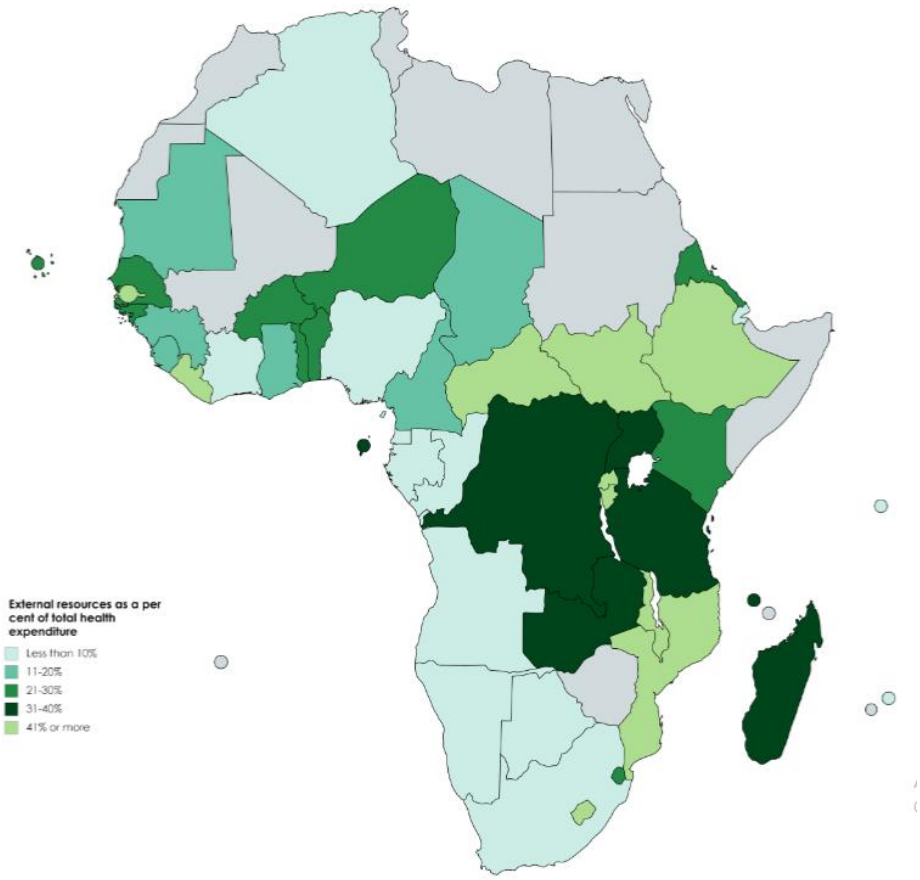
2.5 Health Financing Since 2010

In 2011, more than US$6.9 trillion was spent globally on health (WHO, 2014, p. 2), making it one of the largest industries in the world. According to the WHO Global Health Expenditure Atlas (WHO, 2014, p. 7), most of the health spending was in the 34-member countries of the Organization for Economic Cooperation and Development (OECD). These countries represent only 18% of the global population and approximately 10% of the global disease burden yet accounts for 82% (US$ 5.7 trillion) of global health expenditure. Conversely, sub-Saharan Africa accounts for 15% of the global population and 24% of the world's disease burden (including almost half of the world's under-five deaths and the highest maternal mortality), yet only 1% of global health expenditure (WHO, 2014, p. 7; and World Bank, 2008, p. iii).

The High-Level Taskforce on Innovative International Financing for Health Systems estimated that an average of US$44 per capita needed to be spent in low-income countries to strengthen health systems and provide a basic package of health services (Taskforce on Innovative International Financing for Health Systems, 2009). In 2012, 28 countries, out of 49 in the Africa region, were spending more than US$44 per capita, an increase from 11 countries in 2002 (WHO, 2014, p. 3-4). However, as government resources are limited, many low- and middle- income countries rely on foreign aid to cover the public health financing gaps. Foreign aid has risen steadily since 1995 from about US$8 billion to nearly US$35.9 billion in 2014 (Institute for Health Metrics and Evaluation, 2015, p. 9), with the major donors continuing to be the European Union, United States, United Kingdom, Germany, Japan and France. Many countries in the sub-Saharan Africa region rely heavily on donor funding to finance health care. More than half of the countries in the sub-Saharan Africa region source 20% or more of the total health expenditure from external sources (WHO, 2014, p. 9; WHO, 2014b, p. 40, refer to Figure 7, noting that there was no data for Somalia and Zimbabwe).

Figure 7

External resources as a per cent of total health expenditure (Source: WHO 2014b)



By 2015, there was a recognition that there was an overreliance on external resources for health and, with the launch of the SDGs, there was an increasing demand to diversify funding sources and for policies and regulatory frameworks to set the right incentives for investments.

The latest political framework is 2030 Development Agenda "Transforming our world: the 2030 Agenda for Sustainable Development". Under this agenda, one SDG is to ensure healthy lives and promote well-being for all at all ages (SDG3). The guidance for financing the SDGs was provided at the third UN Financing for Development Conference, in the Addis Ababa Action Agenda (AAAA). The AAAA focuses on domestic resource mobilization and it details all sources of finance that will contribute to meeting the SDGs including ODA, south-south cooperation and private investment.

With a defined health goal under the SDGs, and related health indicators, along with recognition of the various sources of health financing, it is an important time to look more in detail at the relationships between sources of health financing and health outcomes as a means to inform health financing policies and decision-making.

2.6 Summary

Successes in rolling out simple interventions such as oral rehydration solutions and vaccines as part of a basic health service administered by caregivers and/or village volunteers influenced the development political frameworks such as the Alma Ata Declaration which prioritized "health for all". Since then, numerous political frameworks have generated global attention for health. However, these political frameworks often ignored or were vague about how health services would be provided to all. Many countries relied on borrowing funds but, with the demands of creditors, moved to cost recovery programmes where user fees were put in place. The detrimental effects of these actions resulted in an overemphasis on external resources for health.

From 2000, the MDGs raised attention for some of the biggest development issues, especially related to the control of infectious diseases such as HIV/AIDS and malaria, and generated momentum for increased external resources for health including through new health financing mechanisms. The importance of other sources of financing, specifically domestic inputs into financing health, was largely ignored. However, in most countries, the majority of health financing comes from domestic sources (government, out of pocket or private expenditure on health). The adoption of the latest political framework, the SDGs, increased attention to health development issues and highlighted the importance of other sources of health financing and the need to diversify funding sources.

Chapter 3: Literature Review

3.1 Introduction

This chapter reviews existing literature on sources of funding and their relationship to health outcomes. This chapter provides the available literature on:

- government expenditure on health and health outcomes;
- external expenditure on health and health outcomes; and
- private and out of pocket expenditure on health and health outcomes.

The latter part of this chapter will detail a literature review for published works that contain information on health financing sourced from the government and donors on health outcomes. This part focuses on the methodological aspects of the studies and the corresponding findings related to the relationship between source of health financing and health outcomes.

3.2 The relationship of government expenditure on health on health outcomes

There is limited research on the relationship between government expenditure on health and health outcomes. The results of the research were inconclusive. Zakir and Wunnava (1999) used a cross-sectional model to analyze government expenditure on health as a percentage of gross national product (GNI) in 117 high-, low- and middle-income countries. Using generalized least squares regressions, they found that government spending on health did not significantly affect infant mortality. As mentioned in the previous section, Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) suggest that outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data). This may also be the case for the study by Zakir and Wunnava (1999).

Kruk et al. (2007) examined the share of government health expenditure in relation to total health expenditure and utilization of maternal health services in 42 low and lower-middle-income countries using panel data multivariate regressions. The study showed that the government share of health care spending is not significantly associated with uptake of antenatal care but is associated with the presence of a skilled birth attendant

and increases in Caesarean sections. As the presence of a skilled birth attendant and increases in Caesarean sections are essential interventions to reduce maternal mortality, the study suggests that higher shares of government health expenditure in relation to the total health expenditure result in better health outcomes (maternal mortality). One of the limitations of the study was that the dependent variables were available for only one point in time but that point ranged from 1990 – 2004 for the countries included in the study. With the government share of health expenditure data from 1998 – 2004, there were eight countries in which the dependent variable data was from a period prior to the health expenditure data.

3.3 The relationship of development assistance for health on health outcomes

As government resources are limited, many low- and middle- income countries rely on foreign aid to cover the public health financing gaps. Foreign aid has risen steadily since 1995 from about US$8 billion to nearly US$35.9 billion in 2014 (Institute for Health Metrics and Evaluation, 2015, p. 9). Many countries in the sub-Saharan Africa region rely heavily on donor funding to finance public health care. Almost half of the countries in the sub-Saharan Africa region source 20% or more of the total health expenditure from external sources (Kirigia & Diarra-Nama, 2008).

Research on the relationship between development assistance for health and health outcomes indicates that increases in development assistance for health have resulted in improved health outcomes (Akachi & Atun 2011; Bendavid & Bhattacharya 2009; and Mishra & Newhouse 2009). Akachi and Atun (2011), using panel data regression analysis for 34 sub-Saharan African countries, showed that for every US$1 million of ODA for malaria control, 50,478 bed nets were distributed and, between 2002 – 2008, a cumulative investment of US$1,916 million in ODA for malaria in sub-Saharan African countries prevented 240,000 deaths.

Bendavid & Bhattacharya (2009) examined investments from one donor, the United States, earmarked for HIV under the President's Emergency Plan for AIDS Relief (PEPFAR) and the impact on HIV-related deaths across twelve African countries. They found that compared to selected control countries not funded by PEPFAR, the PEPFAR funded countries showed a 10.5% reduction annually in the number of HIV-

related deaths which equated to a reduction of roughly 0.5 HIV-related death per 1,000 population.

Mishra and Newhouse (2009) examined the relationship between health aid and infant mortality using panel data from 118 countries. Using ordinary least squares and generalized method of moments regression, they found that doubling per capita health aid is associated with a 2 per cent reduction in the infant mortality rate.

However, these studies failed to consider the crowding out effect of aid. For most donors, the purpose of foreign aid is to increase the total amount of funding available to support health programs. Donors expect governments to maintain their own funding for health programs regardless of the amount received from foreign sources. In reality, additional funding from donors does not necessarily translate into greater funds for health programs. Several studies (Dieleman & Hanlon, 2014; Lu et al., 2010; and Farag et al., 2009) showed that foreign funding often substitutes for national funding. Lu and colleagues, using panel data regressions for developing countries, showed that for every dollar of international health aid provided to governments, government health funding fell by US$0.43—1.14. Dieleman and Hanlon (2014) explored the relationship between government health expenditure and development assistance for health using general method of moments estimation for 119 countries covering 16 years. They found that for every US$1 increase in donor funding for health, there was a US$0.62 decrease in government funding and for every US$1 decrease in donor funding for health, there was no statistically significant increase in government funding. Dieleman and Hanlon estimate that between 1995 and 2010 total government health expenditure reduced by US$152.8 billion.

The reductions in government health expenditure are a result of deliberate policy choices. With limited domestic resources and a number of competing priorities, governments may redirect funds that would have otherwise been invested in health. If countries may accept the trade-offs of selecting priority areas for funding as donors will fund based on their own priorities; and the unpredictability of donor funding which makes it difficult for countries to effectively plan, coordinate and manage the public health system including losing the ability to ensure priority areas are funded as

governments allocate funds based on an expected level of donor funding which may not be realized.

3.4 The relationship of private and out of pocket expenditures on health outcomes

Globally, private expenditure on health accounts for 40% of total health expenditure (WHO, 2019, p. 11). In the African region, 56% of health expenditure comes from private sources (Atim et al, 2008, p.10).

Research on the relationship between private expenditure on health and health outcomes suggests that private expenditure reduces under-five, infant and maternal mortality. Kiross et al (2020), using a panel analysis for 46 sub-Saharan African countries, showed that private health expenditure was not significantly associated with either infant or neonatal mortality. Novignon et al. (2012) used panel data covering 44 countries in sub-Saharan Africa to perform fixed and random effects regressions and showed that a 1 per cent increase in private expenditure on health reduced infant mortality by 2 infants per 1,000 live births. Continuing with panel data for sub-Saharan African countries and performing fixed and random effects regressions, Novignon and Lawanson (2017) showed that increases in private expenditure on health reduced infant and under-five mortality.

Moreover, research by Issa and Ouattara (2005) suggests that differences in the relationship between private expenditure on health and health outcomes may be due to income levels of the countries. Issa and Ouattara divided 160 countries into two groups based on income level. They used panel data and ordinary least square regression. In the high-income group (54 countries), the results showed that a 1% increase in private expenditure on health caused a 0.35% to 0.85% decrease in infant mortality rates. In the low-income group (106 countries), the results showed that a 1% increase in private expenditure on health was associated with decreases in infant mortality but at a much smaller scale than the high-income group and only significant at a 10% level. When all countries were grouped together, the results were inconclusive.

The research findings may be inherently mixed due to the components that make up private expenditure on health: private insurance and out of pocket expenditure. Private insurance is purchased prior to any illness or health need and is intended to protect individuals from unpredictable and catastrophic health costs. Conversely, out of pocket expenditures on health occur at the time of illness or when health services are needed. In the United States, mortality rates among the uninsured exceeded mortality rates of insured individuals by between 25 and 40 per cent (Wilper et al. 2009; and Franks et al. 1993) indicating that relying on out of pocket expenditures may have significant effects on mortality.

In the African region, approximately 80% of private expenditure on health was sourced from out of pocket payments by households (Atim et al, 2008, p. 10). Research on the relationship between out of pocket expenditure on health and health outcomes varies but the literature suggests increased out of pocket payments are associated with increases for under-five, infant and maternal mortality.

Plumper & Neumayer (2012) showed that a higher out-of-pocket expenditure, as a share of total health expenditure, was associated with lower mortality rates in 21 OECD countries over the period 1984 to 2007. They suggest that one potential reason why a higher share of out of pocket expenditure does not lead to higher mortality rates is that many of these countries exempt the very poor or the very ill from such payments thus reducing any negative effects on health. This work aggregated mortality data for mothers and children with the general population. When examining infant and child mortality rates, Muldoon et al (2011) found that out of pocket expenditure on health was associated with higher infant and child mortality rates across 128 UN member countries.

Looking at regional findings, Akinci et al. (2014) found that increased out of pocket expenditure on health is associated with slight increases in under-five, infant and maternal mortality in a panel study of 19 countries in the MENA region between 1990 and 2010. Fofack & Sarpong (2019) found that increasing out of pocket health expenditure was related to an increase in maternal mortality in a panel study of twenty Central and Latin American countries between 2000 and 2015. This also aligns with country specific data including the work by Keats et al (2018) which found

that under-five mortality increased in Kenya between 1990 and 2000, following the introduction of out of pocket payments for health services.

As out of pocket payments rely on the ability to pay, it can cause financial hardship for poor households or those households where someone needs long-term treatment and can be catastrophic. Catastrophic health spending is defined as "out of pocket payments that exceed a predefined percentage or threshold of a household's ability to pay for health care" (OECD/European Union, 2018, p. 172). With the 2030 Agenda, there is renewed focus on reducing the impact of out of pocket expenditure on health on the household's budget to ensure greater financial protection.

3.5 The relationship of proportion of health financing sourced from the government and donors on health on health outcomes

While there is research examining a funding source and the corresponding health outcomes, very little research was found that examined the relationship between the proportion of health financing sourced from the government and donors and the impact this has on the health outcomes of a population.

A review of existing literature was conducted using the following electronic databases: Science Direct, Proquest, Econolit, MedLine (Ovid) and PubMed for articles published between 2000 and 2015. Further articles were also identified by citation snowballing from the identified journal articles. The search terms used were health funding, health financing, government health expenditure, total health expenditure, sources of funding, domestic, foreign, health outcomes and maternal and child health (refer to Appendix 2: Keyword Search for Literature Review).

For this research, only studies meeting the following criteria were included:

- Interventions: public/government commitments, disbursements or expenditures AND foreign/donor commitments, disbursements or expenditures had to be reported. If only one intervention was reported, the study was excluded from this review. Studies on private financing, health

insurance, user fees, taxation, conditional cash transfers, incentives and performance-based financing were excluded.

- Outcomes: a health outcome(s) or intervention coverage had to be the dependent variable of a study. A health outcome was defined as a change in the health status of an individual, group or population which is attributable to a planned intervention or series of interventions, regardless of whether such an intervention was intended to change health status. Studies examining health reforms or cost of service/medical intervention were excluded from the review.
- Studies had to be published in English.

A total of 300 references were identified during the electronic database searches and an additional 6 references were identified through citations or web site searches. The removal of duplicates resulted in 29 references being excluded. A total of 277 were reviewed for relevance. Titles were screened, and abstracts were reviewed and evaluated according to the exclusion criteria outlined in the methods section. Following the review, 258 references were excluded on the basis of irrelevance. A total of 19 references were included for the more in-depth review. Fifteen studies were excluded with reasons following the in-depth review (refer to Appendix 3: Literature Review References Identified).

Only four studies met the above criteria. A summary of these studies is provided in Table 1.

Table 1

Impact of source of health financing on health outcomes studies

Study	Location/Sample	Data dates	Data Sources	Study Design	Data Analysis	Key Findings
Achoki and Chansa (2013)	Zambia	2004 – 2009	Programme reports, OECD, UNICEF, UN Statistics Division, WHO, DHS IHME, CHERG, IGME	Panel	GMM	A 60% annual increase in funding channelled through the government system would lead to the achievement of overall intervention coverage of 85% for key maternal and child health interventions within a 6-year period whereas a 60% annual increase in funding disbursed directly by donors would take over 9 years to achieve a similar effect.
Bokhari et al. (2007)	127 countries	2000	OECD, WHO, World Bank, UN Statistics Division UNESCO, UNICEF	Cross-Sectional	2SLS, GMM-H2SLS	Increased government health expenditures improve health outcomes (U5 and maternal mortality) with substantial variation across countries. For a 10% increase in government health expenditures the change in maternal mortality is typically 1.6–1.7% more than the change in U5 mortality. Donor funding does not have any significant impact on health outcomes.
Gottret and Schreiber (2006)	113 countries	2000	OECD, World Bank, UNICEF, WHO	Cross-Sectional	2SLS, GMM-H2SLS	Government health expenditures improves under-five and maternal mortality. Donor funding impacts under-five mortality but does not directly impact maternal mortality. `Donor funding indirectly affects maternal mortality by increasing the impact of governmental health expenditures.
Shaw et al. (2015)	2 countries	1990-2011	OECD, NHA, World Bank	Case Study	Observe, think, test, revise	Ethiopia has better primary health care related outcomes although it sources less total health expenditure from government sources and has greater amounts of donor financing than Nigeria. Allocative efficiency of public spending on primary health care depends greatly on the (i) political will to improve both financing and delivery of services; (ii) harmonization or at least strong synergies of external and domestic spending on primary health care; and (iii) allocation of spending to services most relevant to reducing the country's burden of disease.

The four studies showed mixed results. Two studies (Gottret & Schieber, 2006; and Bokhari et al., 2007) found that increases in government funding for health improved health outcomes (under-five and maternal mortality) but donor funding for health had little to no effect on health outcomes. One study (Achoki & Chansa, 2013) showed that government health financing achieves coverage of health interventions faster than donor financing. The last study (Shaw et al., 2015) suggests that donor financing may show better health outcomes than government funding.

The mixed results may have been due to the inherently different methods of examining the data in the studies under review with the studies using different types of data and different study designs. Given that observable changes in health outcomes take time, it was surprising that only one study examined multi-year data for trends. This indicates a significant gap in the available information about government and donor financing and their relationship to health outcomes. Although there are limitations in panel data, it is recognized as having greater reliability than cross-sectional data (Wooldridge, 2002) and thus should be prioritized for further research.

Gottret & Schieber (2006) and Bokhari et al. (2007) used donor commitment data yet not all commitments are disbursed and not all funds disbursed are expensed. Interestingly, to adjust for this, both Gottret & Schieber (2006) and Bokhari et al. (2007) used lag data for donor commitments for the year 2000. It raises questions on whether donor expenditure data would have caused significantly different results, as relationships with health outcomes would only be expected after the funds have been spent.

Moreover, as it takes time for funding to be translated into health services and even more time to become observable changes in health outcomes, it is uncertain whether a cross-sectional study design is the most appropriate to provide information on these relationships. Examining funding and health outcomes over a longer period of time would be beneficial to understanding the relationships of these variables. Only one of the studies (Achoki & Chansa 2013) included in this review used data in a longitudinal manner that allowed comparisons to be made between financing and outcomes thus recognizing the time it takes for funding to be translated into health services and subsequently for these to have any impact on health outcomes. However, Achoki &

Chansa (2013) did not provide clear information on the total health expenditures including how much of the total health expenditure is at the provincial level and whether there are significant and relevant expenditures at national level that may contribute to the coverage of key health interventions in the provinces.

The mixed results found in this review may have also been due to masking of effects by country income or other contributions to the health sector. Previous research by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005), described earlier in this chapter, indicated that outcomes may be different for countries with different income levels. In Shaw et al. (2015) the two countries examined were of different income levels. Hence, it is unclear whether other variables may have masked the impact of government and donor financing on health outcomes since countries of different income levels may have substantially different sources of financing for their health system. Categorizing countries according to income level may help in better understanding relationships.

The effects may have also been masked because the funding was related to the entire health sector not just the health outcomes examined. There is very little disaggregated health financing data available that attributes funding to intervention area. While financial inputs in the health sector would presumably improve the health provided for child health, it would be interesting to explore the relationship between health expenditures on children and child health outcomes.

The effects may have also been masked because of the different contributions to health financing. We can assume that most of the government and donor funding is directed to the public health systems. However, the health outcome data reflects all inputs in the health system including those by the private sector and by individuals through out of pocket expenditures. Most of the studies did not detail the other contributions to the financing of the health services. For the one study that did detail this information (Shaw et al., 2015), the researchers compared countries where there were significant differences in household contributions. In Nigeria, 69% of the total health expenditure is from household contributions whereas in Ethiopia it is 33%. As the study only examines donor and government funding not household expenditure, it is questionable why these two countries were compared and whether any of the conclusions drawn

may have in fact been due to the impact of household expenditures. Therefore, it may be useful to analyse countries with similar funding sources and track over a period of time to see if there are any trends that may be observed.

While the results of this review are inconclusive, this review has shown the need for a rigorous method for analysing the government and donor financing and corresponding health outcomes to generate much needed evidence on effectiveness and efficiency of health financing.

3.6 Summary

There is existing research examining the association between a single funding source and health outcomes. In examining government expenditure on health, Zakir and Wunnava (1999) found no significant effect on infant mortality in their cross-sectional study for high, middle and low-income countries; and Kruk et al. (2007) showed mixed results. These studies had several limitations including failure to account for a lag between when the funding is expensed and the provision of health services; the relationship between government expenditure on health and health outcomes may be masked due to other factors related to country income levels; and they fail to take into account the investments from other financing sources which contribute to the health outcomes of the country.

Research on the relationship between external funding and health outcomes has indicated that increases in external funding have resulted in improved health outcomes (Akachi & Atun, 2011; Bendavid & Bhattacharya, 2009; and Mishra & Newhouse, 2009). These studies were limited because many focused on results from one source of donor funding or funding to one sector; did not account for countries with different income levels; and did not account for the effect of donor funding on government funding (crowding out effect).

More panel research was found when examining the literature on the relationship between private expenditure on health and health outcomes. The literature suggests that increased private expenditure reduces under-five, infant and maternal mortality. However, the research did not differentiate between the components that make up

private expenditure on health: private insurance and out of pocket expenditure. Focusing only on out of pocket payments, as this is the predominant source of private expenditure in sub-Saharan Africa, it appears that increased out of pocket payments are associated with increases for under-five, infant and maternal mortality but may be dependent on income levels of countries.

Only four studies (Gottret & Schreiber, 2006; Bokhari et al., 2007; Achoki & Chansa, 2013; and Shaw et al., 2015) were found that examined the relationship between the proportion of health financing sourced from the government and donors and the impact this has on the health outcomes of a population. Two studies found that government health expenditures produced better health outcomes than donor financing; one study shows that government financing enables coverage of health interventions faster than donor financing; and one study shows one country with higher donor financing had better health outcomes than another country with higher government financing.

The mixed results found in this review may have been due to the inherently different methods of examining the data in the studies under review with the studies using different types of data and different study designs, with only one study examining multi-year data for trends.

While the results of this review are inconclusive, this review has shown the need for a rigorous method for analysing government and donor financing and corresponding health outcomes to generate much needed evidence on effectiveness and efficiency of health financing.

Chapter 4: Methodology

4.1 Introduction

Chapter 3 presented the gaps in research while Chapter 1 presented the objectives of the thesis and the conceptual framework that guided the analysis. This chapter focuses on presenting the research design, ethical considerations and potential implications for the study.

4.2 Design for this Research

The aim of this research was to fill a gap in knowledge regarding the impact that the source funding has on health outcomes. This will be done by analyzing existing data from 2000-2014 to compare sources of health expenditure and their effect on health outcomes (under-five, infant, neonatal and maternal mortality). This research used a mixed-methods approach to examine the relationships between source of health funding and health outcomes of a population by combining quantitative research methods with case studies (Denzin & Lincoln 2000). The quantitative component used panel analyses of secondary data on health expenditure by source and maternal and child health outcomes for the period of 2000 to 2014. These analyses were supplemented with a comparative analysis of cases studies. A summary of the proposed objectives and associated methodologies are listed in Table 1.

4.2.1 Objectives

As stated in Chapter 1, the aim of this research was to fill the gap in knowledge regarding the impact that the source of funding has on health outcomes (maternal, neonatal, infant and under-five mortality) by analyzing existing data from 2000-2014. The specific objectives of this research are as follows:

> *Objective 1: This research compares sources of health expenditure and their effect on under-five, infant, neonatal and maternal mortality in sub-Saharan African countries between 2000 and 2014.*

Objective 2: This research compares sources of child health expenditure on under-five, infant and neonatal mortality in selected sub-Saharan African countries between 2000 and 2014.

Objective 3: The research provides a detailed analysis of health financing sources and health outcomes (maternal, neonatal, infant and under-five mortality) in two sub-Saharan African countries.

4.2.2 Quantitative Research

4.2.2.1 Data

Panel data was used as it enables better modelling for complex behaviours (in this case financial investments) across time (Hsiao, 2007b). All data collected were available online and were free of charge.

The data for health expenditure by funding source were obtained from the WHO Global Health Expenditure Database. The database provides internationally comparable national health expenditures based on publicly available reports (National Health Account (NHA) reports, reports from the Ministry of Finance, Central Bank, National Statistics Offices, public expenditure information and reports from the World Bank, the International Monetary Fund, etc.) and are validated by the Ministries of Health of each respective country.

Data on health expenditure by funding source were also obtained from the Institute for Health Metrics and Evaluation's (IHME) Global Health Data Exchange (GHDx), a data catalogue for health. The dataset prepared by the Global Burden of Disease Health Financing Collaborator Network produced retrospective national health spending estimates for 1995-2014 for 184 countries. The database was developed based on program reports, budget data, national estimates, and 964 National Health Accounts. This data was published in The Lancet in April 2017 in "Evolution and patterns of global health financing 1995–2014: development assistance for health, and

government, prepaid private, and out-of-pocket health spending in 184 countries" (Global Burden of Disease Health Financing Collaborator Network, 2017).

For this research, the IHME data for health expenditure by funding source were used as it included private expenditure on health whereas the WHO data set did not.

The data for total child health expenditure by funding source were obtained from National Health Accounts published under the WHO Country Platform Documentation Centre. Data for child health expenditure were not routinely reported, hence are missing for many countries. Further, those countries that have reported child health expenditure have gaps in the data. Despite the limitations in the data, they may provide useful information about child health investments and impacts on health outcomes, hence the rationale for moving forward with this data.

The World Bank compiles health outcome data from officially recognized international sources in the World Bank's World Development Indicators (WDI) including neonatal, infant, under-five and maternal mortality for all countries across the world. The World Bank used the estimates developed by the UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA Population Division) for under-five, infant and neonatal mortality and estimates for maternal mortality data that were derived from another UN Inter-agency Group (WHO, UNICEF, UNFPA, World Bank Group, and the United Nations Population Division). The World Bank database was also used for the data on HIV prevalence and prevalence of undernourishment. This data was obtained by the World Bank from UNAIDS estimates and the Food and Agriculture Organization, respectively.

Data for the proportion of population with access to an improved water source was obtained from the Joint Monitoring Programme of WHO and UNICEF. Data for mean years of schooling (females 25 years and older) was obtained from UNDP Human Development Reports. As data was not collected each year, the data from the preceding year(s) were carried over.

A raw data set was created by merging the World Bank, IHME, UNDP and WHO data in excel. This data set was later imported into StataIC 15 once it was cleaned.

4.2.2.2 Data Limitations

There are several challenges that make the data measurement complex and uncertain resulting in inconsistent data for the same country across different published sources. These include: (a) definitions, data collection methods, population coverage and estimation methods used can differ between countries; (b) difficulties tracking funds since not all financing is channelled through the national treasury; (c) financing structures are complicated with over 40 bilateral development agencies, more than 20 regional development agencies, thousands of non-governmental organizations, the United Nations family of organizations and numerous private foundations. In an effort to maximise the quality of data, only data obtained from internationally recognized sources have been used; and (d) external resources often flow through various intermediaries and implementing agencies thereby increasing the risk of those funds being counted multiple times.

Expenditure data can be difficult to obtain and in some cases disbursement data may be used, particularly for external resources for health whereby disbursements to recipient countries as reported by donors is lagged one year to account for the delay between disbursement and expenditure. Disbursement data tends to overestimate expenditure since the disbursement may not be fully absorbed or absorbed within the year after it is received. It is noted that before 2002, disbursement data were not available for external resources for health and commitments were used. Commitments increase the overestimation since donors may not disburse the full commitment and countries may not spend the full disbursement.

Countries use different fiscal years and accounting methods, which complicate the task of developing coherent information over time. Typically, the data has been recorded such that for countries where the fiscal year begins before July, expenditure data was allocated to the earlier calendar year and when the fiscal year begins after July, expenditure data was allocated to the later calendar year.

Countries which report on child health expenditure are self-selected which introduces bias to the child health expenditure analysis of the work. Being able to generate such data, shows strong capacity to record, manage and analyze health expenditures which

suggests stronger overall planning, implementation and monitoring of health programmes which in turn would influence health outcomes of the population. It is noted that these countries are some of the largest in the sub-Saharan Africa region, they have more access to resources, and there is likely greater investment in public services/goods which also influences health outcomes of the population.

Finally, investments in other sectors also contribute to the health of a population (i.e. water and sanitation, education, humanitarian assistance etc). For simplicity, this research only includes investments and/or expenditure recorded as health sector support and disease specific support but excludes support provided for allied sectors such as water and sanitation, nutrition, education, and humanitarian assistance as well as general budget support.

4.2.2.3 Missing Data

There were missing observations in the raw data set. A summary of missing data points was generated in Stata. Missing observations were noted in the control variables (GDP per capita and prevalence of undernourishment).

The World Bank data for prevalence of undernourishment had missing data points for Burundi, the Democratic Republic of Congo, Comoros, Eritrea, Equatorial Guinea and Sudan for prevalence of undernourishment. Searches for the missing data were conducted in other UN agency databases, specifically the Food and Agriculture Organization (FAO) and the World Food Programme (WFP). Data points were found for Burundi, Comoros, Eritrea and Sudan. Data points could not be found for the Democratic Republic of Congo (DRC) (15 data points) and Equatorial Guinea (15 data points). Neither of these countries were removed from the dataset since one of the countries, DRC, has data points for child health expenditure.

There were 14 missing observations for GDP per capita, of which 3 observations were for Eritrea (2012 – 2014) and 11 observations were for South Sudan (2000 – 2010). Data are often difficult to obtain for Eritrea and for the variable GDP per capita for the years 2012 to 2014, no observations were found from other data sources. The country of South Sudan was only established in 2011. These missing observations

reflect the period prior to the establishment of the country and no further search ensued for the data.

There are very few data points for child health expenditure. It is important to note that the sample size is quite small and the observations per country are small with no country having data for every year included in this research.

4.2.2.4 Sample

The sample consists of sub-Saharan African countries. Due to lack of data, the following countries have been removed from the analysis: Sao Tome and Principe, Seychelles, Sierra Leone, Somalia and Zimbabwe. In total, 43 sub-Saharan African countries were included in the research.

For objective 2 which examines child health expenditure and health outcomes, a sub-set of the data was used. Eight countries were purposively selected for the sub-set based on available data for the independent variable (government and/or external sources of child health expenditure): Democratic Republic of Congo, Cote d'Ivoire, Ethiopia, Malawi, Nigeria, Rwanda, Tanzania and Uganda. For objective 3, two countries were selected based on the findings from objectives 1 and 2 for a detailed analysis. Malawi and Mozambique were selected for several reasons: Mozambique had the second highest development assistance for health as a per cent of total health expenditure at 66.65%, after Liberia, and Malawi had the highest government expenditure on health as a per cent of total health expenditure (39.84%) for a low-income country from the Southern Africa region, third highest of all the countries included in this research after Ghana and Mauritania. Mozambique and Malawi had the lowest combined amounts of private and out of pocket expenditure on health as percentages of THE so they rely more on government and development assistance for health and thus the effects of government and development assistance for health may be easier to identify. Moreover, they had similar mean total health expenditure ranking 26th and 28th highest out of the countries included in this research; neither experienced conflicts during the period included in this research; both are classified as low-income countries; and are from the same region, thus they have some

common ecological, geographical, social, linguistic and cultural characteristics as many ethnic groups are shared, particularly for the northern part of Mozambique.

4.2.2.5 Empirical Model

For objectives 1 and 2, the focus is on comparing the source of health expenditure and their respective effects on health outcomes. The empirical models were reviewed of Gottret and Schreiber (2006), Bokhari et al. (2007) and Achoki and Chansa (2013), the studies identified through the literature review. Gottret and Schreiber (2006) assumed that health outcomes are a function of several independent variables, in this case: government expenditures on health, national income, education, roads, sanitation, donor funding and volatility in donor funding, as well as an error term for each country. Bokhari and al. (2007) used a similar model, with changes only in the independent variable. They used government expenditures on health, income, donor funding, deviation in donor funding from its historic average, education and basic infrastructure (roads, access to improved water sources and sanitation). Achoki and Chansa (2013) added to their model the function of time, noting that the dependent variable changed from a health outcome to coverage of a health intervention.

Other studies that looked at a source of health financing and health outcome looked at independent variables such as caloric intake (Gani, 2009), per capita income (Gani, 2009), HIV (Mishra & Newhouse, 2009; and Novignon & Lawanson, 2017), and country-specific effect (Anyanwu & Erhijakpor, 2007).

Based on the previous models used, this research looks at health outcome as a function of source of health financing, the income of the country generated within the country's borders (per capita), infrastructure (measured by proportion of population with access to an improved water source), caloric intake (measured by prevalence of undernourishment) and HIV prevalence. Under general assumptions, the equation derived describing the health outcome as a function of various factors is:

$$\text{Ln } Y_{it} = \beta_0 + \beta_1 GHES_{it} + \beta_2 DAH_{it} + \beta_3 PRIV_{it} + \beta_4 OOP_{it} + \beta_5 THE_{it} + \beta_6 GDP_{it} + \beta_7 H2OS_{it} + \beta_8 FOOD_{it} + \beta_9 HIV_{it} + \beta_{10} EDU_{it} + \alpha_i + \gamma_t + \upsilon_{it}$$

where Y represents the health outcome (under-five, infant, neonatal, or maternal mortality) of country *i* at time *t*; GHE is the government expenditure on health per capita ; DAH is the development assistance for health (the sum of resources for health obtained from outside the country, including donations, loans, in cash and in-kind resources) per capita; PRIV is the private expenditure on health, excluding out-of-pocket payments, per capita; OOP is the out-of-pocket payments per capita; THE is the total health expenditure per capita; GDP is gross domestic product per capita (constant 2010 US$); H2OS is the proportion of the population with access to improved water source; FOOD is prevalence of undernourishment (as a predictor of food security) expressed as a percentage; HIV is the HIV prevalence expressed as a percentage; and EDU is the mean number of years of schooling for females 25 years and older. β is the coefficient that describe the direction and strength of the relationship between the health outcome and the independent variables. Unobserved country-specific time-invariant effects are represented by α, while time shocks and technology are controlled by γ and error accounted for by υ.

Under objective 2 of this research, the model used is:

$$\text{Ln } Y_{it} = \beta_0 + \beta_1 GHESc_{it} + \beta_2 DAHc_{it} + \beta_3 PRIVc_{it} + \beta_4 OOPc_{it} + \beta_5 GDP_{it} + \beta_6 H2OS_{it} + \beta_7 FOOD_{it} + \beta_8 HIV_{it} + \beta_9 EDU_{it} + \alpha_i + \gamma_t + \upsilon_{it}$$

where Y represents the health outcome (under-five, infant, neonatal, or maternal mortality) of country *i* at time *t*; GHEc is the government expenditure on child health per capita; DAHc is the development assistance for child health (the sum of resources for child health obtained from outside the country, including donations, loans, in cash and in-kind resources) per capita; PRIV is the private expenditure on child health, excluding out-of-pocket payments, per capita; OOP is the out-of-pocket payments per capita; GDP is gross domestic product per capita (constant 2010 US$); H2OS is the proportion of the population with access to improved water source; FOOD is prevalence of undernourishment (as a predictor of food security) expressed as a percentage; HIV is the HIV prevalence expressed as a percentage; and EDU is the mean number of years of schooling for females 25 years and older. β is the coefficient that describe the direction and strength of the relationship between the health outcome and the independent variables. Unobserved country-specific time-invariant effects are

represented by α, while time shocks and technology are controlled by γ and error accounted for by υ.

The dependent variables for objective 1 were transformed to logarithms of under-five, infant, neonatal and maternal mortality. The dependent variables for objective 2 were transformed to logarithms of neonatal, infant and under-five mortality. Mortality rates are often used to provide information on the overall health of a population and on the quality of health care. These are common dependent variables for studies (Filmer & Pritchett, 1999; Berger & Messer, 2003; Gupta et al., 2003; Issa & Ouattara, 2005; Gottret & Schreiber, 2006; Anyanwu & Erhijakpor, 2007; Bokhari et al., 2007; Rajkumar & Swaroop, 2008; Gani, 2009; Schmidt, 2010; Çevik & Taşar, 2013; Dieleman, 2013; Farag et al., 2013; and Kim & Lane, 2013) which enables comparisons to other research.

From 1990 to 2015, the global maternal mortality rate, a measure of the number of maternal deaths (defined as death of a woman while pregnant or within 42 days of termination of pregnancy) per 100,000 live births, declined by 44 per cent. Decreases in maternal mortality were observed worldwide. However, sub-Saharan Africa continues to have the highest maternal mortality, accounting for two thirds (66 per cent) of all maternal deaths per year worldwide (WHO, UNICEF, UNFPA and the World Bank, 2015). By analyzing the investments in health, associations with health outcomes may be possible which could influence future health financing decisions for countries.

To control for economic development, GDP per capita was included as lower income levels are correlated with poorer health outcomes since access to health care can be limited if there are competing priorities for household resources (i.e. food and rent) (Dieleman, 2013). Under-five, infant, neonatal and maternal mortality can be significantly affected by food security, educational attainment of mothers and water and sanitation. The inclusion of prevalence of undernourishment, mean years of schooling of females above 25 years of age and proportion of the population with access to improved water source as variables allows for control of the effect of investments in these areas and their corresponding impacts on health (Peters et al., 2000; Bokhari et al., 2007; Farag et al., 2013; and Jones et al., 2013). In sub-Saharan

Africa, HIV has had a large effect on countries. HIV prevalence is strongly associated with under-five, infant, neonatal and maternal mortality (Adetunji, 2000). The inclusion of HIV prevalence allows for control of the effect of HIV on health outcomes. Maternal education is associated with child health outcomes (Vikram and Vanneman, 2020; Fuchs et al, 2010; Bicego and Boerma, 1993; and Caldwell, 1979)

4.2.2.6 Data Entry and Analysis

Data for objectives 1 and 2 were obtained from the respective sources and merged into a single excel data file. Data were converted to the long format and reviewed to ensure consistency in units of measurement.

For Objectives 1 and 2, data were analyzed using Stata, a statistical software package commonly used in economics, econometrics and biomedicine (Park & Ilyasov, 2016). The excel data file was imported into Stata. String variables were converted to numeric variables and logs of the dependent variables (maternal, neonatal, infant and under-five mortality) were generated as a means of transforming skewed variables into a more normal distribution (Benoit, 2011). The definitions of the data were entered for ID, time, dependent variable and independent variables. Descriptive analyses were run.

To decide on the type of regression analyses to perform, this research looked at the estimation methods used in the research reviewed in Chapter 3 (refer to Table 4.1 below).

Table 4.1

Summary of estimation methodologies used in previous research on health financing and health outcomes

Authors	Year	OLS	2SLS	GLSE	FE	RE	GMM
Achoki & Chansa	2013						X
Akachi & Atun	2011	X			X	X	
Akinkugbe & Mohanoe	2009					X	
Anyanwu & Erhijakpor	2007	X	X		X		

Bendavid & Bhattacharya	2009				X		
Bokhari et al.	2007	X					X
Gani	2008			X	X		
Gottret & Schrieber	2006	X	X				X
Issa & Ouattara	2005	X			X	X	X
Mishra & Newhouse	2009	X					X
Novignon & Lawanson	2017				X	X	
Novignon et al.	2012				X	X	
Zakir	1999			X			

OLS – ordinary least squares; 2SLS – two stage least squares; GSLE – generalized least squares estimator; FE – fixed effects; RE – random effects; GMM – generalized method of moments

Ordinary least squares (OLS), fixed effects (FE), random effects (RE) and generalized method of moments (GMM) are common methods for generating point estimates and they address unobserved group-level characteristics/bias (Snijders & Bosker, 2011; Greene, 2007; Gelman & Hill, 2006; Kennedy, 2003 and Wooldridge, 2001). OLS is used for estimating the unknown parameters in a linear regression model, minimizing the differences between collected observations. However, OLS does not distinguish between the individuality of the various entities, in this case countries. In the RE estimation method, it is assumed that the variation across countries is random and uncorrelated with the independent variables however this method does not control for variable omission bias. Conversely, FE estimation methods controls for omitted variable bias, as it is assumed that something within the country may impact or bias the outcome variables. It enables control of time effects, country-specific factors and data collection methods that are non-observable or difficult to control for but are constant in time. FE is used when studying the causes of changes within the entity, in this case, the country. The Hausman test was used to determine whether FE or RE should be used, with a null hypothesis that RE is the preferred estimation method. If the null hypothesis of the Hausman test was accepted, then Breusch Pagan Lagrange Multiplier test was used to determine if RE or OLS should be used, with the null hypothesis that OLS is the preferred estimation method.

GMM is used in situations when independent variables are correlated with the past and possibly current realizations of the error term (endogeneity). GMM controls for

endogeneity when there is correlation between the explanatory variable and the error term in the model. It also controls for omitted variable bias, unobserved panel heterogeneity and measurement errors. It is effective when the time period is short, as it increases precision and reduces bias caused by the small sample (Blundell & Bond, 1998; Arellano & Bover, 1995; and Arellano & Bond, 1991). Difference GMM corrects endogeneity and removes fixed effects but magnifies gaps in unbalanced data which may weaken results. System GMM corrects endogeneity and improves efficiency by transforming the instruments to make them uncorrelated (exogenous) with the fixed effects and is thus considered a more robust estimation method (Roodman, 2009; Roodman, 2007; Blundell & Bond, 1998; Arellano & Bover, 1995; and Arellano & Bond, 1991).

As per Bond (2001), the model should be initially estimated by OLS and FE, and then GMM applied. GMM estimation methods were also analyzed to correct for heterogeneity. If the difference GMM was close to or below the FE estimate, it suggests a downward bias and therefore system GMM should be used. If GMM produces large standard errors, then the method was not used. Hansen (1982) J test was used to support to the choice of instruments.

4.2.3 Case Studies

Health care financing is complex and case studies help in understanding the environment of health financing decisions. Under Objective 3 of this research, case-studies were used to look in-depth at the relationships between health financing sources and health outcomes. The countries for the case studies were purposefully selected using maximum variation sampling (Palinkas et al., 2015). The case-study design was used to allow for triangulation of data to improve the validity of research findings (Zucker, 2009).

The countries, Malawi and Mozambique, were selected as:

- Mozambique had the second highest development assistance for health as a per cent of total health expenditure at 66.65%, after Liberia, and Malawi had the highest government expenditure on health as a per cent of total health expenditure (39.84%) for a low-income country from the Southern Africa

region, third highest of all the countries included in this research after Ghana and Mauritania.

- Mozambique and Malawi had the lowest combined amounts of private and out of pocket expenditure on health as percentages of total health expenditure (THE) so they rely more on government and development assistance.
- They had similar GDP (US$420.15 for Mozambique and US$323.34 for Malawi) and mean total health expenditure, ranking 26th and 28th highest out of the countries included in this research;
- Neither experienced conflicts during the period included in this work;
- They are both classified as low-income countries; and
- Being from the same region, they have some common ecological, geographical, social, linguistic and cultural characteristics as many ethnic groups are shared, particularly for the northern part of Mozambique.

For each case study, a description of the health system, details of how the health system is financed and a summary of health outcomes/statistics were provided. Subsequently, comparisons are drawn between the two to identify similarities and differences that may contribute to improved health outcomes.

4.3 Ethical Issues

The research was submitted to the Curtin University Human Research Ethics Committee for approval prior to commencement of the work.

4.4 Data Storage

All quantitative data and paper records were stored in the locked office of the researcher. All electronic data and analysis were stored on a computer that is password protected and only accessibly to the researcher. All electronic data were routinely backed up to an external hard drive.

4.5 Summary

This research used a mixed-methods approach to examine the relationships between source of health funding and health outcomes of a population. This research looked at health outcome as a function of source of health financing, per capita country income, infrastructure (measured by proportion of the population with access to an improved water source), caloric intake (measured by prevalence of undernourishment), education (measured by mean years of schooling for females 25 years and above) and HIV prevalence. The quantitative component used a panel analysis of secondary data on health expenditure and child and maternal health outcomes for the period of 2000 to 2014 sourced from IHME, WHO and the World Bank. For objective 1, the sample consisted of 43 sub-Saharan African countries, and for objective 2, eight countries (Democratic Republic of Congo, Cote d'Ivoire, Ethiopia, Malawi, Nigeria, Rwanda, Tanzania and Uganda) were selected based on available data for child health funding. For Objectives 1 and 2, data were analyzed using Stata. Several estimation methods were used: OLS, FE, RE and GMM. The Hausman and Hansen tests, as well as sample size, were used to determine the appropriate estimation method.

The quantitative analyses are supplemented with a comparative analysis of cases studies. Two countries (Malawi and Mozambique) were purposefully selected because of maximum variations in government and donor expenditure on health while having similarities in GDP, region, low private and out of pocket expenditure on health, and country income classification.

Chapter 5: Data Description

5.1 Introduction

This chapter presents a descriptive analysis of the data obtained through the data collection for objective 1. The data were analyzed in terms of measures of central tendency (mean) and measures of variability (standard deviation) to illustrate the basic characteristics of the data set for source of health expenditure and health outcomes; and show the distribution of the data.

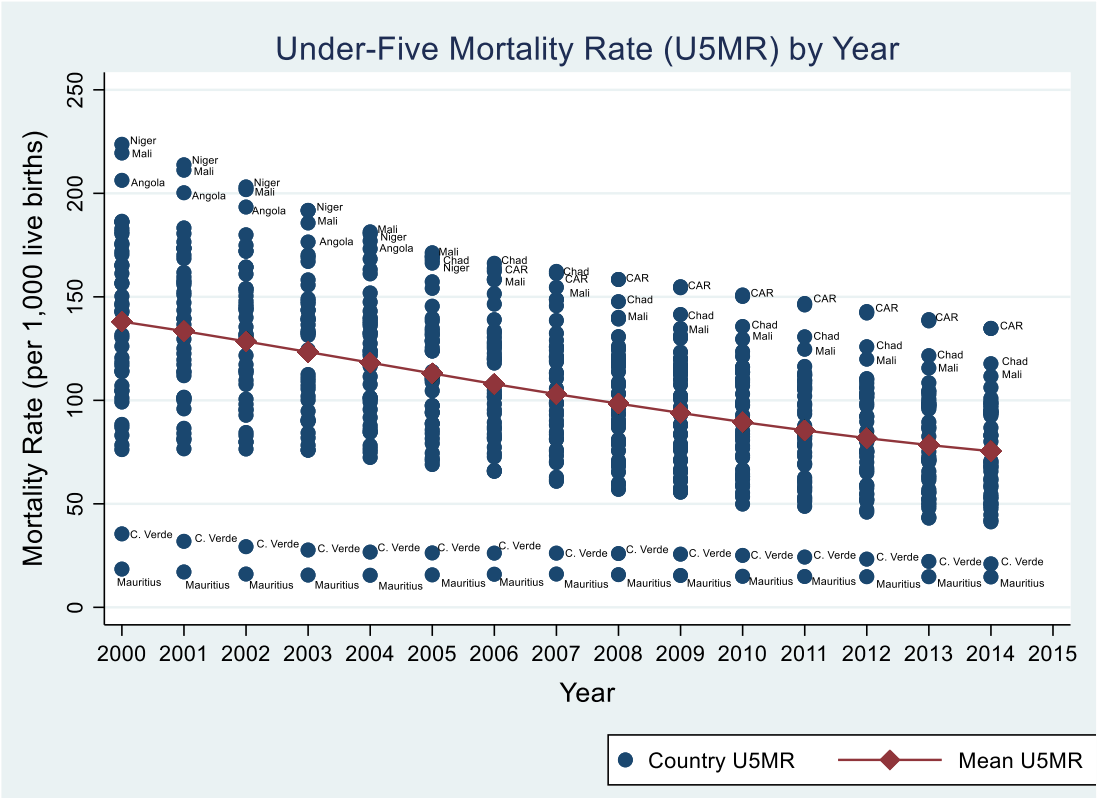
5.2 Descriptive Statistics for health outcomes

Data for the variables of interest were available for 43 sub-Saharan African countries between 2000 and 2014 (15 years). There was a total of 645 observations. The data were strongly balanced, indicating that all the panels have the same time points, or in other words, each country shows data for each year included in this work.

The mean under-five mortality was 104.57 per 1,000 live births, with the lowest mean value 15.73 (Mauritius) and the highest mean value 161.47 (Chad), and noting that, over the years included in this work, the under-five mortality rate ranged from 14.70 (Mauritius, 2014) to 223.70 (Niger, 2000) (refer to Table 5.1). Figure 5.1 shows the distribution of under-five mortality with the mean under-five mortality by year. Figure 5.1 shows the mean under-five mortality rate steadily decreasing from 138.05 in 2000 to 75.44 in 2014. Details of the mean under-five mortality by year can be found in Table 5.2. Graphical representations of the distribution of under-five mortality by country can be found in Appendix 4.

Figure 5.1

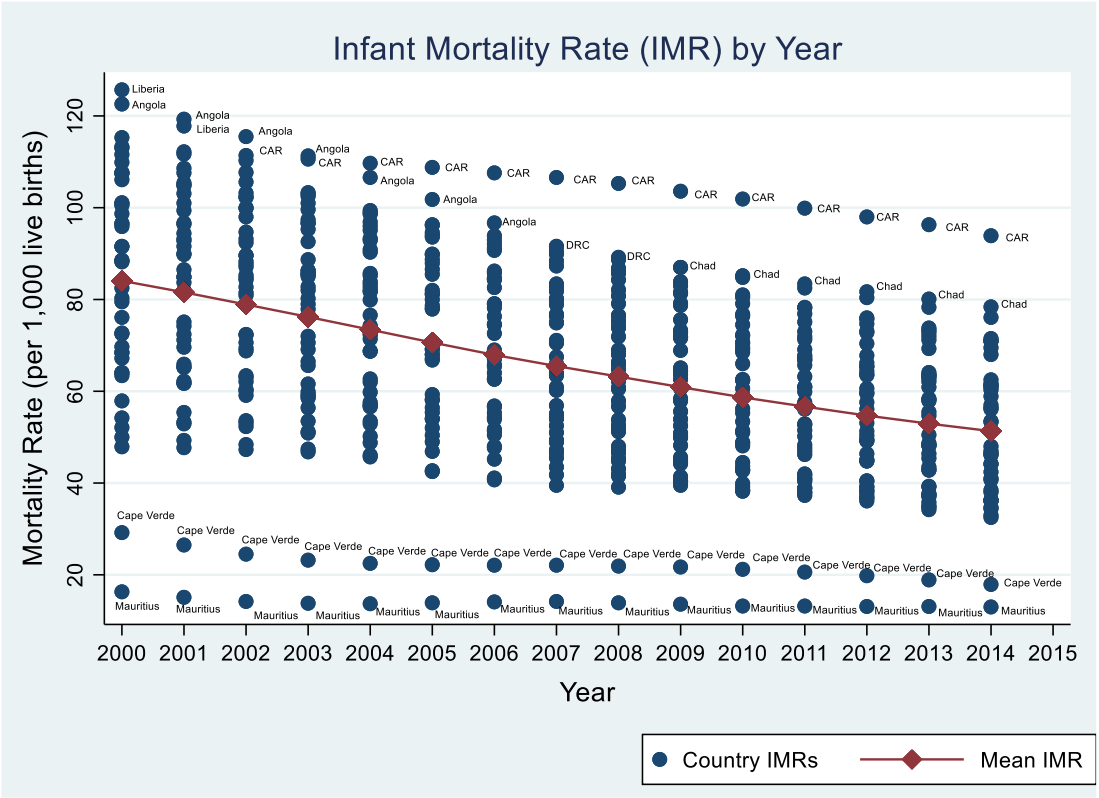
Under-five mortality rate by year



The mean infant mortality was 66.44 per 1,000 live births, with the lowest mean value 13.89 (Mauritius) and the highest mean value 105.25 (Central African Republic), and noting that, over the years included in this work, infant mortality rate ranged from 13.00 (Mauritius, 2014) to 125.70 (Liberia, 2000) (refer to Table 5.1. Figure 5.2 shows the distribution of infant mortality with the mean infant mortality by year. Figure 5.2 shows the mean infant mortality rate steadily decreasing from 84.07 in 2000 to 51.31 in 2014. Details of the mean infant mortality by year can be found in Table 5.2. Graphical representations of the distribution of infant mortality by country can be found in Appendix 4.

Figure 2

Infant mortality rate by year



The mean neonatal mortality was 32.44 per 1,000 live births, with the lowest mean value 9.84 (Mauritius) and the highest mean value 48.15 (Guinea-Bissau) and noting that, over the years included in this work, the neonatal mortality rate ranged from 9.00 (Mauritius, 2010) to 57.20 (South Sudan, 2000) (refer to Table 5.1). Figure 5.3 shows the distribution of neonatal mortality with the mean neonatal mortality by year. Figure 5.3 shows the mean neonatal mortality rate steadily decreasing from 37.97 in 2000 to 27.39 in 2014. Details of the mean neonatal mortality by year can be found in Table 5.2. Graphical representations of the distribution of neonatal mortality by country can be found in Appendix 4.

Figure 5.3

Neonatal mortality rate (# of deaths per 1,000 live births) by year

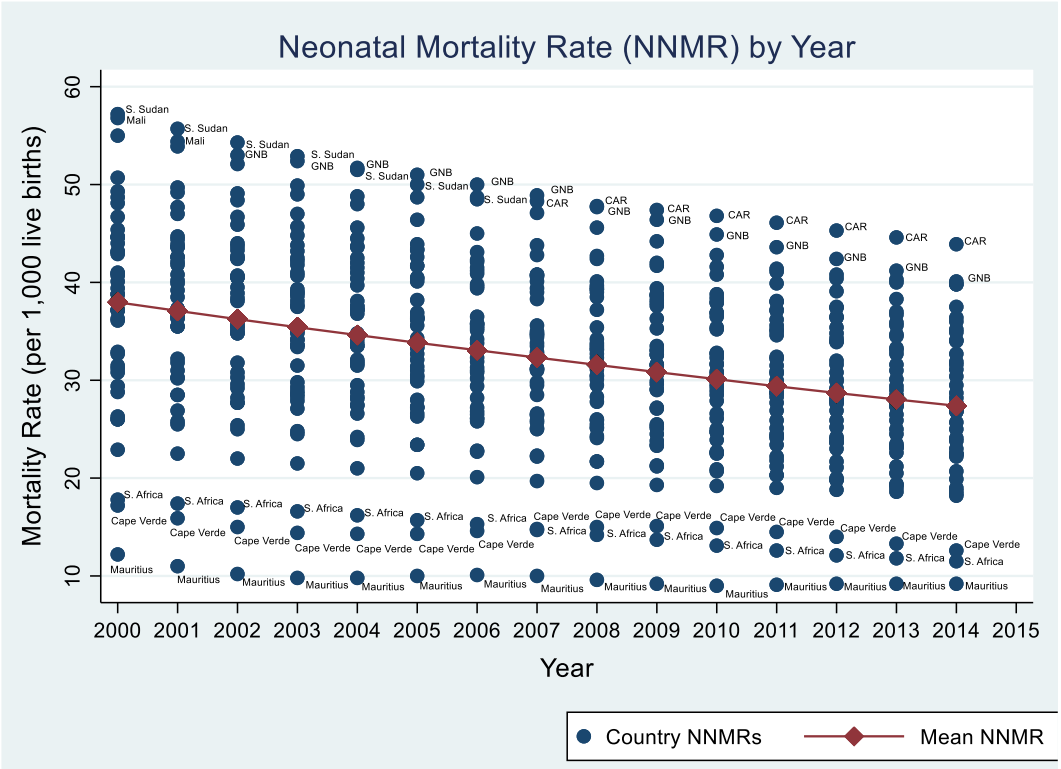


Table 5.1

Mean Under 5, Infant and Neonatal Mortality Rates by Country

Country	Under 5 Mortality Rate	Standard Deviation	Lowest annual U5MR	Highest annual U5MR	Infant Mortality Rate	Standard Deviation	Lowest annual IMR	Highest annual IMR	Neonatal Mortality Rate	Standard Deviation	Lowest annual NNMR	Highest annual NNMR
Angola	149.32	38.15	93.60	206.30	91.61	20.81	60.90	122.60	41.03	6.36	31.60	50.70
Benin	121.55	11.58	106.20	143.20	76.55	6.44	68.00	88.60	36.26	1.79	34.10	40.10
Botswana	64.16	16.49	42.20	87.00	42.12	5.12	34.40	50.00	29.27	1.59	26.30	31.20
Burkina Faso	137.96	30.05	92.60	180.40	74.62	12.08	56.10	91.50	34.05	4.65	27.30	41.00
Burundi	112.00	28.73	70.80	156.70	71.13	16.05	48.00	95.90	30.94	4.33	24.10	37.10
Cabo Verde	26.49	3.65	21.00	35.50	22.29	2.84	17.90	29.20	14.66	1.05	12.60	17.20
Cameroon	123.03	18.54	93.80	150.30	76.25	10.27	60.30	91.60	30.32	1.78	27.00	32.90
Central African Republic	158.56	13.13	134.80	175.20	105.25	6.09	93.90	113.00	47.52	1.78	43.90	49.30
Chad	161.47	16.78	134.70	186.50	90.04	7.26	78.40	100.90	39.39	2.44	36.40	44.60
Comoros	91.18	9.01	75.50	101.10	66.34	5.73	56.40	72.70	38.37	2.41	34.00	40.90
Congo, Dem. Rep.	129.99	19.61	101.00	161.30	91.72	10.14	76.10	107.50	34.88	2.87	30.40	38.80
Congo, Rep.	30.37	21.63	53.3	114.30	53.37	12.22	38.00	72.50	25.65	3.74	20.70	31.50
Cote d'Ivoire	121.53	16.16	97.70	146.80	83.69	9.58	69.50	98.70	40.21	3.31	35.20	45.40
Equatorial Guinea	126.78	18.58	99.30	156.40	88.91	11.72	71.40	107.50	38.50	4.07	32.70	44.60
Eritrea	64.85	13.01	47.60	88.40	44.57	7.38	34.70	57.90	22.37	2.29	19.00	26.00
Ethiopia	101.64	24.56	67.50	142.60	65.33	13.79	46.10	88.20	40.60	5.49	31.90	48.70
Gabon	69.73	9.33	54.60	83.10	46.48	5.20	38.50	54.20	26.19	1.88	23.00	28.80
Gambia, The	91.87	15.44	70.20	118.40	53.07	6.14	44.20	63.40	34.82	3.63	29.50	40.70
Ghana	79.83	12.65	58.00	99.20	53.10	7.16	40.70	64.10	32.17	2.74	27.00	36.30
Guinea	124.74	22.27	94.90	165.40	78.24	12.30	61.60	100.50	35.13	6.79	25.70	46.70
Guinea-Bissau	133.40	26.94	94.50	175.80	83.00	14.82	61.40	106.10	48.15	4.83	40.10	55.00
Kenya	73.07	18.23	50.50	104.50	47.57	9.40	36.30	64.00	26.13	2.91	22.20	30.80

Lesotho	112.26	11.67	94.70	124.00	79.88	5.60	70.90	85.70	42.35	1.34	39.80	43.80
Liberia	121.86	33.02	83.00	186.10	85.69	20.70	61.20	125.70	35.97	5.76	26.80	44.70
Madagascar	75.01	18.31	49.90	107.10	50.35	10.37	36.10	68.50	25.15	3.62	19.90	31.20
Malawi	108.90	32.40	65.70	171.90	66.86	17.44	44.10	101.10	30.75	4.14	25.00	39.40
Mali	160.98	33.69	117.70	219.50	89.99	14.62	71.00	115.30	45.09	6.04	37.50	56.80
Mauritania	103.57	9.36	86.80	113.80	64.97	4.37	57.00	69.70	40.15	2.29	36.00	42.90
Mauritius	15.73	1.00	14.70	18.50	13.89	0.87	13.00	16.30	9.84	0.85	9.00	12.20
Mozambique	122.61	27.87	83.20	170.40	82.46	17.42	58.90	113.30	35.07	4.76	28.70	44.00
Namibia	63.22	10.99	49.00	76.60	41.62	4.30	36.10	47.90	20.20	1.46	18.40	22.90
Niger	154.18	41.24	98.60	223.70	72.84	14.15	53.50	96.50	35.05	4.78	28.20	43.10
Nigeria	146.98	24.34	111.60	186.20	90.45	13.24	71.00	111.60	40.98	4.25	34.90	48.10
Rwanda	98.70	45.44	44.70	181.40	62.86	24.81	33.00	107.70	27.43	6.80	18.20	38.80
Senegal	85.99	26.03	52.60	131.70	50.43	10.53	36.30	68.40	29.93	5.23	22.50	38.20
South Africa	68.43	16.19	41.30	84.60	45.23	7.93	32.50	53.60	14.65	2.12	11.50	17.80
South Sudan	130.33	29.12	96.40	182.90	81.29	16.00	62.50	109.90	47.44	5.98	39.80	57.20
Sudan	84.93	11.38	69.10	104.80	55.96	6.44	47.00	67.20	33.84	1.84	31.10	37.20
Swaziland	106.43	25.86	62.20	132.40	68.65	13.22	46.50	82.80	22.43	2.42	18.70	26.00
Tanzania	89.01	22.02	61.30	130.40	56.79	11.85	42.40	79.50	26.99	3.24	22.50	32.70
Togo	99.36	12.94	80.10	120.60	64.13	7.29	53.30	76.10	31.25	3.10	26.80	36.10
Uganda	98.40	28.53	59.00	146.00	62.29	15.67	41.00	88.40	25.76	1.96	22.40	29.40
Zambia	105.96	31.50	68.00	165.10	65.21	16.30	46.30	96.60	29.55	4.34	23.80	37.20
All Countries	**104.57**	**40.01**	**14.70**	**223.70**	**66.44**	**22.50**	**13.00**	**15.70**	**32.44**	**9.49**	**9.00**	**57.20**

Table 5.2

Mean Under 5, Infant and Neonatal Mortality Rates by Year

Year	Under 5 Mortality Rate	Standard Deviation	Lowest annual U5MR	Highest annual U5MR	Infant Mortality Rate	Standard Deviation	Lowest annual IMR	Highest annual IMR	Neonatal Mortality Rate	Standard Deviation	Lowest annual NNMR	Highest annual NNMR
2000	138.05	45.83	18.50	223.70	84.07	25.06	16.30	125.70	37.97	10.29	12.20	57.20
2001	133.45	43.60	17.10	213.80	81.57	24.05	15.10	119.30	37.10	10.08	11.00	55.70
2002	128.49	41.42	16.10	203.10	78.91	23.09	14.20	115.50	36.24	9.88	10.20	54.30
2003	123.38	39.38	15.60	191.80	76.20	22.20	13.80	111.30	35.42	9.70	9.80	52.90
2004	118.23	37.53	15.50	181.40	73.43	21.40	13.70	109.70	34.62	9.48	9.80	51.70
2005	113.02	36.01	15.70	171.30	70.63	20.84	13.90	108.80	33.83	9.28	10.00	51.00
2006	107.90	34.63	16.00	166.20	67.93	20.16	14.10	107.60	33.07	9.06	10.10	50.00
2007	103.01	33.44	16.10	162.30	65.49	19.52	14.20	106.60	32.32	8.88	10.00	48.90
2008	98.44	32.34	15.80	158.40	63.20	19.03	13.90	105.30	31.57	8.71	9.60	47.80
2009	93.93	31.27	15.40	154.90	60.91	18.51	13.60	103.60	30.84	8.56	9.20	47.40
2010	89.51	30.25	15.00	150.90	58.68	18.06	13.20	101.90	30.11	8.41	9.00	46.80
2011	85.50	29.41	14.90	146.80	56.66	17.57	13.20	99.90	29.39	8.26	9.10	46.10
2012	81.74	28.68	14.80	142.90	54.71	17.24	13.10	98.00	28.70	8.15	9.20	45.30
2013	78.42	28.03	14.80	139.00	52.94	16.99	13.10	96.30	28.04	8.05	9.20	44.60
2014	75.44	27.35	14.70	134.80	51.31	16.68	13.00	93.90	27.39	7.97	9.20	43.90

The mean maternal mortality was 587.69 per 100,000 live births, with the lowest mean value 45.47 (Mauritius) and the highest mean value 1,119.80 (Chad), and noting that, for the years covered in this work, the maternal mortality rate ranged from 35.00 (Mauritius, 2002) to 1,370.00 (Chad, 2000) (refer to Table 5.3). Graphical representations of the distribution of maternal mortality by country can be found in Appendix 5.

Table 5.3

Mean Maternal Mortality Rates by Country

Country	Maternal Mortality Rate	Standard Deviation	Lowest annual MMR	Highest annual MMR
Angola	667.07	139.74	493.00	924.00
Benin	486.20	52.89	414.00	572.00
Botswana	233.47	76.48	134.00	338.00
Burkina Faso	453.47	52.71	379.00	547.00
Burundi	842.53	59.84	737.00	954.00
Cabo Verde	57.80	10.76	44.00	83.00
Cameroon	696.87	47.99	609.00	751.00
Central African Republic	1,014.27	123.69	872.00	1,200.00
Chad	1,119.80	160.25	881.00	1,370.00
Comoros	417.73	47.97	344.00	499.00
Congo, Dem. Rep.	795.13	38.33	717.00	874.00
Congo, Rep.	561.53	72.50	452.00	657.00
Cote d'Ivoire	711.07	28.50	665.00	745.00
Equatorial Guinea	468.53	117.16	351.00	702.00
Eritrea	611.93	59.89	524.00	733.00
Ethiopia	647.80	175.04	378.00	897.00
Gabon	351.47	37.32	295.00	405.00
Gambia, The	793.60	52.16	719.00	887.00
Ghana	368.47	52.18	320.00	467.00
Guinea	806.33	109.61	688.00	976.00
Guinea-Bissau	662.80	99.86	553.00	800.00
Kenya	668.60	88.50	525.00	768.00
Lesotho	647.20	80.59	513.00	746.00
Liberia	967.60	198.77	741.00	1,270.00
Madagascar	470.13	56.58	369.00	536.00
Malawi	690.73	100.69	613.00	890.00
Mali	694.93	74.87	601.00	834.00
Mauritania	737.60	53.14	629.00	813.00
Mauritius	45.47	7.95	35.00	59.00

Mozambique	705.07	127.10	506.00	915.00
Namibia	341.47	39.26	273.00	391.00
Niger	693.53	69.55	574.00	794.00
Nigeria	933.93	122.53	819.00	1,170.00
Rwanda	561.80	238.43	304.00	1,020.00
Senegal	410.07	53.66	323.00	488.00
South Africa	124.40	24.76	85.00	154.00
South Sudan	1,021.40	171.39	823.00	1,310.00
Sudan	411.53	77.42	318.00	544.00
Swaziland	510.20	84.62	400.00	601.00
Tanzania	617.87	141.31	418.00	842.00
Togo	421.00	34.29	378.00	491.00
Uganda	478.60	84.32	356.00	620.00
Zambia	349.73	110.75	231.00	541.00
All Countries	**587.69**	**262.72**	**35.00**	**1,370.00**

The mean maternal mortality steadily decreased from 716.84 in 2000 to 476.86 in 2014. Refer to Table 5.4 and Figure 5.4 show the distribution of maternal mortality with the mean maternal mortality by year.

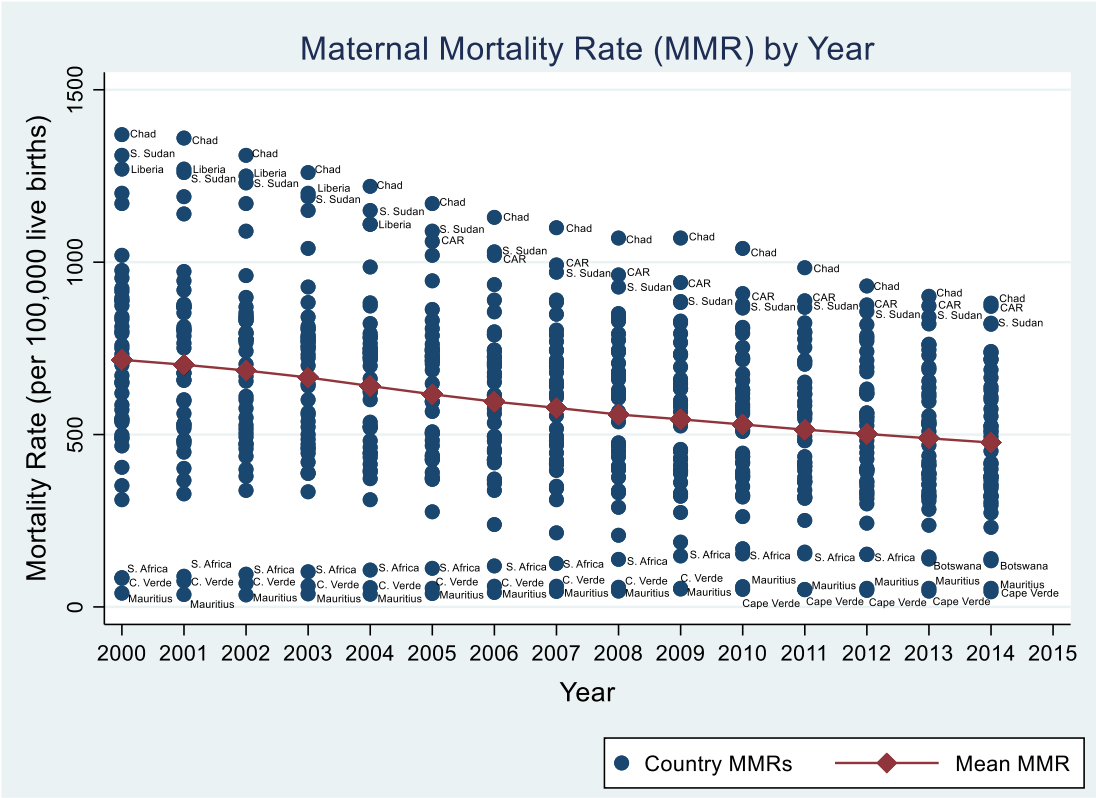
Table 5.4

Mean Maternal Mortality Rates by Year

Year	Maternal Mortality Rate	Standard Deviation	Lowest annual MMR	Highest annual MMR
2000	716.84	310.13	40.00	1,370.00
2001	702.70	302.31	36.00	1,360.00
2002	685.77	292.07	35.00	1,310.00
2003	665.63	280.29	38.00	1,260.00
2004	640.93	269.05	37.00	1,220.00
2005	616.88	257.92	39.00	1,170.00
2006	595.44	247.54	42.00	1,130.00
2007	577.49	242.79	45.00	1,100.00
2008	558.14	235.64	46.00	1,070.00
2009	544.23	234.47	52.00	1,070.00
2010	529.26	229.68	51.00	1,040.00
2011	514.26	224.13	50.00	984.00
2012	501.81	220.20	48.00	931.00
2013	489.14	217.34	46.00	901.00
2014	476.86	214.52	44.00	881.00

Figure 5.4

Maternal mortality rate by year



5.3 Descriptive Statistics for country income and source of health expenditure

The countries included in this work cover upper-middle, lower-middle and low-income countries. Out of the 43 countries, 20 countries changed income classification during the period covered in this work. To adjust for this, an average GNI was taken for the 15 years included in this study. Based on the average GNI, the country was classified based on the World Bank definition. Table 5.5 indicates the classification, noting that the countries with an asterisk (*) are the countries that had at least one change in income classification during the period of this work.

Table 5.5

Average GNI per Capita (US$) and Country Income Classification

Country	Average GNI per capita	Country Income Classification
Angola*	2,365.33	Lower middle
Benin	654.00	Low-income
Botswana*	5,404.55	Upper middle
Burkina Faso	478.09	Low-income
Burundi	178.67	Low-income
Cabo Verde	2,532.00	Lower middle
Cameroon*	1,102.67	Lower middle
Central African Republic	355.33	Low-income
Chad	599.33	Low-income
Comoros*	1,136.00	Lower middle
Congo, Dem. Rep.	266.67	Low-income
Congo, Rep.*	1,441.33	Lower middle
Cote d'Ivoire*	974.67	Low-income
Equatorial Guinea*	7,858.00	Upper middle
Eritrea	294.17	Low-income
Ethiopia	266.00	Low-income
Gabon*	6,271.33	Upper middle
Gambia, The	516.00	Low-income
Ghana*	926.67	Low-income
Guinea	480.67	Low-income
Guinea-Bissau	455.33	Low-income
Kenya*	740.67	Low-income
Lesotho*	1,106.67	Lower middle
Liberia	373.27	Low-income
Madagascar	344.67	Low-income
Malawi	314.00	Low-income
Mali	541.33	Low-income
Mauritania*	906.00	Low-income
Mauritius*	6,636.00	Upper middle
Mozambique	407.33	Low-income
Namibia*	3,883.94	Lower middle
Niger	284.00	Low-income
Nigeria*	1,580.00	Lower middle
Rwanda	416.67	Low-income
Senegal*	1,044.67	Lower middle
South Africa*	5,178.00	Upper middle
South Sudan	1,010.00	Low-income**
Sudan*	928.67	Low-income
Swaziland*	2,778.67	Lower middle
Tanzania	588.67	Low-income
Togo	456.67	Low-income
Uganda	415.33	Low-income
Zambia*	954.00	Low-income

** South Sudan is classified as a low-income country for this work as data is only available for 2011 onwards, after the country was established.

The quantity of countries per income classification are listed in Table 5.6.

Table 5.6

Number of countries per income classification

Income Classification	Quantity
Low-income	28
Lower middle-income	10
Upper middle-income	5

Across the years included in this work, the mean GDP per capita was US$1,748.75, with the lowest mean value US$185.61 (Burundi) and the highest mean value US$12,974.40 (Equatorial Guinea), and noting that, for the years covered in this work, GDP per capita ranged from US$111.36 (Ethiopia, 2002) to US$22,742.38 (Equatorial Guinea, 2008). Refer to Table 5.7 and Figure 5.5.

Table 5.7

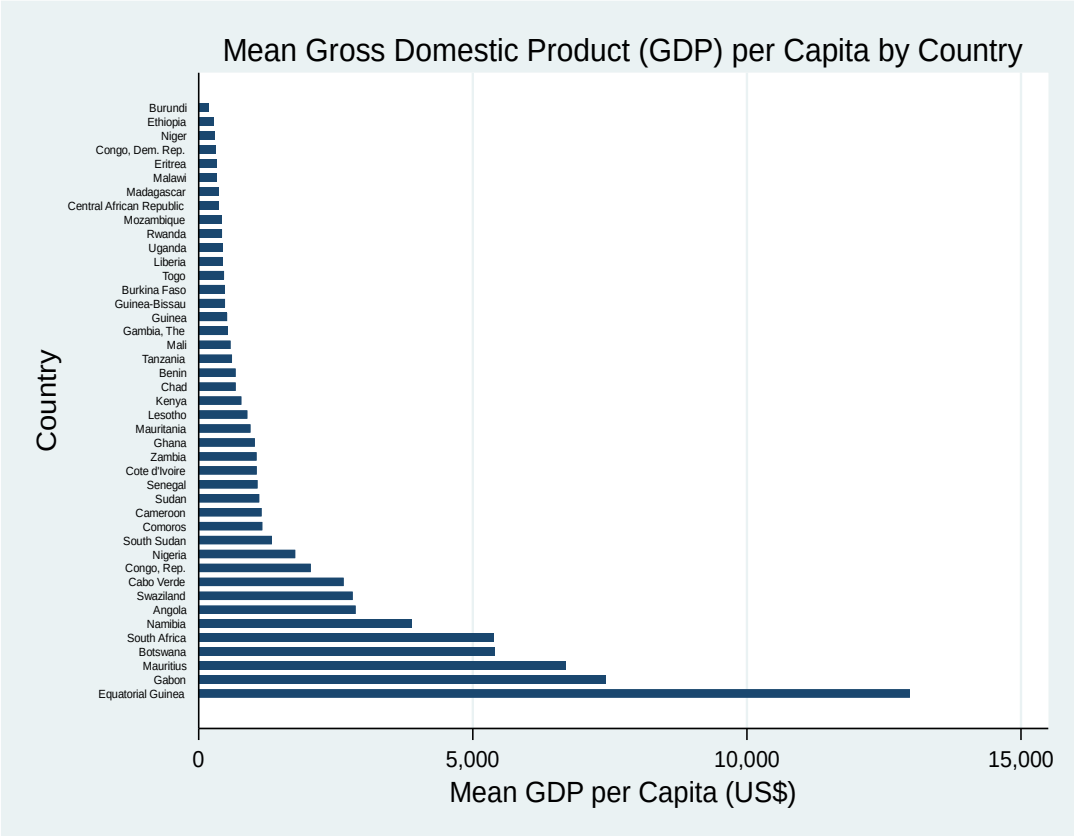
Mean GDP per Capita (US$)

Country	Mean GDP per Capita	Standard Deviation	Lowest annual GDP per Capita	Highest annual GDP per Capita
Angola	2,861.65	1,780.21	526.17	5,412.69
Benin	673.48	190.21	374.19	943.69
Botswana	5,404.55	1,494.88	3,055.62	7,493.75
Burkina Faso	478.09	170.69	226.48	703.82
Burundi	185.61	55.48	112.95	273.54
Cabo Verde	2,643.86	953.22	1,239.38	3,670.43
Cameroon	1,146.52	307.36	660.19	1,571.18
Central African Republic	363.34	87.32	243.16	490.51
Chad	674.07	321.21	166.02	1,026.00
Comoros	1,159.66	297.15	645.82	1,511.83
Congo, Dem. Rep.	305.42	109.79	153.70	487.08
Congo, Rep.	2,044.88	873.82	842.71	3,196.65

Cote d'Ivoire	1,058.87	277.67	642.25	1,568.63
Equatorial Guinea	12,974.40	7,828.14	1,702.69	22,742.38
Eritrea	321.58	119.14	201.77	582.78
Ethiopia	276.79	115.56	111.36	571.16
Gabon	7,427.21	2,392.21	3,976.11	10,716.20
Gambia, The	527.50	102.13	359.65	735.24
Ghana	1,024.86	673.66	263.11	2,401.75
Guinea	519.69	168.18	303.42	743.59
Guinea-Bissau	480.45	128.49	297.75	688.14
Kenya	777.61	327.12	395.85	1,335.12
Lesotho	887.24	309.60	407.81	1,350.64
Liberia	437.12	165.23	240.03	716.05
Madagascar	360.38	88.45	245.12	470.73
Malawi	323.34	99.90	146.76	512.17
Mali	580.26	201.04	269.35	845.72
Mauritania	943.39	373.11	460.95	1,450.58
Mauritius	6,698.56	2,258.16	3,792.18	10,153.94
Mozambique	420.15	124.91	256.44	623.29
Namibia	3,883.94	1,430.37	1,669.43	5,749.41
Niger	293.65	92.44	158.41	429.79
Nigeria	1,760.95	900.03	567.61	3,221.68
Rwanda	426.68	197.13	196.52	706.60
Senegal	1,072.92	292.42	599.37	1,388.88
South Africa	5,382.36	1,767.41	2,461.36	7,967.68
South Sudan	1,335.18	250.35	1,041.46	1,653.13
Sudan	1,104.67	625.07	361.03	2,176.90
Swaziland	2,809.37	860.72	1,325.00	3,934.27
Tanzania	607.43	200.40	398.07	985.23
Togo	462.92	113.89	289.75	632.03
Uganda	432.11	172.22	234.98	702.80
Zambia	1,054.84	561.28	341.91	1,850.79
All Countries	**1,748.75**	**2,849.87**	**111.36**	**22,742.38**

Figure 5.5

Mean GDP per Capita by Country



GDP per capita increased from low-income (US$569.19) to lower middle (US$2,027.10) to upper middle-income (US$7,577.41) countries (refer to Table 5.8)

Table 5.8

GDP per Capita by Country Income Classification (US$)

Income classification	GDP per Capita	Standard Deviation	Lowest annual GDP per Capita	Highest annual GDP per Capita
Low-income	569.19	379.71	111.36	2,401.75
Lower middle-income	2,027.09	1,314.39	407.81	5,749.41
Upper middle-income	7,577.41	4,759.59	1,702.69	22,742.38

The mean total health expenditure as a per cent of GDP was 5.95%. Liberia shows the highest per cent of total health expenditure as a factor of GDP at 16.83% and South Sudan has the lowest per cent of total health expenditure as a factor of GDP at

2.77%. Mean total health expenditure as a per cent of GDP by country is shown in Table 5.9 and Figure 5.6.

Table 5.9

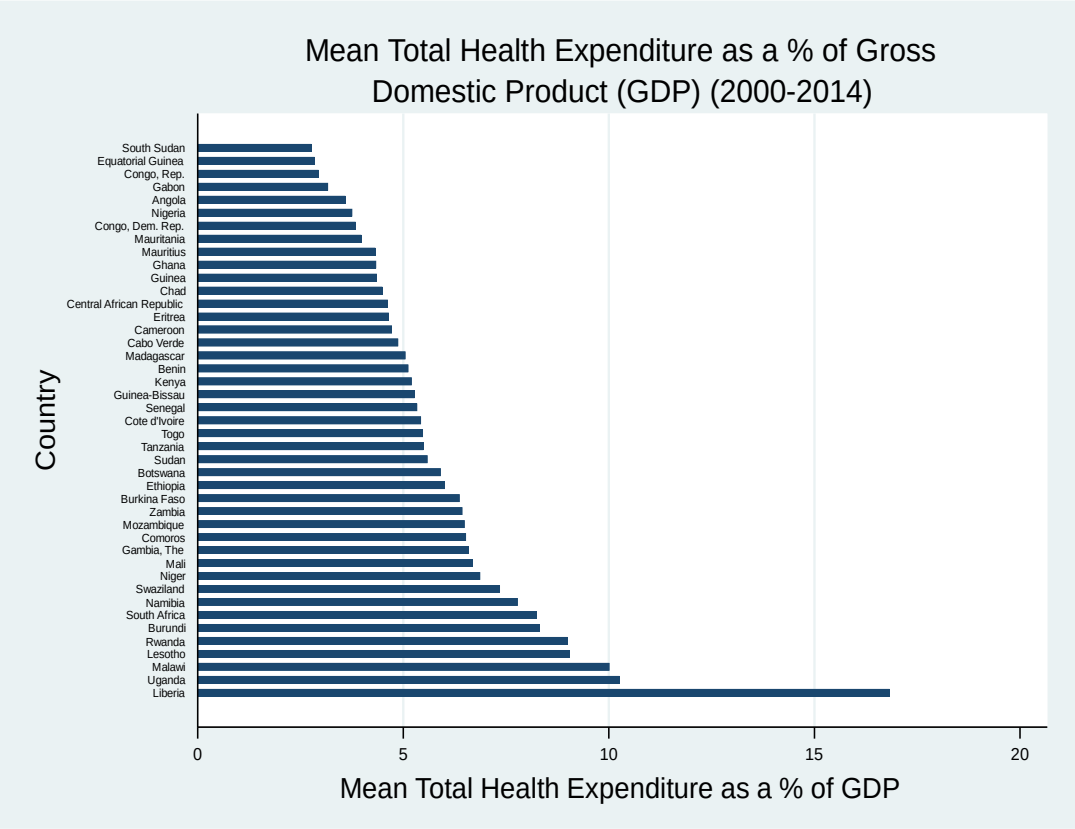
Mean Total Health Expenditure as a per cent of GDP by Country

Country	THE as per cent of GDP	Standard Deviation	Lowest annual THE as % of GDP	Highest annual THE as % of GDP
Angola	3.59	0.67	2.42	5.01
Benin	5.12	0.39	4.59	5.92
Botswana	5.91	1.08	4.57	8.65
Burkina Faso	6.37	0.98	5.02	8.03
Burundi	8.32	2.27	4.98	12.17
Cabo Verde	4.88	0.51	3.95	5.94
Cameroon	4.72	0.49	3.71	5.36
Central African Republic	4.63	0.52	3.74	5.67
Chad	4.49	1.66	2.94	8.44
Comoros	6.53	1.18	4.61	8.91
Congo, Dem. Rep.	3.84	1.12	1.54	6.07
Congo, Rep.	2.94	1.03	2.14	5.19
Cote d'Ivoire	5.43	0.74	4.07	6.29
Equatorial Guinea	2.84	1.01	1.65	5.22
Eritrea	4.65	0.85	3.58	6.51
Ethiopia	6.01	1.08	4.64	8.46
Gabon	3.17	0.35	2.55	3.97
Gambia, The	6.59	2.08	3.65	9.67
Ghana	4.34	0.86	2.97	5.38
Guinea	4.36	1.22	3.08	7.41
Guinea-Bissau	5.28	1.51	3.301	8.97
Kenya	5.21	0.63	4.67	6.39
Lesotho	9.05	2.62	6.04	13.25
Liberia	16.83	10.13	4.52	39.33
Madagascar	5.05	0.65	3.67	6.29
Malawi	10.01	2.82	5.23	13.63
Mali	6.68	0.46	5.89	7.38
Mauritania	3.98	0.84	2.81	5.46
Mauritius	4.32	0.47	3.48	5.14
Mozambique	6.49	0.69	5.64	7.76
Namibia	7.79	1.17	6.15	9.28
Niger	6.87	0.55	6.07	7.99
Nigeria	3.76	0.57	2.50	4.54
Rwanda	8.99	2.57	4.83	12.10
Senegal	5.34	0.58	4.68	6.33
South Africa	8.24	0.47	7.56	8.87
South Sudan	2.77	0.46	2.31	3.75

Sudan	5.59	2.52	2.82	8.37
Swaziland	7.35	1.72	4.91	9.51
Tanzania	5.49	1.29	2.97	7.92
Togo	5.48	0.78	4.17	7.24
Uganda	10.26	2.61	7.47	18.08
Zambia	6.44	1.19	4.74	8.40
All Countries	**5.95**	**3.17**	**1.54**	**39.34**

Figure 5.6

Total Health Expenditure as a % of GDP



Total health expenditure as a per cent of GDP increased steadily over the years in this work from 4.79% in 2000 to 7.16% in 2014, ranging from 1.54% in DRC in 2000 to 39.33% in Liberia in 2014 (refer to Table 5.10 and Figure 5.7). Graphical representations of total health expenditure as a per cent of GDP for each country are contained in Appendix 6.

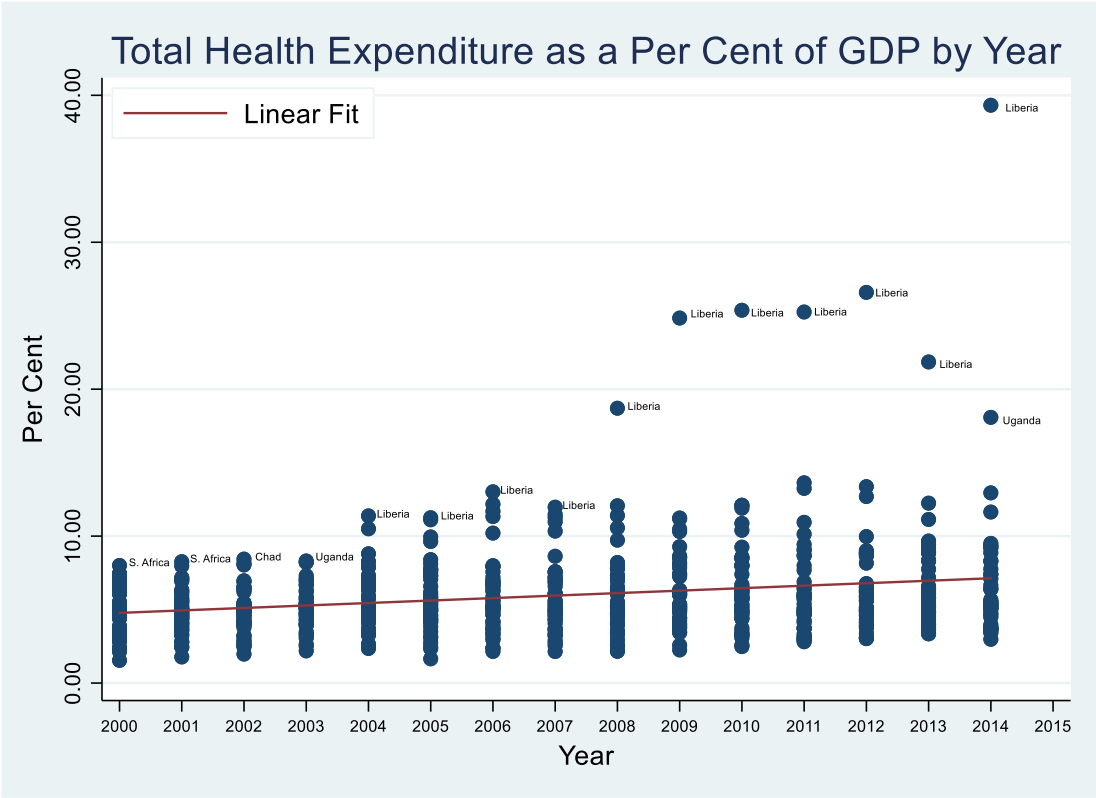
Table 5.10

Total Health Expenditure as a Per Cent of GDP by Year

Year	THE as a per cent of GDP	Standard Deviation	Lowest annual THE as % of GDP	Highest annual THE as % of GDP
2000	4.79	1.62	1.54	8.01
2001	4.88	1.49	1.78	8.26
2002	4.85	1.57	1.97	8.44
2003	5.14	1.53	2.19	8.31
2004	5.59	19.96	2.35	11.38
2005	5.75	2.26	1.65	11.25
2006	5.94	2.65	2.15	13.02
2007	5.86	2.50	2.15	11.97
2008	6.19	3.07	2.16	18.71
2009	6.63	3.62	2.25	24.84
2010	6.74	3.87	2.48	25.37
2011	6.52	3.96	2.81	25.25
2012	6.64	3.96	3.02	26.59
2013	6.64	3.27	3.35	21.85
2014	7.16	5.82	2.98	39.33

Figure 5.7

Total Health Expenditure as a Per Cent of GDP by Year



The mean annual health expenditure across all countries and years (rounded to the nearest million) was US$3,300 million, with the lowest mean value US$70 million (Comoros) and the highest mean value US$49,200 million (South Africa), noting that the annual health expenditure ranged from US$44 million (Comoros, 2001) to US$62,299 million (South Africa, 2014). Refer to Table 5.11 and Figure 5.8. Table 5.12 shows the mean annual health expenditure by country income classification.

Table 5.11

Mean Total Health Expenditure, rounded to the nearest million (US$, in millions)

Country	Mean THE	Standard Deviation	Lowest annual THE	Highest annual THE
Angola	3,840	1,610	1,160	7,080
Benin	845	180	565	1,120
Botswana	1,530	446	856	2,200
Burkina Faso	1,280	360	685	1,830
Burundi	508	197	227	772

Cabo Verde	128	24	86	164
Cameroon	2,400	318	1,810	2,880
Central African Republic	173	18	152	211
Chad	831	180	629	1,220
Comoros	70	17	44	102
Congo, Dem. Rep.	1,610	880	423	3,420
Congo, Rep.	606	374	284	1,410
Cote d'Ivoire	2,980	671	2,010	3,950
Equatorial Guinea	666	422	156	1,300
Eritrea	238	44	181	314
Ethiopia	5,020	2,660	1,990	8,640
Gabon	790	153	587	1,170
Gambia, The	179	78	77	305
Ghana	3,210	1,280	1,400	5,240
Guinea	603	249	378	1,240
Guinea-Bissau	119	45	65	226
Kenya	5,220	1,840	3,490	8,850
Lesotho	411	188	206	678
Liberia	500	409	94	1,520
Madagascar	1,270	144	1,090	1,610
Malawi	1,520	691	547	2,470
Mali	1,730	466	1,060	2,770
Mauritania	437	58	356	611
Mauritius	821	205	533	1,120
Mozambique	1,340	413	797	2,490
Namibia	1,330	493	706	2,240
Niger	882	200	542	1,250
Nigeria	25,700	10,800	8,310	40,000
Rwanda	1,150	562	344	1,790
Senegal	1,400	198	985	1,780
South Africa	49,200	8,800	36,700	62,300
South Sudan	681	228	402	1,110
Sudan	7,160	4,600	2,130	13,200
Swaziland	632	213	358	946

Tanzania	4,960	2,300	1,510	8,610
Togo	440	106	279	589
Uganda	5,170	2,680	2,120	13,200
Zambia	2,370	679	1,450	3,730
All countries	**3,300**	**8,450**	**44**	**62,300**

Figure 5.8

Mean Annual Health Expenditure (US$ in millions)

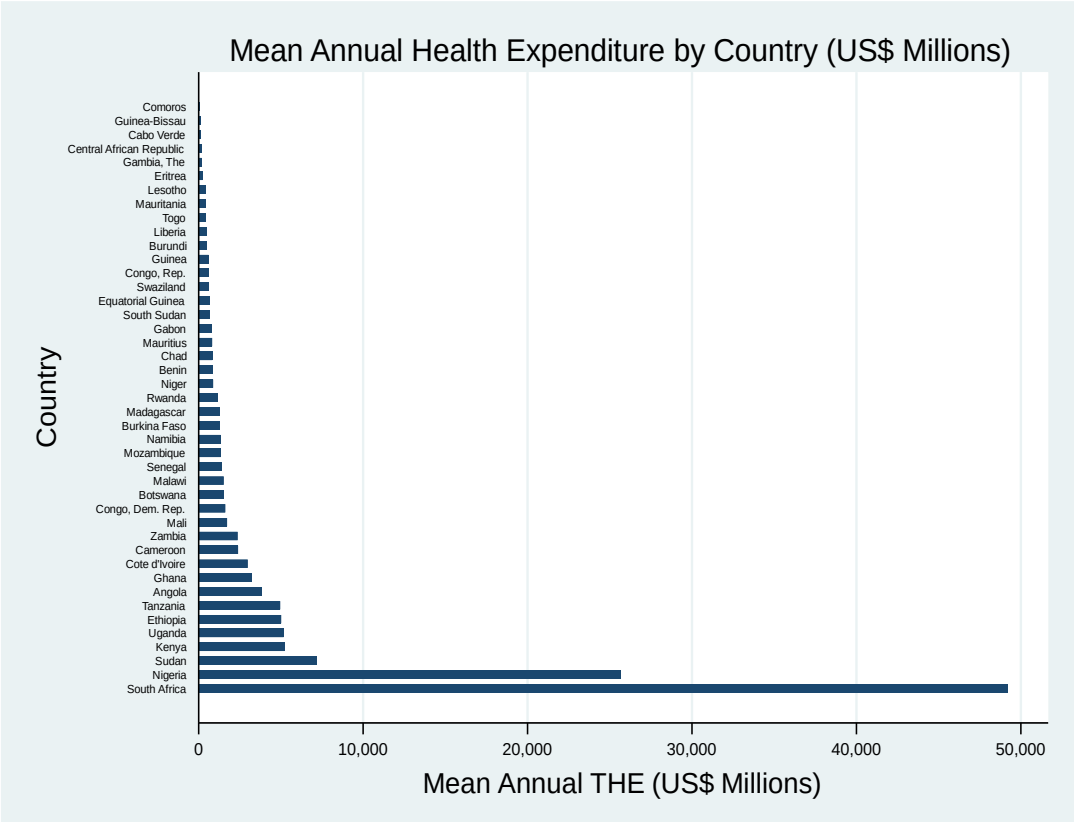


Table 5.12

Total Health Expenditure (in millions) by Country Income Classification

Income classification	Mean THE	Standard Deviation	Lowest annual THE	Highest annual THE
Low-income	1,870	2,280	65	13,200
Lower middle-income	3,650	8,170	44	40,000
Upper middle-income	10,600	19,800	156	62,300

The mean total health expenditure per capita across all years was US$213.01, with the lowest mean value US$25.31 (Democratic Republic of Congo) and the highest mean value US$991.68 (South Africa), noting that the annual total health expenditure ranged from US$8.75 (Democratic Republic of Congo, 2000) to US$1,843.65 (Equatorial Guinea, 2009). Refer to Table 5.13 and Figure 5.9. Table 5.14 shows the mean total health expenditure per capita by country income classification.

Table 5.13

Mean Total Health Expenditure per Capita (US$)

Country	Total Health Expenditure per Capita	Standard Deviation	Lowest annual THE per Capita	Highest annual THE per Capita
Angola	189.76	57.30	76.36	299.48
Benin	95.88	9.07	81.19	111.01
Botswana	775.93	182.26	492.07	1092.15
Burkina Faso	87.28	17.16	58.96	117.49
Burundi	57.11	16.38	32.70	78.33
Cabo Verde	265.65	38.74	195.61	329.06
Cameroon	125.10	10.99	100.30	141.40
Central African Republic	41.05	4.43	32.44	49.21
Chad	77.20	14.63	56.48	106.38
Comoros	105.03	16.58	78.18	138.25
Congo, Dem. Rep.	25.31	10.54	8.75	45.64
Congo, Rep.	153.82	75.08	91.04	313.44
Cote d'Ivoire	155.11	22.91	117.22	178.90
Equatorial Guinea	936.73	512.74	288.31	1,843.65
Eritrea	55.08	12.36	40.96	84.21
Ethiopia	59.23	25.52	29.98	95.46
Gabon	541.02	60.54	446.60	710.41
Gambia, The	110.41	34.42	60.48	162.65
Ghana	137.46	42.76	74.42	200.35

Guinea	57.12	17.37	38.66	101.18
Guinea-Bissau	75.77	21.74	49.05	128.41
Kenya	135.60	31.43	106.75	196.63
Lesotho	306.03	87.20	110.98	334.14
Liberia	128.44	90.07	30.36	345.50
Madagascar	66.06	7.48	51.55	76.23
Malawi	106.77	38.34	47.09	159.16
Mali	122.80	16.47	96.27	162.34
Mauritania	131.41	13.46	106.52	153.27
Mauritius	664.03	153.76	448.09	879.75
Mozambique	58.61	11.27	43.08	91.58
Namibia	616.62	185.67	371.46	935.81
Niger	59.38	5.05	48.34	66.82
Nigeria	167.50	58.12	64.24	228.28
Rwanda	115.02	48.23	42.14	169.57
Senegal	115.97	10.78	99.73	136.72
South Africa	991.68	129.81	813.30	1,172.15
South Sudan	73.96	11.38	59.99	98.02
Sudan	201.01	114.81	73.78	336.30
Swaziland	541.20	154.45	330.21	745.15
Tanzania	113.14	40.38	44.15	166.41
Togo	73.31	10.67	54.19	94.70
Uganda	163.51	62.05	88.87	347.18
Zambia	180.25	31.62	136.76	244.24
All Countries	**213.01**	**260.55**	**8.75**	**1,843.65**

Figure 5.9

Mean Total Health Expenditure per Capita

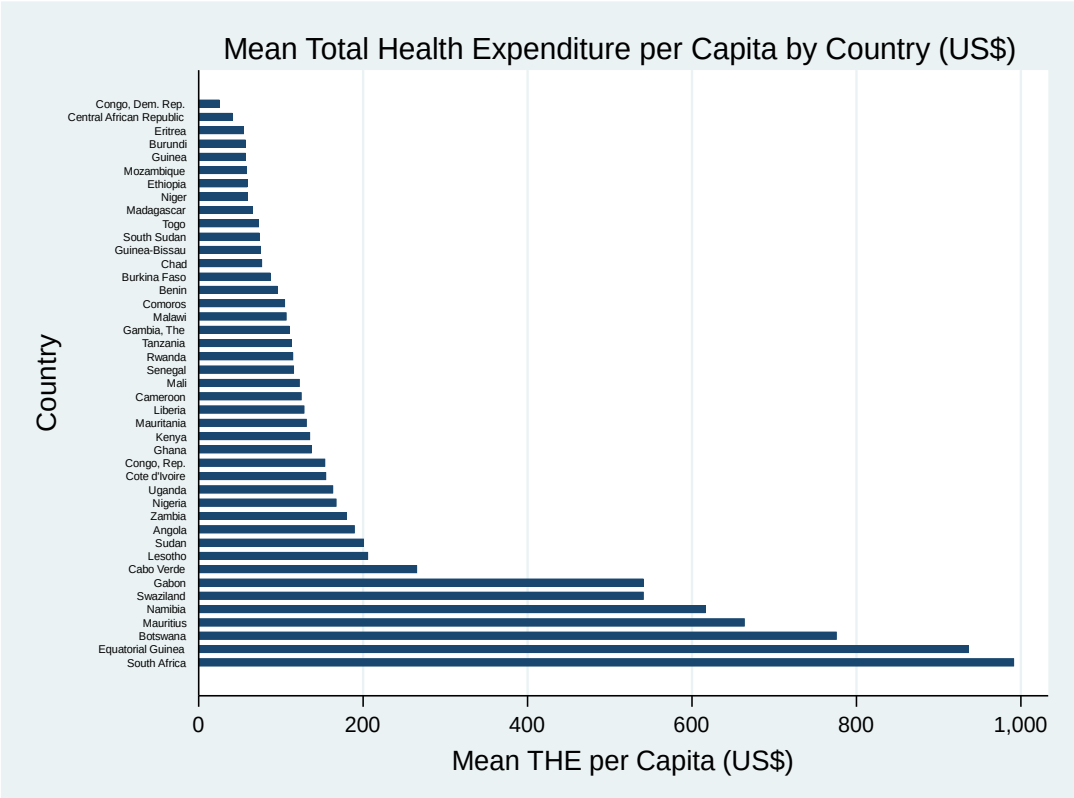


Table 5.14

THE per Capita by Country Income Classification

Income classification	THE per Capita	Standard Deviation	Minimum Range	Maximum Range
Low-income	98.69	56.68	8.75	327.18
Lower middle-income	248.67	193.14	64.24	935.81
Upper middle-income	781.88	304.53	288.31	1,843.65

Across all years, mean government health expenditure as a per cent of total health expenditure was 35.15% while the mean per capita government health expenditure was US$99.40. The distribution of government health expenditure as a per cent of total health expenditure by country is shown in Figure 5.10 and the distribution of per capita government expenditure on health is shown in Figure 5.11. Mean private health

expenditure as a percent of total health expenditure was 7.19%, with the distribution by country shown in Figure 5.12, while the mean per capita private health expenditure was US$27.11, with the distribution shown by country in Figure 5.13. Mean OOP expenditure as a percent of total health expenditure was 36.06% while mean per capita OOP was US$57.78 with the distribution by country shown in Figures 5.14 and 5.15 respectively. Development assistance for health expenditure as a percent of total health expenditure was 21.60% while mean per capita development assistance for health was US$28.71, with the distribution by country shown in Figures 5.16 and 5.17 respectively. The sources of health financing as a per cent of total health expenditure are detailed in Table 5.15, per capita sources of health financing are detailed in Table 5.17 and the graphical representations by country are found in Appendix 7.

Figure 5.10

Government Health Expenditure as a Per Cent of Total Health Expenditure

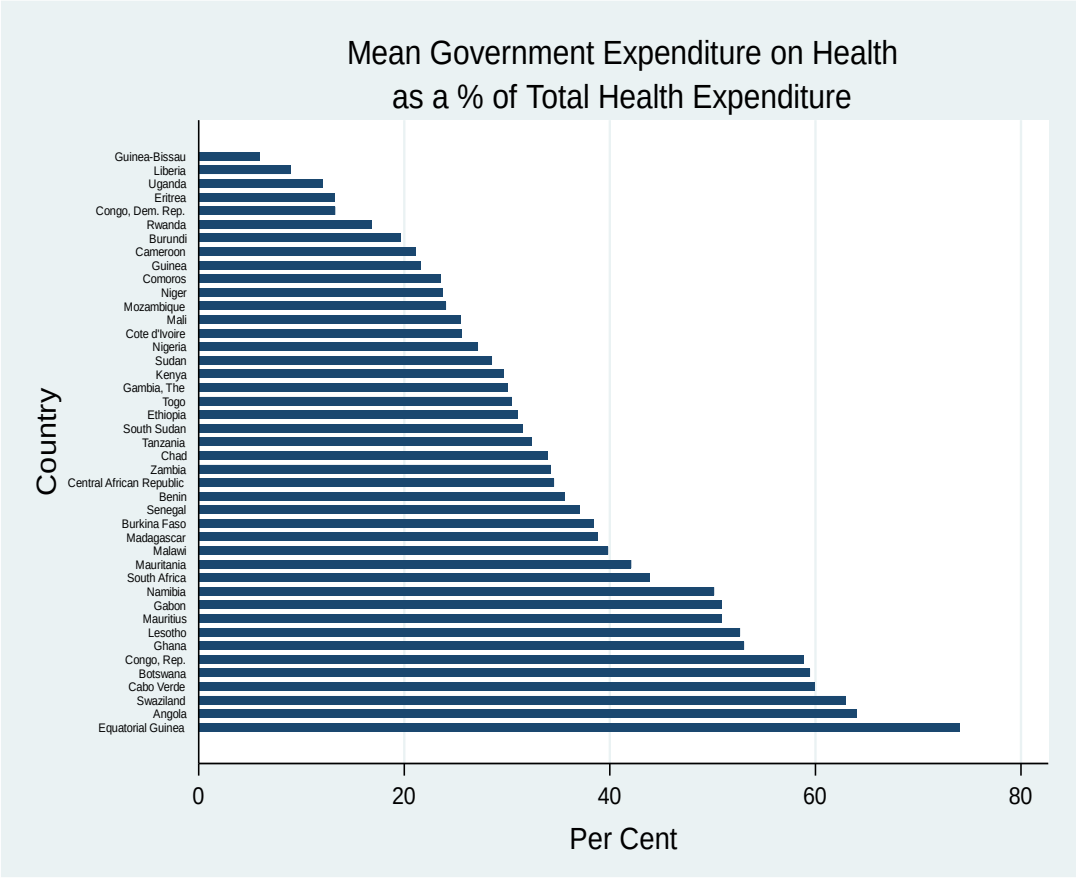


Figure 5.11

Mean Per Capita Government Health Expenditure

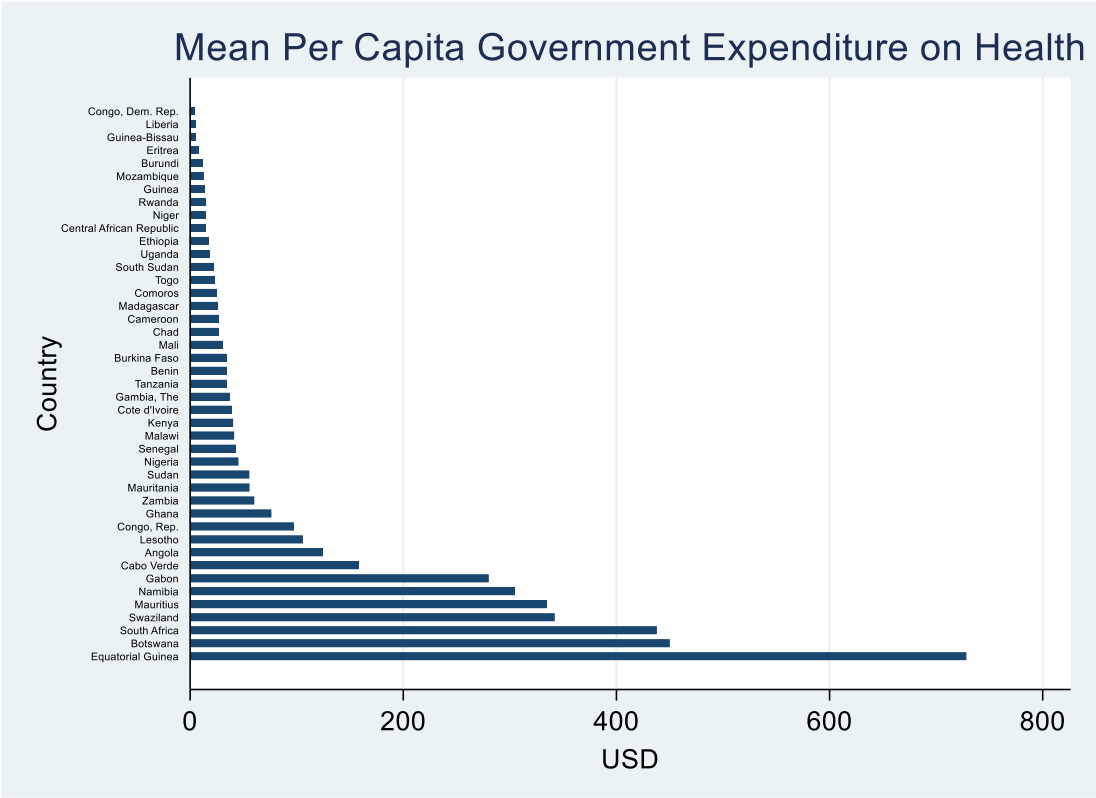


Figure 5.12

Private Health Expenditure as a Per Cent of Total Health Expenditure

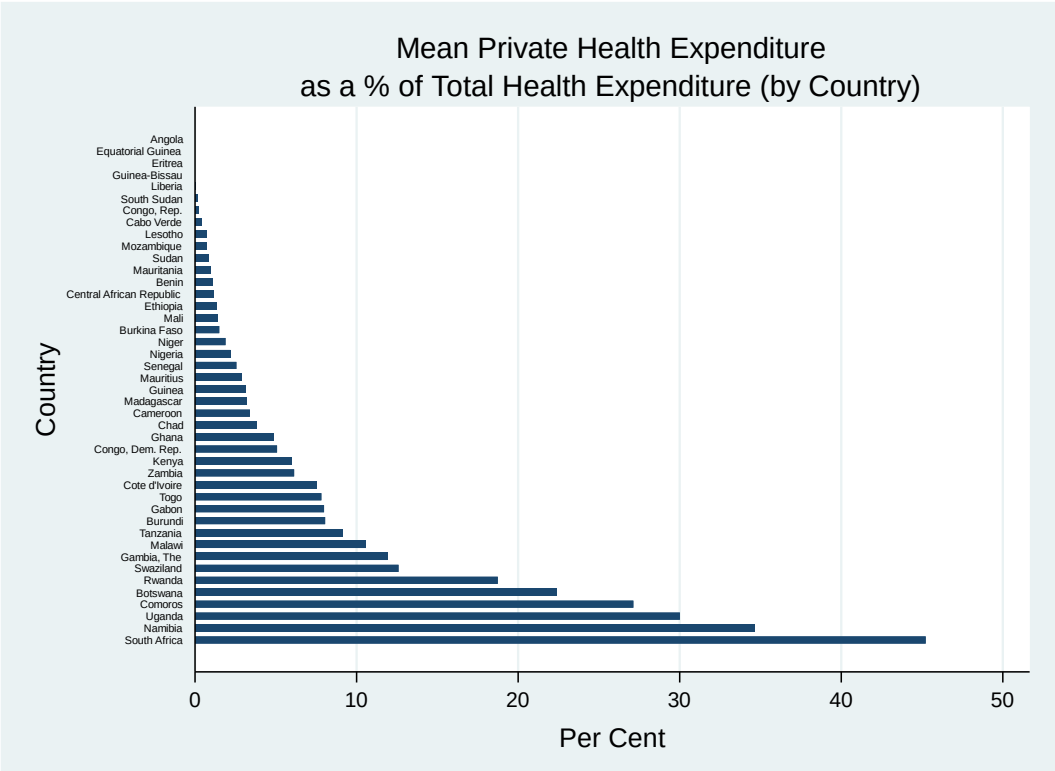


Figure 5.13

Mean Per Capita Private Health Expenditure

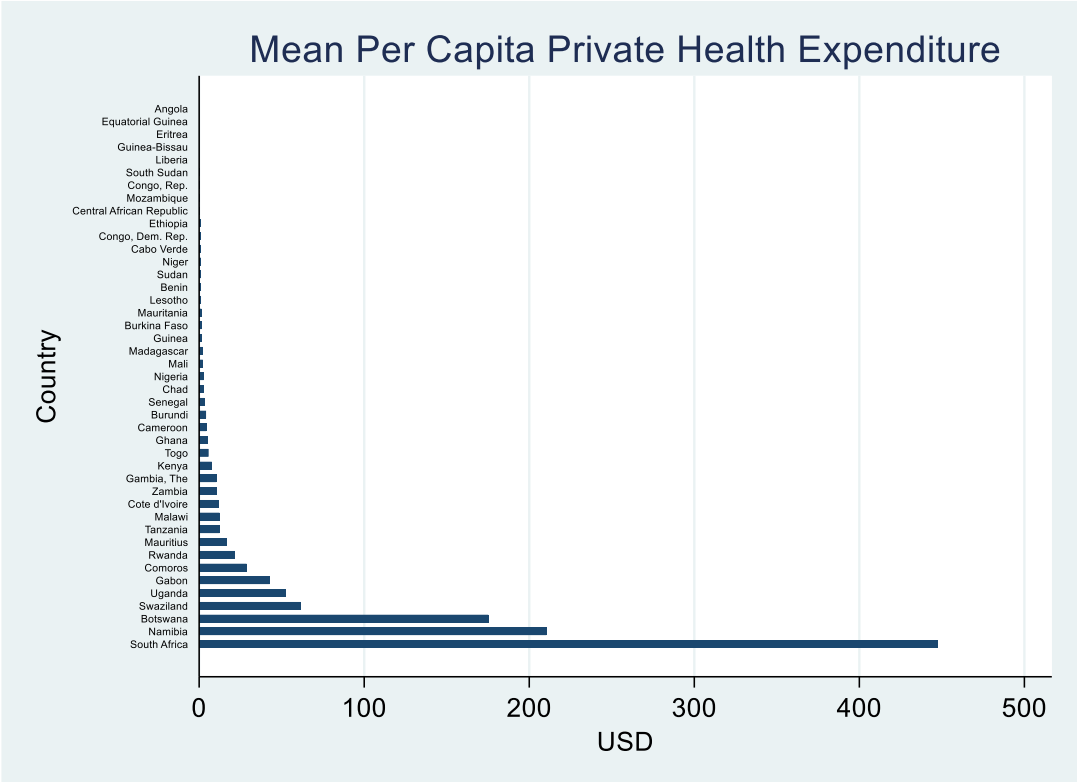


Figure 5.14

Out of Pocket Expenditure on Health as a Per Cent of Total Health Expenditure

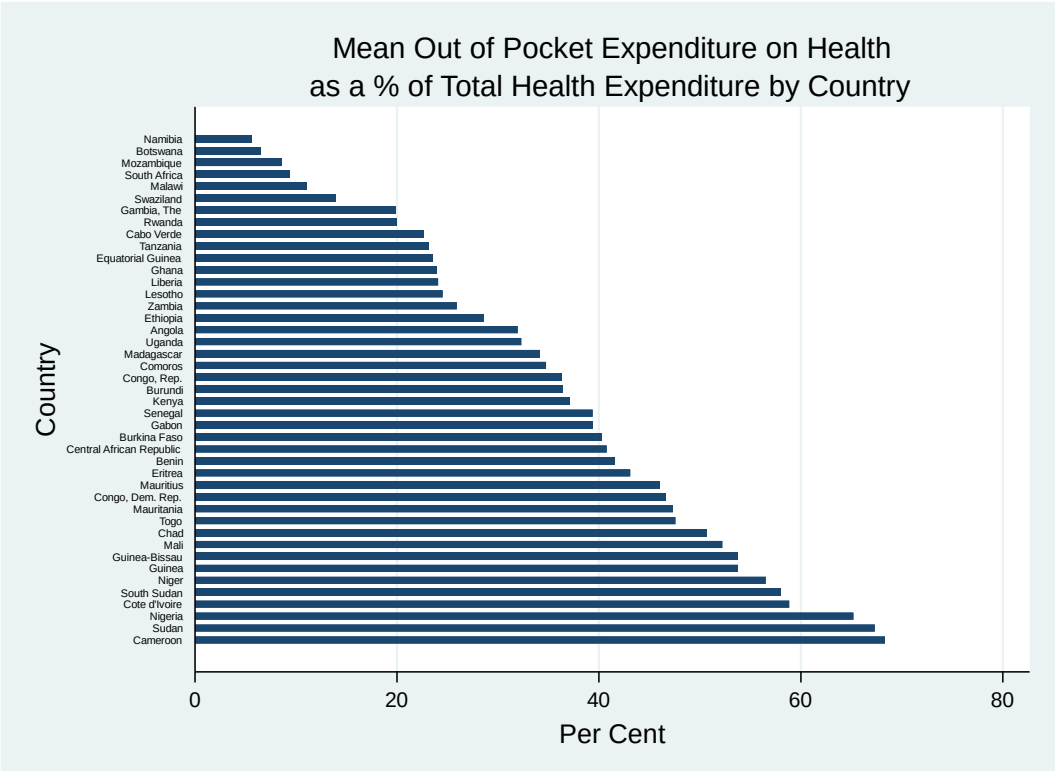


Figure 5.15

Mean Per Capita Out of Pocket Expenditure on Health

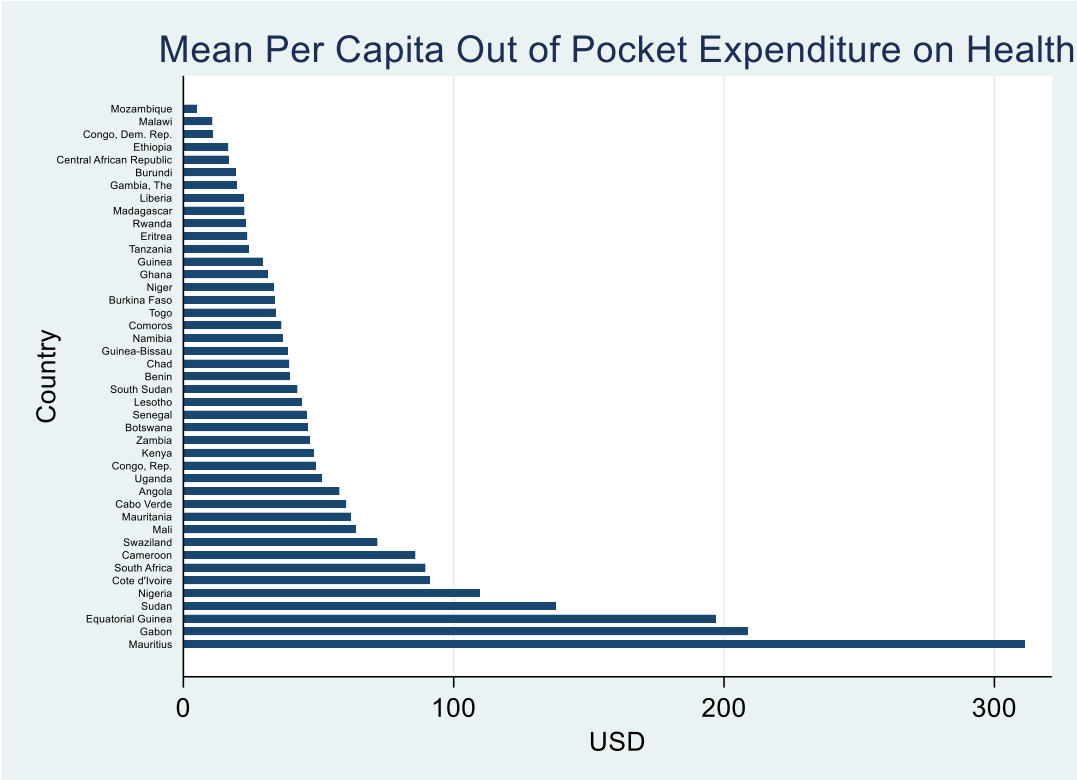


Figure 5.16

Development Assistance for Health as a Per Cent of Total Health Expenditure

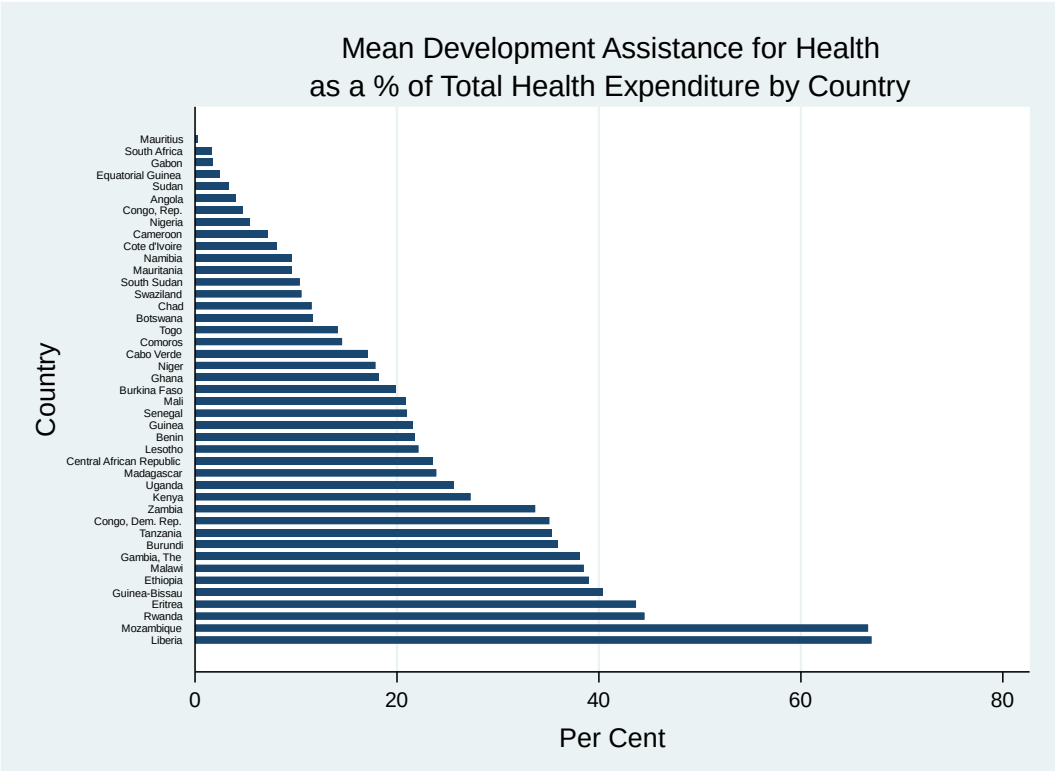
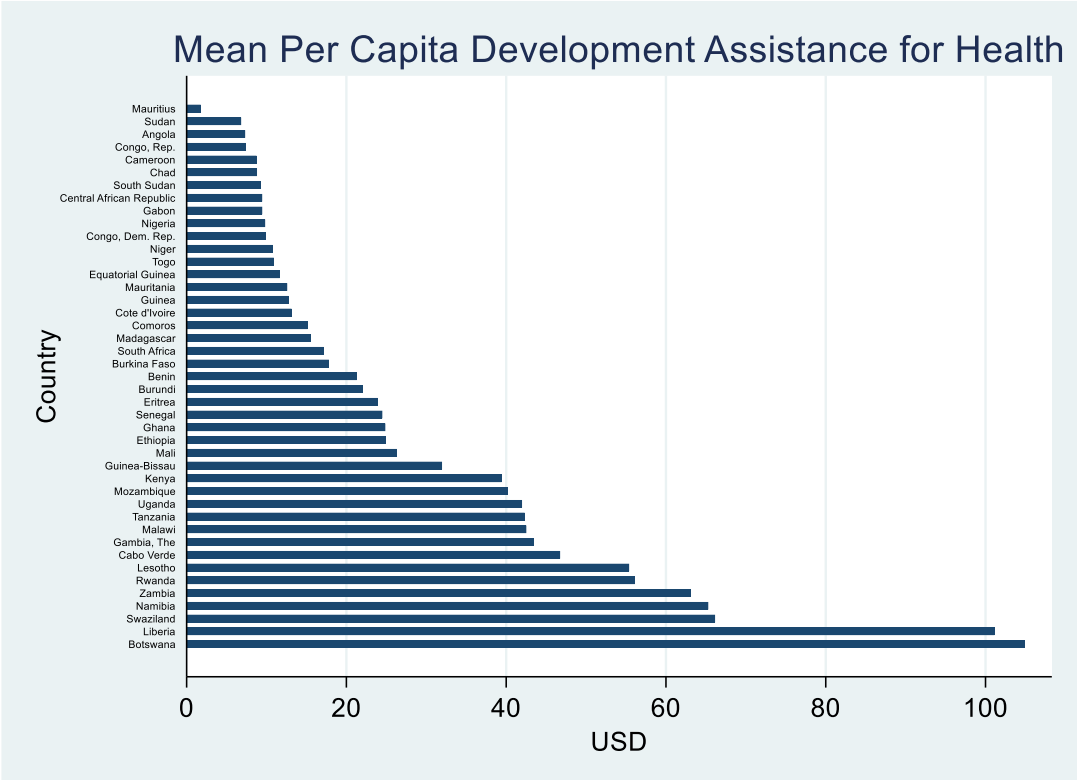


Figure 5.17

Mean Per Capita Development Assistance for Health



For low-income countries, government health expenditure as a per cent of total health expenditure was 27.67% and was approximately double for lower middle-income countries (45.74%) and upper middle-income countries (55.82%). Private health expenditure as a percent of total health expenditure was 5.25% for low-income countries; 8.38% for lower middle-income countries; and 15.68% for upper middle-income countries. Out of pocket expenditure was highest for low-income countries at 38.69% and lowest for upper middle-income countries 24.96%. Development assistance for health was highest for low-income countries at 28.40% and lowest for upper middle-income countries at 3.53%. Refer to Table 5.16.

Mean per capita government expenditure on health was highest for upper middle-income countries at US$466.18, followed by lower middle-income countries at US$127.10 and low-income countries at US$27.59. Mean per capita private health expenditure was highest for upper middle-income countries at US$136.30, followed by lower middle-income countries at US$31.29 and low-income countries at US$6.12. Mean per capita out of pocket expenditure on health was also highest for upper middle-income countries at US$170.42, followed by lower middle-income countries at US$59.64 and low-income countries at US$37.01. Mean per capita development assistance for health was roughly the same across the different country income classifications with low-income countries at US$27.98, lower middle-income countries at US$30.65, and upper middle-income countries at US$29.98. Refer to Table 5.18.

Table 5.15

Source of Health Expenditure as a Per Cent of Total Health Expenditure

Country	Government Health Expenditure per THE (%)	Standard Deviation (%)	Lowest Annual GHE (%)	Highest Annual GHE (%)	Private Health Expenditure per THE (%)	Standard Deviation (%)	Lowest Annual PHE (%)	Highest Annual PHE (%)	Out of Pocket per THE (%)	Standard Deviation (%)	Lowest Annual OOP (%)	Highest Annual OOP (%)	Development Assistance for Health per THE (%)	Standard Deviation (%)	Lowest Annual DAH (%)	Highest Annual DAH (%)
Angola	64.05	9.21	50.08	76.76	-	-	-	-	31.96	8.85	19.95	46.44	4.00	1.34	2.86	8.24
Benin	35.61	3.04	30.23	41.59	1.09	2.58	-	8.78	41.53	6.17	32.56	51.89	21.76	6.89	10.63	31.22
Botswana	59.47	10.04	46.18	76.30	22.35	7.79	11.98	34.97	6.53	3.23	2.64	13.99	11.65	10.16	0.50	34.51
Burkina Faso	38.41	5.30	27.19	45.41	1.50	3.01	-	10.13	40.25	8.08	29.39	54.82	19.84	4.87	11.61	25.98
Burundi	19.62	7.53	6.62	29.59	8.05	5.93	-	16.32	36.38	13.67	16.87	53.80	35.95	15.09	14.75	57.15
Cabo Verde	59.90	6.85	49.26	71.94	0.40	0.45	-	1.07	22.65	1.48	20.12	25.60	17.05	7.09	2.79	27.77
Cameroon	21.12	3.70	16.60	29.49	3.40	0.89	1.79	4.61	68.33	4.95	51.98	73.72	7.15	4.25	1.78	16.73
Central African Republic	34.58	8.95	9.03	44.43	1.12	1.68	-	5.54	40.77	4.71	32.83	46.34	23.53	12.92	7.66	56.73
Chad	33.94	6.48	23.94	48.53	3.81	1.39	1.34	5.78	50.70	7.66	37.16	63.10	11.55	3.47	6.55	19.25
Comoros	23.55	8.60	11.68	39.94	27.13	4.73	19.03	32.50	34.77	5.50	27.78	46.56	14.56	7.31	5.44	26.51
Congo, Dem. Rep.	13.29	7.30	2.12	22.94	5.08	7.15	-	25.26	46.55	13.15	28.49	70.41	35.08	14.53	14.19	58.09
Congo, Rep.	58.83	10.41	45.82	80.66	0.19	0.21	-	0.57	36.26	10.75	17.39	49.29	4.72	3.20	0.86	11.23
Cote d'Ivoire	25.57	3.82	19.80	31.85	7.51	1.07	5.79	8.78	58.85	3.77	52.45	65.64	8.07	4.04	1.42	15.11
Equatorial Guinea	74.04	10.50	55.37	85.48	-	-	-	-	23.56	9.19	14.46	41.81	2.40	2.89	0.04	7.34
Eritrea	13.23	10.46	-	27.88	-	-	-	-	43.10	7.61	27.89	57.76	43.67	11.26	24.80	58.97
Ethiopia	31.06	8.19	19.65	45.27	1.31	1.42	-	3.80	28.62	3.63	23.17	34.97	39.00	11.18	18.97	52.71

Gabon	50.85	14.22	37.55	72.68	7.98	1.11	4.84	9.37	39.41	13.39	18.80	52.22	1.76	0.76	0.86	3.46
Gambia, The	30.07	13.81	7.14	47.38	11.92	9.11	-	26.07	19.89	7.33	13.06	35.04	38.12	10.37	26.33	54.45
Ghana	53.06	9.41	36.09	66.97	4.87	3.78	-	10.79	23.90	5.29	16.36	32.93	18.17	3.58	11.29	26.16
Guinea	21.60	11.39	2.45	37.80	3.11	2.83	-	6.76	53.77	9.58	34.53	71.14	21.52	7.74	13.89	45.07
Guinea-Bissau	5.96	6.77	-	19.64	-	-	-	-	53.73	10.90	31.33	73.15	40.31	9.35	22.37	61.57
Kenya	29.67	8.14	9.65	39.79	6.00	2.33	2.18	8.67	37.05	7.30	23.38	43.24	27.28	11.74	10.01	44.26
Lesotho	52.67	8.71	27.58	63.43	0.69	0.39	0.24	1.32	24.52	8.65	14.07	39.00	22.12	14.40	4.71	55.55
Liberia	8.93	9.13	-	23.49	0.01	0.01	-	0.03	24.07	12.37	7.84	48.18	67.00	20.60	33.33	92.16
Madagascar	38.78	5.48	29.53	47.90	3.18	3.36	-	7.93	34.16	3.01	26.19	38.53	23.89	8.19	9.65	36.21
Malawi	39.84	11.22	23.00	58.55	10.57	6.27	1.42	26.13	11.08	4.58	4.01	22.00	38.50	6.33	29.57	53.15
Mali	25.51	10.27	6.22	39.33	1.42	3.74	-	10.92	52.22	5.39	43.57	61.01	20.86	8.18	6.68	35.00
Mauritania	42.09	3.26	35.56	47.22	0.98	0.85	-	2.39	47.33	2.92	43.13	52.16	9.60	1.94	5.29	12.28
Mauritius	50.91	4.74	40.26	56.94	2.85	1.86	0.71	5.31	46.01	6.00	38.06	57.77	0.23	0.18	0.01	0.53
Mozambique	24.07	21.01	-	49.52	0.74	0.28	0.39	1.41	8.54	2.06	4.87	11.52	66.65	22.64	38.92	92.19
Namibia	50.15	7.15	38.71	67.97	34.62	5.93	24.19	46.58	5.63	1.79	2.94	7.92	9.60	5.16	2.26	17.81
Niger	23.72	4.83	13.97	33.24	1.89	2.39	-	5.64	56.53	5.60	47.78	64.88	17.86	5.28	10.15	27.92
Nigeria	27.18	4.36	18.78	33.81	2.19	1.84	0.43	6.68	65.20	4.34	58.61	73.70	5.43	2.01	2.68	8.88
Rwanda	16.83	14.07	-	41.28	18.74	4.44	7.53	24.91	19.92	1.99	15.10	23.10	44.50	12.61	25.22	63.21
Senegal	37.06	5.89	22.64	44.77	2.56	2.17	-	5.73	39.38	7.69	27.78	51.49	20.99	5.39	11.26	29.06
South Africa	43.85	2.68	40.14	47.22	45.23	1.53	43.56	47.76	9.31	2.41	6.43	13.78	1.61	1.02	0.26	2.92
South Sudan	31.51	10.39	10.86	41.38	0.13	0.14	-	0.58	57.98	7.56	40.65	67.02	10.38	16.93	0.38	42.35

Sudan	28.54	4.46	20.37	34.07	0.85	0.79	-	2.22	67.31	5.09	58.62	76.59	3.29	1.26	1.38	5.86
Swaziland	62.92	3.08	57.60	67.63	12.60	5.00	4.24	20.85	13.94	2.85	10.01	19.45	10.54	7.17	1.64	22.53
Tanzania	32.40	12.88	9.55	52.34	9.15	5.90	-	17.33	23.15	8.60	11.87	42.05	35.29	10.22	20.20	50.25
Togo	30.47	5.06	21.29	40.31	7.82	2.75	2.89	14.51	47.57	7.09	35.75	60.88	14.13	6.62	3.32	24.67
Uganda	12.06	5.10	0.89	21.24	30.01	11.33	15.69	64.77	32.31	5.26	16.36	37.73	25.62	7.38	10.91	40.60
Zambia	34.26	11.61	17.06	50.76	6.13	3.84	-	13.13	25.93	3.51	19.65	31.69	33.68	12.33	13.26	48.83
All countries	**35.15**	**18.32**	**-**	**85.48**	**7.19**	**10.86**	**-**	**64.77**	**36.06**	**18.12**	**2.64**	**76.59**	**21.60**	**18.56**	**0.01**	**92.19**

Table 5.16

Source of Health Expenditure by Country Income Classification

Income classification	Government Health Expenditure per THE	Std. Dev.	Lowest Annual GHE (%)	Highest Annual GHE (%)	Private Health Expenditure Per THE	Standard Deviation (%)	Lowest Annual PHE (%)	Highest Annual PHE (%)	OOP per THE	Standard Deviation (%)	Lowest Annual OOP (%)	Highest Annual OOP (%)	DAH Per THE	Standard Deviation (%)	Lowest Annual DAH (%)	Highest Annual DAH (%)
Low-income	27.67	14.19	0	66.97	5.25	7.65	0	64.77	38.69	16.62	4.87	76.59	28.40	18.78	0.38	92.19
Lower middle-income	45.74	17.58	11.68	80.66	8.38	12.29	0	46.58	34.26	20.07	2.94	73.72	11.62	9.13	0.86	55.55
Upper middle-income	55.82	13.88	37.55	85.48	15.68	17.15	0	47.76	24.96	17.63	2.64	57.77	3.53	6.21	0.01	34.51

Table 5.17

Per Capita Source of Health Expenditure

Country	Per Capita Government Health Expenditure (USD)	Standard Deviation (USD)	Lowest Annual Per Capita GHE (USD)	Highest Annual Per Capita GHE (USD)	Per Capita Private Health Expenditure (USD)	Standard Deviation (USD)	Lowest Annual Per Capita PHE (USD)	Highest Annual Per Capita PHE (USD)	Per Capita Out of Pocket (USD)	Standard Deviation (USD)	Lowest Annual Per Capita OOP (USD)	Highest Annual Per Capita OOP (USD)	Per Capita Development Assistance for Health (USD)	Standard Deviation (USD)	Lowest Annual Per Capita DAH (USD)	Highest Annual Per Capita DAH (USD)
Angola	124.73	50.65	52.41	229.87	0	0	0	0	57.70	13.20	19.84	78.90	7.33	2.57	4.11	13.41
Benin	34.11	4.13	28.41	42.67	1.11	2.57	0	8.60	39.36	3.12	36.00	44.14	21.30	8.05	8.75	32.46
Botswana	449.97	74.81	311.92	561.17	175.13	80.95	84.59	315.83	45.96	12.69	28.75	68.84	104.87	113.89	2.56	375.57
Burkina Faso	34.02	9.39	16.34	45.23	1.56	3.38	0	11.01	33.89	1.78	31.85	38.40	17.81	6.29	6.85	29.26
Burundi	11.61	6.29	2.63	20.73	4.20	3.55	0	10.49	19.26	6.52	12.38	35.44	22.04	12.45	4.82	38.51
Cabo Verde	157.66	19.07	125.85	186.12	1.01	1.12	0	3.03	60.23	10.31	48.49	80.38	46.75	22.08	5.46	85.26
Cameroon	26.32	4.44	19.83	34.01	4.26	1.17	1.80	5.93	85.78	11.46	52.14	103.56	8.74	4.54	2.02	16.78
Central African Republic	14.41	4.36	3.13	18.73	0.44	0.63	0	1.93	16.73	2.46	10.65	19.06	9.46	4.64	3.23	19.68
Chad	26.43	7.80	14.40	43.38	2.83	0.88	1.20	3.99	39.13	10.20	28.77	64.99	8.81	2.96	5.44	16.70
Comoros	24.99	10.94	11.55	46.30	28.69	7.60	16.10	44.58	36.22	6.79	29.91	47.56	15.14	7.73	6.30	27.31
Congo, Dem. Rep.	3.77	3.02	0.24	9.72	0.85	1.05	0.00	3.57	10.78	2.75	4.49	17.08	9.91	6.65	1.80	19.18
Congo, Rep.	97.29	69.21	51.92	251.30	0.28	0.34	0.00	1.00	48.89	5.84	38.00	60.14	7.36	5.66	0.78	17.39
Cote d'Ivoire	39.16	5.53.	32.92	51.31	11.64	2.42	9.01	14.77	91.18	13.70	63.18	105.95	13.13	7.87	2.29	26.98
Equatorial Guinea	728.22	465.39	216.70	1576.04	0.00	0.00	0.00	0.00	196.85	75.63	47.33	292.16	11.66	14.49	0.68	47.13
Eritrea	7.55	6.25	0.00	17.31	0.00	0.00	0.00	0.00	23.61	6.68	17.90	39.47	23.92	7.78	14.40	36.97
Ethiopia	16.91	5.03	10.06	27.62	0.81	1.15	0.00	3.59	16.56	6.72	9.65	25.84	24.94	14.46	5.69	48.19
Gabon	280.07	104.35	187.28	516.33	42.79	5.14	34.41	53.63	208.69	63.31	101.17	274.38	9.46	3.96	4.15	17.79
Gambia, The	36.79	22.69	4.32	71.58	10.34	6.67	0.00	15.94	19.86	1.80	15.56	21.84	43.41	20.71	17.74	82.76
Ghana	76.12	33.38	29.29	123.21	5.27	2.87	0.00	8.52	31.21	7.37	23.88	51.92	24.87	7.94	8.40	37.45
Guinea	13.38	8.77	1.01	29.33	1.60	1.42	0.00	3.62	29.39	4.28	24.07	38.39	12.75	9.31	8.13	45.60

Guinea-Bissau	5.24	6.80	0.00	17.76	0.00	0.00	0.00	0.00	38.56	2.37	33.11	40.89	31.97	16.38	10.97	70.98
Kenya	40.34	15.29	12.39	74.26	7.65	2.11	3.62	9.69	48.19	4.11	42.68	58.18	39.42	23.06	11.26	76.77
Lesotho	105.74	43.79	58.75	202.29	1.13	0.29	0.64	1.66	43.76	3.14	39.38	48.81	55.39	52.05	5.23	164.18
Liberia	4.91	5.01	0.00	12.50	0.00	0.00	0.00	0.01	22.41	6.10	5.97	29.64	101.12	90.71	12.80	318.40
Madagascar	25.74	5.23	15.22	36.22	2.21	2.35	0.00	5.54	22.54	3.10	17.16	26.38	15.56	5.24	6.91	26.02
Malawi	41.27	14.54	11.49	62.51	12.28	9.11	0.93	31.47	10.69	2.70	6.88	13.99	42.52	19.99	15.96	72.14
Mali	30.60	10.99	7.54	44.01	2.23	5.89	0.00	17.73	63.65	6.84	51.89	72.33	26.32	11.82	6.97	42.45
Mauritania	55.56	9.08	42.90	70.73	1.33	1.15	0.00	2.80	61.93	4.32	51.67	68.57	12.59	2.71	6.96	15.92
Mauritius	334.76	70.83	253.26	447.33	16.41	8.30	5.72	27.77	311.10	98.17	174.09	422.47	1.76	1.60	0.07	4.41
Mozambique	13.08	11.01	0.00	31.70	0.43	0.19	0.21	0.85	4.93	1.23	2.91	7.80	40.17	17.75	16.99	73.49
Namibia	304.18	89.68	211.03	500.72	210.33	57.70	89.85	291.63	36.81	19.36	11.21	64.54	65.30	42.38	8.40	126.42
Niger	14.24	3.71	7.45	20.55	1.04	1.30	0.00	3.21	33.32	1.50	31.36	37.38	10.77	3.81	4.90	17.96
Nigeria	45.21	16.87	15.78	68.22	2.77	1.00	0.85	4.53	109.69	39.51	40.68	157.99	9.83	5.84	2.11	19.56
Rwanda	14.11	10.79	0.00	32.72	21.68	10.06	3.47	37.01	23.11	10.45	8.83	35.72	56.12	33.47	11.31	103.03
Senegal	42.91	8.04	30.19	61.21	3.05	2.67	0.00	7.64	45.52	9.41	37.22	66.39	24.49	6.86	11.23	32.60
South Africa	437.86	82.32	333.93	550.43	447.17	48.49	365.17	519.82	89.50	11.89	75.42	112.07	17.15	12.09	2.13	33.14
South Sudan	22.46	6.42	9.46	31.83	0.09	0.09	0.00	0.39	42.14	2.75	38.19	46.39	9.27	15.67	0.27	41.51
Sudan	55.47	30.47	19.60	104.09	1.07	0.96	0.00	2.85	137.64	83.73	51.40	256.15	6.82	4.28	1.08	13.44
Swaziland	341.95	103.03	195.15	496.17	61.35	10.83	28.74	71.75	71.74	10.25	55.16	88.05	66.15	54.17	5.48	172.95
Tanzania	34.39	15.73	11.86	78.34	12.29	10.10	0.00	28.47	24.16	8.42	13.33	39.82	42.31	22.32	10.75	71.68
Togo	22.58	6.12	11.54	38.17	5.61	1.61	1.99	7.87	34.20	1.52	31.83	37.49	10.92	5.95	1.80	20.61
Uganda	18.00	8.15	3.09	33.04	52.41	48.58	25.94	224.88	51.11	13.82	30.23	64.06	41.99	16.70	11.38	67.13
Zambia	60.13	17.11	26.20	84.56	10.39	6.19	0.00	24.56	46.62	9.84	34.32	61.49	63.10	29.25	18.13	113.55
All countries	**99.40**	**171.04**	**0.00**	**1576.04**	**27.11**	**79.06**	**0.00**	**519.82**	**57.78**	**63.43**	**2.91**	**422.47**	**28.71**	**36.85**	**0.07**	**375.57**

Table 5.18

Per Capita Source of Health Expenditure by Country Income Classification

Income classification	Per Capita Government Health Expenditure (USD)	Standard Deviation (USD)	Lowest Annual Per Capita GHE (USD)	Highest Annual Per Capita GHE (USD)	Per Capita Private Health Expenditure (USD)	Standard Deviation (USD)	Lowest Annual Per Capita PHE (USD)	Highest Annual Per Capita PHE (USD)	Per Capita Out of Pocket (USD)	Standard Deviation (USD)	Lowest Annual Per Capita OOP (USD)	Highest Annual Per Capita OOP (USD)	Per Capita Development Assistance for Health (USD)	Standard Deviation (USD)	Lowest Annual Per Capita DAH (USD)	Highest Annual Per Capita DAH (USD)
Low-income	27.59	21.95	0.00	123.21	6.12	14.19	0.00	224.88	37.01	31.32	2.91	256.15	27.98	30.09	0.27	318.40
Lower middle-income	127.10	119.16	11.55	500.72	31.29	65.30	0.00	291.63	59.64	27.35	11.21	157.99	30.65	36.45	0.78	172.95
Upper middle-income	446.18	265.66	187.28	1576.04	136.30	173.35	0.00	519.82	170.42	112.42	28.75	422.47	28.98	63.31	0.07	375.57

Across all countries, mean government health expenditure as a per cent of total health expenditure varied between 32.57% (year 2008) and 37.74% (year 2000), averaging 35.15% in the years included in this work (refer to Table 5.19 and Figure 5.18). Mean per capita government expenditure on health rose from US$65.54 in 2000 to US$134.77 in 2014, averaging US$99.40 over the years included in this work (refer to Table 5.20 and Figure 5.19). Graphical representations of sources of health financing by country are found in Appendix 7.

Table 5.19

Mean Government Health Expenditure as a Per Cent of Total Health Expenditure by Year (%)

Year	Government Health Expenditure as a Per Cent of Total Health Expenditure (GHEPRTHE)	Standard Deviation	Lowest Annual GHEPRTHE (%)	Highest Annual GHEPRTHE (%)
2000	37.74	17.71	2.78	76.61
2001	36.89	17.13	0.00	75.16
2002	37.07	16.53	4.62	76.30
2003	35.86	16.95	0.98	69.78
2004	34.74	16.00	0.00	66.61
2005	35.74	16.85	0.00	70.85
2006	36.94	17.26	0.00	72.24
2007	35.27	18.09	0.00	76.44
2008	32.57	19.00	0.00	81.17
2009	35.02	17.39	0.00	85.48
2010	33.04	20.40	0.00	81.83
2011	33.72	19.81	0.00	81.42
2012	34.93	19.82	0.00	85.33
2013	33.01	21.60	0.00	81.58
2014	34.63	21.05	0.00	80.66
All Years	**35.15**	**18.32**	**0.00**	**85.48**

Table 5.20

Mean Per Capita Government Health Expenditure by Year (USD)

Year	Mean Per Capita Government Health Expenditure (GHEPRCAP) (USD)	Standard Deviation	Lowest Annual GHEPRCAP (USD)	Highest Annual GHEPRCAP (USD)
2000	65.54	88.88	0.24	333.93
2001	69.60	98.66	0.00	438.55
2002	72.35	109.56	0.66	538.67
2003	73.63	102.34	0.64	361.32
2004	79.89	114.78	0.00	453.39
2005	82.92	116.81	0.00	508.13
2006	90.05	124.19	0.00	483.72
2007	92.66	136.28	0.00	595.75
2008	100.50	162.76	0.00	754.56
2009	127.35	263.01	0.00	1576.04
2010	117.39	206.49	0.00	1118.52
2011	118.43	200.66	0.00	1059.29
2012	132.69	242.80	0.00	1362.60
2013	133.23	227.51	0.00	1168.08
2014	134.77	221.30	0.00	1117.91
All Years	**99.40**	**171.04**	**0.00**	**1576.04**

Figure 5.18

Mean Government Health Expenditure as a Per Cent of Total Health Expenditure by Year

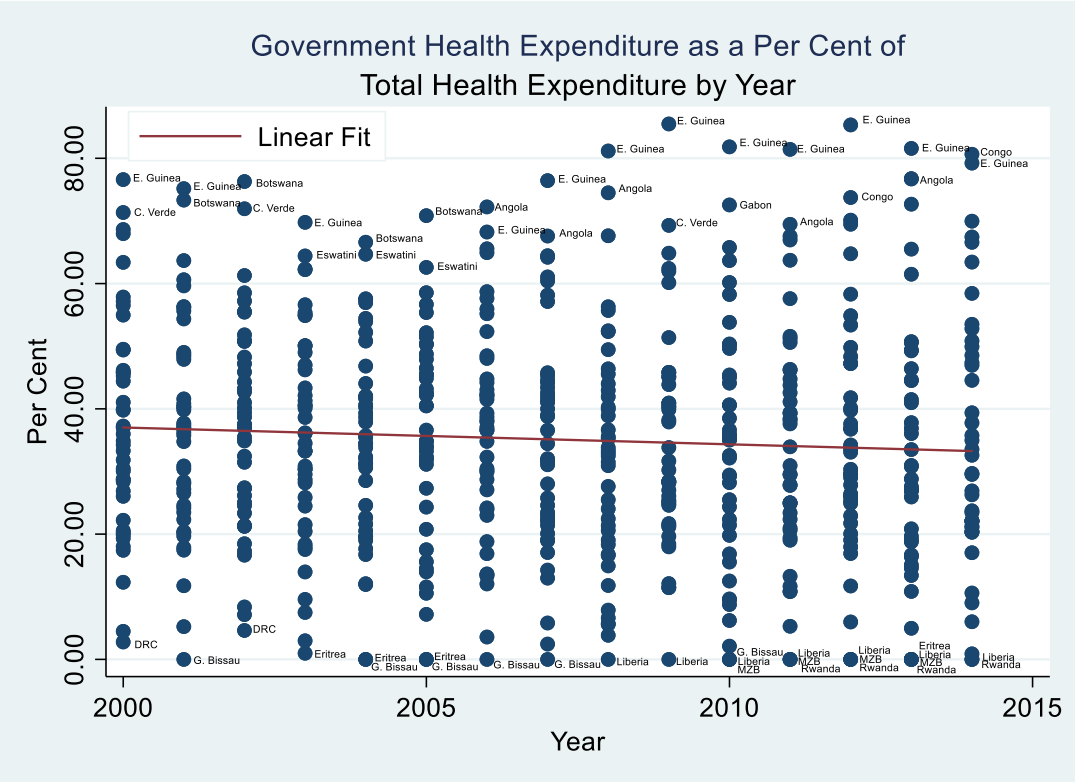
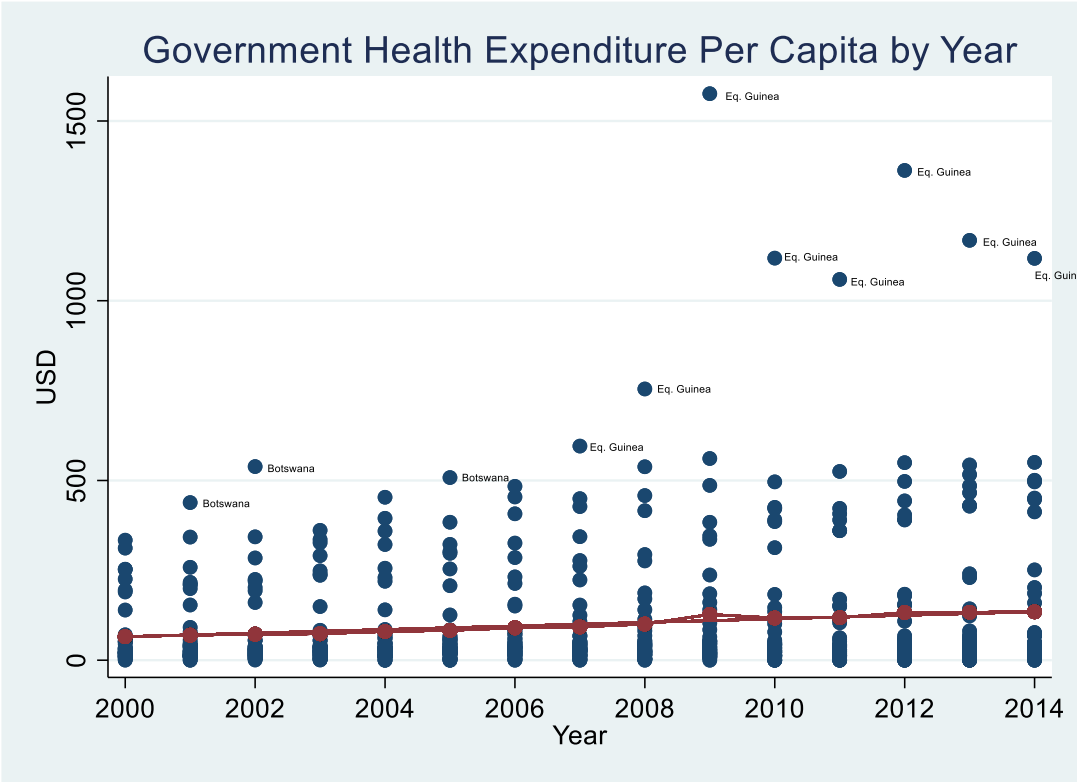


Figure 5.19

Mean Per Capita Government Health Expenditure by Year



Mean private health expenditure as a per cent of total health expenditure varied between 5.65% (year 2011) and 8.75% (year 2000), averaging 7.19% in the years included in this work (refer to Table 5.21 and Figure 5.20). Mean per capita private health expenditure increased from US$20.26 in 2000 to US$38.27 in 2014, averaging US$27.11 in the years included in this work (refer to Table 5.22 and Figure 5.21). Graphical representations of sources of health financing by country are found in Appendix 7.

Table 5.21

Mean Private Health Expenditure as a Per Cent of Total Health Expenditure by Year

Year	Private Health Expenditure as a Per Cent of Total Health Expenditure (PRVHETHE)	Standard Deviation	Lowest Annual PRVHETHE (%)	Highest Annual PRVHETHE (%)
2000	8.75	10.62	0.00	44.90
2001	8.69	11.19	0.00	46.65
2002	8.08	10.97	0.00	47.73

2003	7.83	10.86	0.00	47.76
2004	8.03	11.37	0.00	47.73
2005	7.23	11.11	0.00	46.01
2006	7.03	11.30	0.00	46.58
2007	7.56	10.76	0.00	44.65
2008	5.97	9.68	0.00	43.87
2009	6.28	10.02	0.00	43.86
2010	6.94	10.72	0.00	44.57
2011	5.65	10.17	0.00	43.85
2012	6.11	10.46	0.00	43.56
2013	6.51	10.61	0.00	44.43
2014	7.20	13.75	0.00	64.77
All Years	**7.19**	**10.86**	**0.00**	**64.77**

Table 5.22

Mean Per Capita Private Health Expenditure by Year (USD)

Year	Per Capita Private Health Expenditure (PRVPRCAP)	Standard Deviation	Lowest Annual PRVPRCAP (USD)	Highest Annual PRVPRCAP (USD)
2000	20.26	58.79	0.00	365.17
2001	22.05	64.57	0.00	396.67
2002	21.86	65.94	0.00	408.14
2003	23.17	69.36	0.00	425.31
2004	25.55	71.93	0.00	421.96
2005	25.97	73.77	0.00	415.11
2006	27.20	76.67	0.00	411.55
2007	26.68	73.51	0.00	428.13
2008	25.54	75.81	0.00	441.01
2009	27.15	80.28	0.00	465.33
2010	29.88	86.28	0.00	487.07
2011	28.75	89.71	0.00	497.34
2012	31.26	93.84	0.00	507.06
2013	33.07	98.08	0.00	519.82
2014	38.27	103.64	0.00	517.90
All Years	**27.11**	**79.06**	**0.00**	**519.82**

Figure 5.20

Mean Private Health Expenditure as a Per Cent of Total Health Expenditure by Year

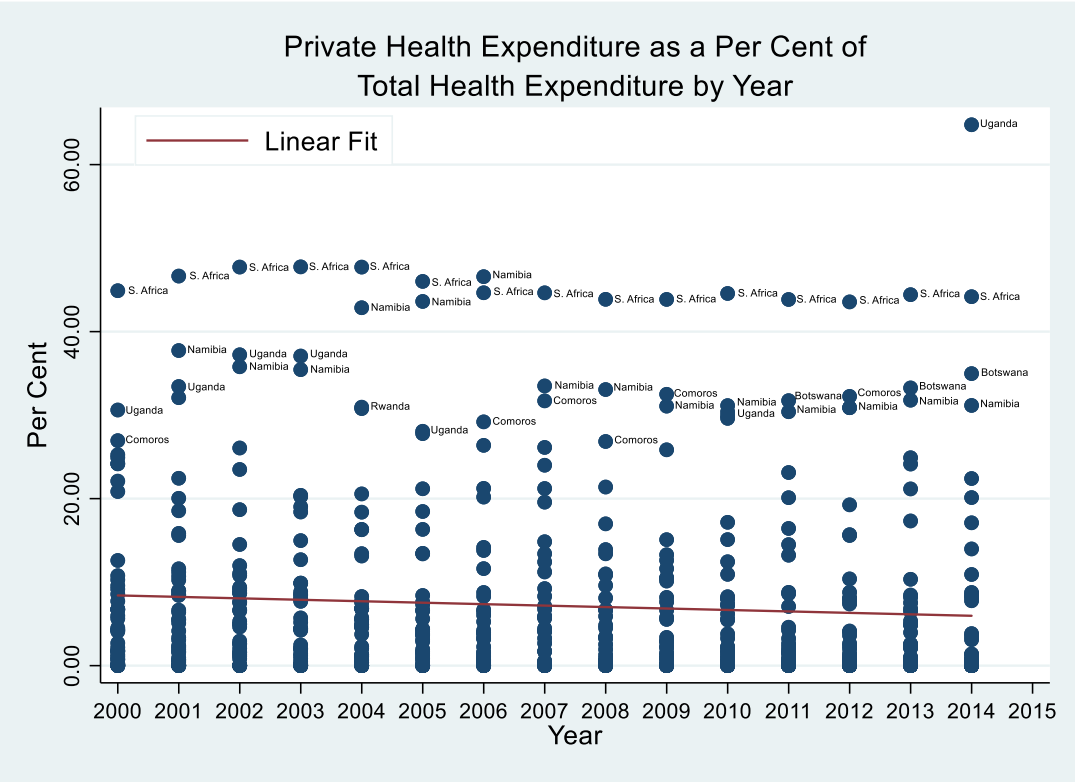
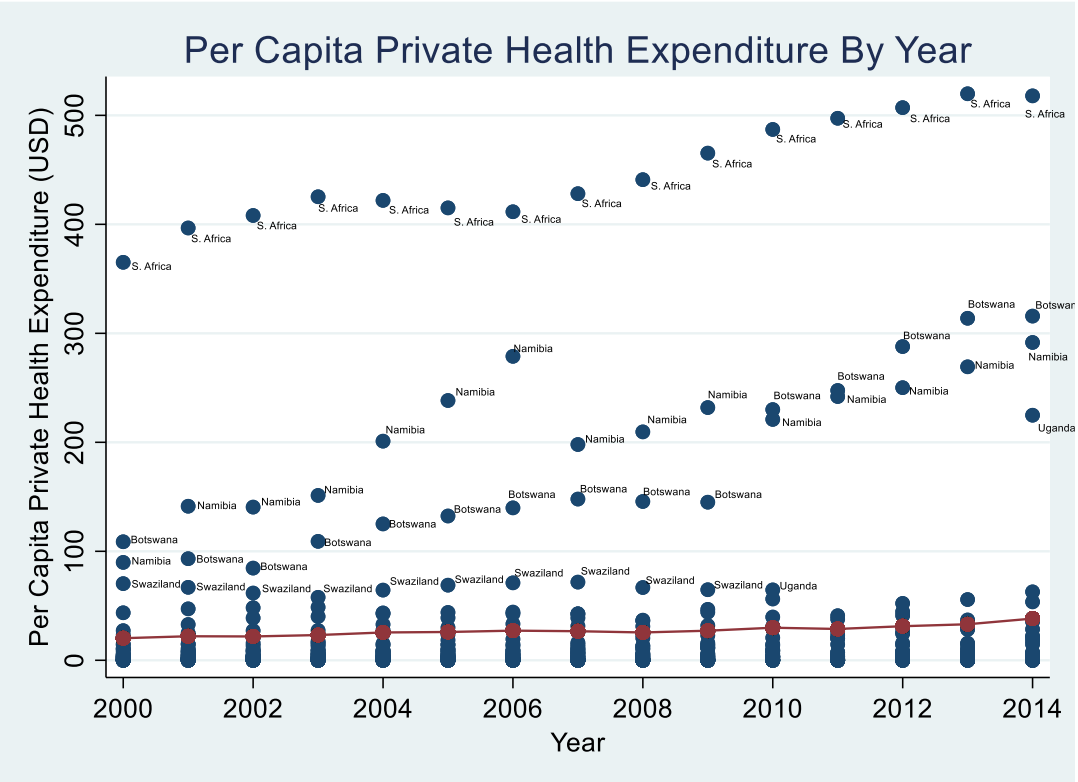


Figure 5.21

Per Capita Private Health Expenditure by Year



Mean out of pocket health expenditure as a per cent of total health expenditure varied between 30.74% (year 2013) and 42.06% (year 2002), averaging 36.06% in the years included in this work (refer to Table 5.23 and Figure 5.22). Per capita out of pocket health expenditure increased from US$46.06 in 2000 to US$67.26 in 2014, averaging US$57.78 in the years included in this work (refer to Table 5.24 and Figure 5.23). Graphical representations of sources of health financing by country are found in Appendix 7.

Table 5.23

Mean Out of Pocket Health Expenditure as a Per Cent of Total Health Expenditure by Year (%)

Year	OOP Health Expenditure as a Per Cent of Total Health Expenditure	Standard Deviation	Lowest Annual OOPPRTHE (%)	Highest Annual OOPPRTHE (%)
2000	41.21	17.49	5.58	73.72
2001	41.22	17.99	2.99	70.76
2002	42.06	17.77	3.91	70.41
2003	39.10	17.99	4.99	73.70
2004	37.95	17.30	3.59	69.02
2005	37.07	18.04	3.55	69.55
2006	36.59	18.53	2.94	69.72
2007	36.53	18.64	4.84	71.14
2008	35.34	18.86	2.64	73.24
2009	34.71	18.33	2.95	69.02
2010	32.73	17.92	4.41	69.33
2011	32.86	17.32	4.74	65.67
2012	31.81	17.67	4.62	74.35
2013	30.74	17.52	4.90	75.30
2014	31.00	17.65	5.14	76.59
All Years	**36.06**	**18.12**	**2.64**	**76.59**

Table 5.24

Mean Per Capita Out of Pocket Health Expenditure by Year (USD)

Year	Per Capita OOP Health Expenditure (OOPPRCAP) (USD)	Standard Deviation	Lowest Annual OOPPRCAP (USD)	Highest Annual OOPPRCAP (USD)
2000	46.06	43.13	4.49	238.21
2001	47.53	45.58	4.73	264.29
2002	50.30	50.64	5.15	268.75
2003	50.59	50.69	5.72	274.38
2004	55.66	59.56	6.19	273.61
2005	54.70	56.78	5.97	256.03
2006	55.04	56.06	6.07	282.76
2007	58.05	60.03	3.94	310.59
2008	60.97	70.05	2.91	396.49
2009	66.43	78.30	3.80	406.99
2010	62.77	71.27	4.10	406.16
2011	62.64	71.71	4.14	401.77
2012	63.14	70.75	4.23	397.02
2013	65.57	76.27	4.46	408.29
2014	67.26	79.50	7.80	422.47
All Years	**57.78**	**63.43**	**2.91**	**422.47**

Figure 5.22

Mean Out of Pocket Health Expenditure as a Per Cent of Total Health Expenditure by Year

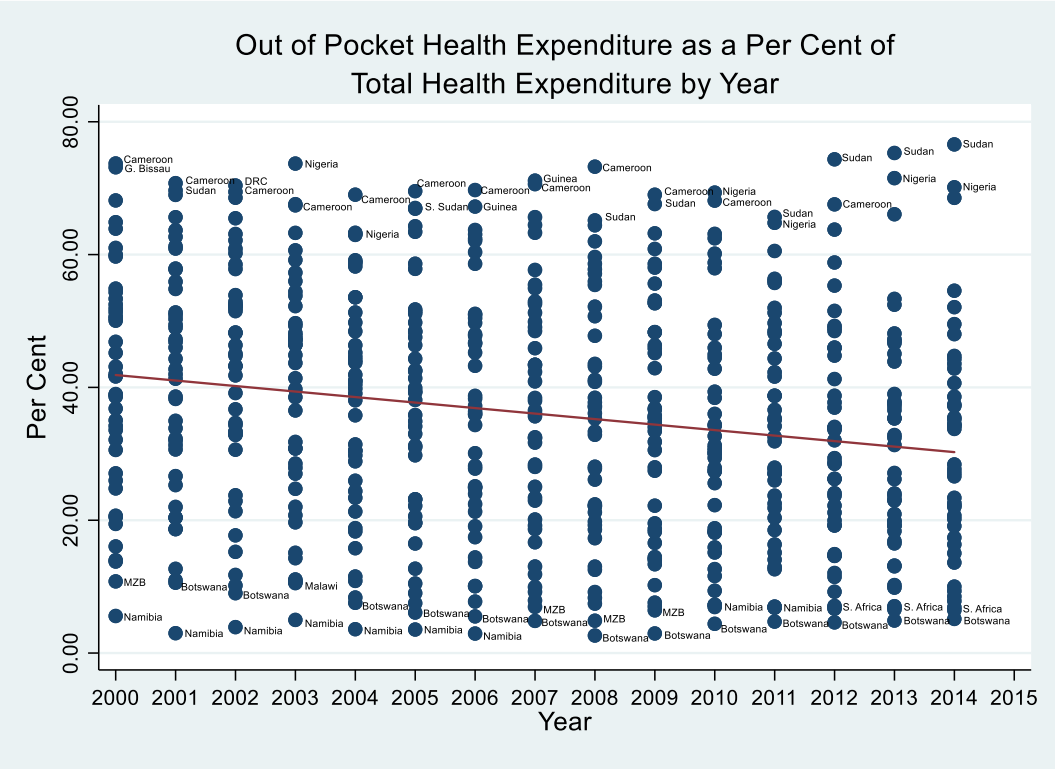
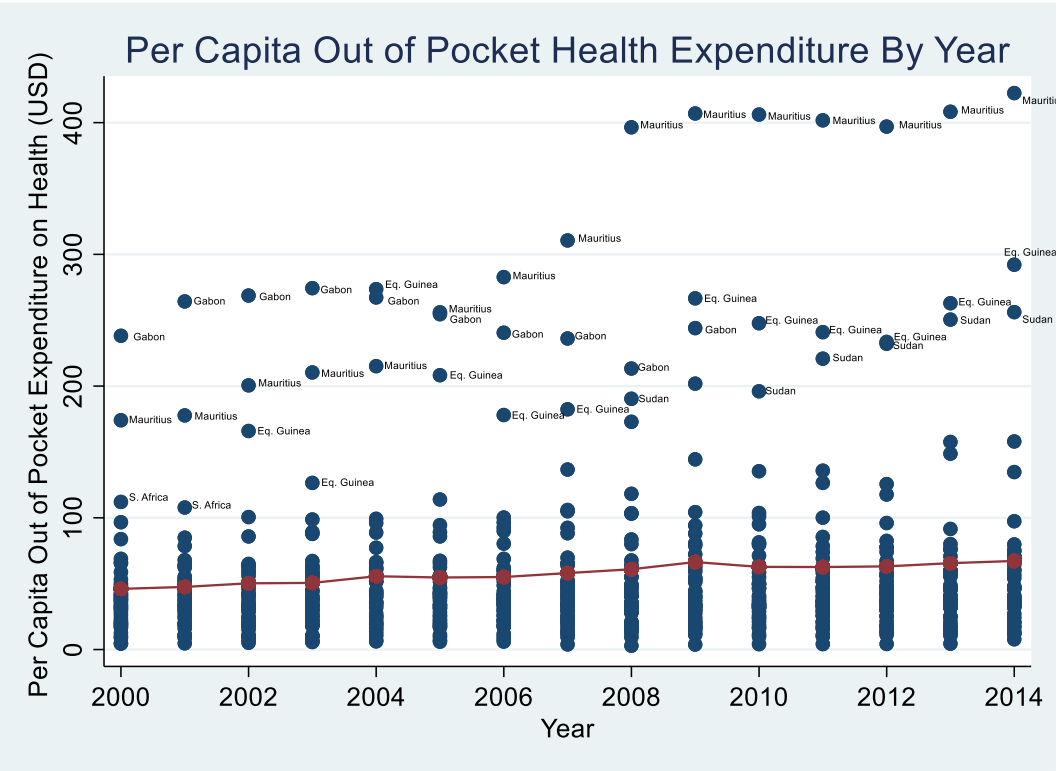


Figure 5.23

Per Capita Out of Pocket Health Expenditure by Year



Mean development assistance for health expenditure as a per cent of total health expenditure varied between 12.31% (year 2000) and 29.74% (year 2013), averaging 21.60% in the years included in this work (refer to Table 5.25 and Figure 5.24). Per capita development assistance for health increased from US$8.77 in 2000 to US$46.81 in 2013, with a slight drop in 2014 to US$44.41, averaging US$28.71 in the years included in this work (refer to Table 5.26 and Figure 5.25). Graphical representations of sources of health financing by country are found in Appendix 7.

Table 5.25

Mean Development Assistance for Health Expenditure as a Per Cent of Total Health Expenditure by Year (%)

Year	DAH Expenditure as a Per Cent of Total Health Expenditure	Standard Deviation	Lowest Annual DAHPRTHE (%)	Highest Annual DAHPRTHE (%)
2000	12.31	11.83	0.11	51.38
2001	13.19	11.49	0.09	40.00
2002	12.79	11.37	0.01	40.74
2003	17.21	14.49	0.08	61.94
2004	19.27	15.87	0.09	58.97
2005	19.97	15.57	0.09	58.65
2006	19.43	14.00	0.22	52.05
2007	20.64	17.06	0.16	72.40
2008	26.12	20.86	0.03	89.07
2009	23.99	19.97	0.05	86.63
2010	27.28	21.92	0.05	92.00
2011	27.77	21.26	0.05	91.69
2012	27.16	21.56	0.04	91.74
2013	29.74	22.40	0.06	92.19
2014	27.17	21.33	0.06	92.16
All Years	**21.60**	**18.56**	**0.01**	**92.19**

Table 5.26

Per Capita Development Assistance for Health Expenditure by Year

Year	Per Capita DAH Expenditure (DAHPRCAP) (USD)	Standard Deviation	Lowest Annual DAHPRCAP (USD)	Highest Annual DAHPRCAP (USD)
2000	8.77	7.04	0.49	28.01
2001	10.20	7.76	0.40	36.71
2002	9.64	6.27	0.07	23.47
2003	15.00	10.34	0.37	39.67
2004	19.21	13.55	0.41	50.67
2005	21.98	16.12	0.44	61.33
2006	23.44	17.17	0.59	70.47
2007	24.72	20.40	0.61	84.95
2008	38.40	58.44	0.19	375.57
2009	39.50	58.72	0.55	353.68
2010	41.65	39.93	0.61	167.52
2011	44.08	44.58	0.71	172.95
2012	42.90	40.79	0.70	194.91
2013	46.81	41.96	0.81	166.32
2014	44.41	51.16	0.86	318.40
All Years	**28.71**	**36.85**	**0.07**	**375.57**

Figure 5.24

Mean Development Assistance for Health Expenditure as a Per Cent of Total Health Expenditure by Year

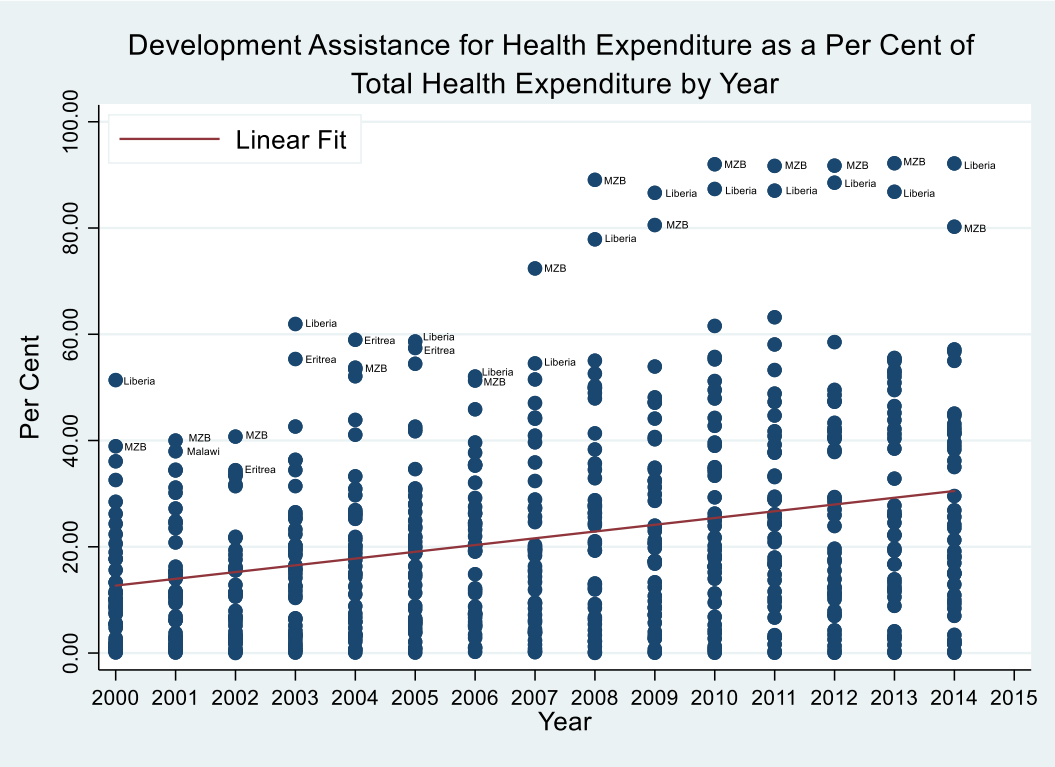
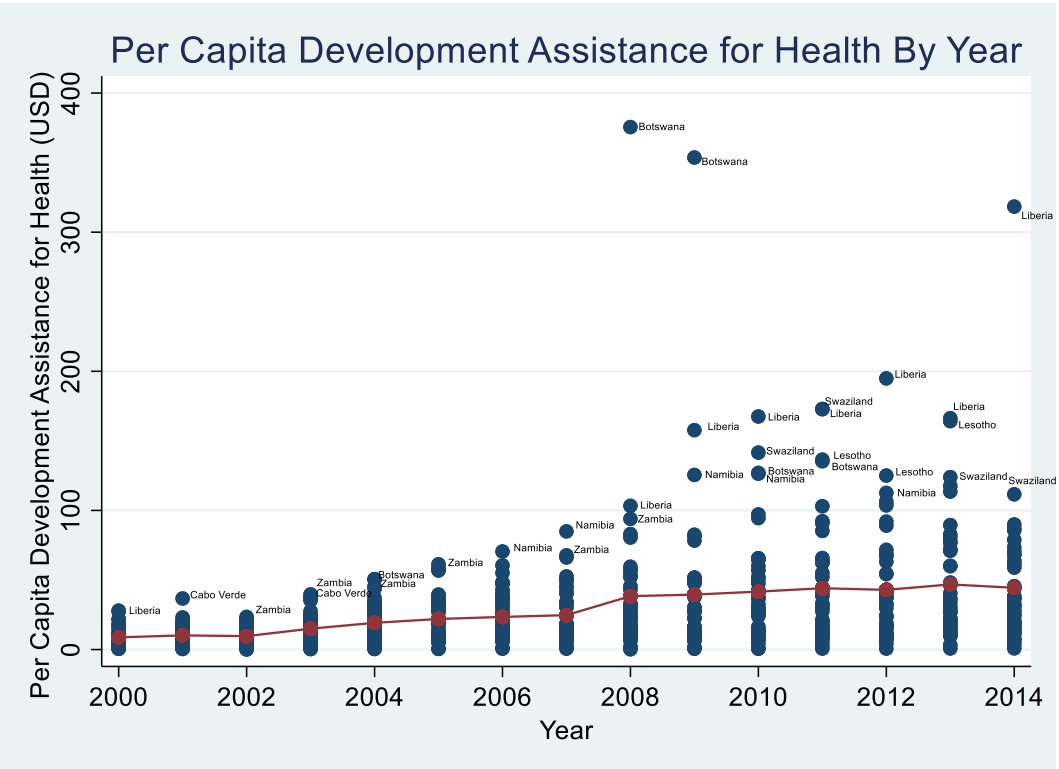


Figure 5.25

Per Capita Development Assistance for Health Expenditure by Year



Over the years included in this work, mean government expenditure on health as a per cent of total health expenditure showed a small decreasing trend. In examining the per capita government expenditure on health, there is an increasing trend indicating that governments are investing more in health however the proportion of health expenditure financed by government reduced. Although governments are investing more in health, the change in proportion of health expenditure financed by government is likely driven by considerable increases in development assistance for health which increased five-fold over the period of this work. The increase in development assistance for health is related to the increase in funding for the control of infectious diseases such as HIV/AIDS and malaria through such financing bodies such as President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund. This resulted in corresponding decreases in the proportion of government expenditure on health especially in Botswana, Cape Verde, Central African Republic, Ethiopia, Liberia, Mozambique and Rwanda. Decreases in government expenditure on health were also driven by moves to health insurance schemes in Botswana, Rwanda and Uganda (Chemouni, 2018; Odokonyero et al, 2017; and Health Policy Project, 2016b).

Mean development assistance for health as a per cent of total health expenditure showed an increasing trend, caused largely by Mozambique and Liberia. In Mozambique, approximately 30 to 50% of THE was related to the HIV response (UNICEF, 2017b; and Amico et al., 2010) which was primarily funded by donors (97% in 2013 according to the Health Policy Project, 2016). In 2004, both PEPFAR and the Global Fund started financing programmes in Mozambique. Changes in financing from these donors correspond to changes in development assistance for health including in 2007 when the Global Fund disbursements to Mozambique substantially increased and were larger than 2004-6 combined. The same was also true in Liberia where the Global Fund and the US Government were the largest drivers of health financing accounting for more than 47% of the health resources in 2009-2010 (http://www9.who.int/gho/governance_aid_effectiveness/countries/lbr.pdf).

Examining per capita development assistance for health, increases in financing for Botswana, Namibia, Swaziland and Lesotho, reflect surges in funding from both PEPFAR and the Global Fund to address critical needs for the HIV, tuberculosis and malaria epidemics.

Out of pocket expenditures as a proportion of total health expenditure have been decreasing, driven largely by Burundi, Gabon, Lesotho, and Liberia, where free health care programmes covering targeted populations with a package of health interventions or social health insurance schemes were introduced (UNICEF, 2017c; Bulletin of the World Health Organization, 2013; Government of Lesotho, 2013; WHO Regional Office Africa, 2013; and Republic of Liberia, 2011). Reference is made to Table 5.21 and Figure 5.18.

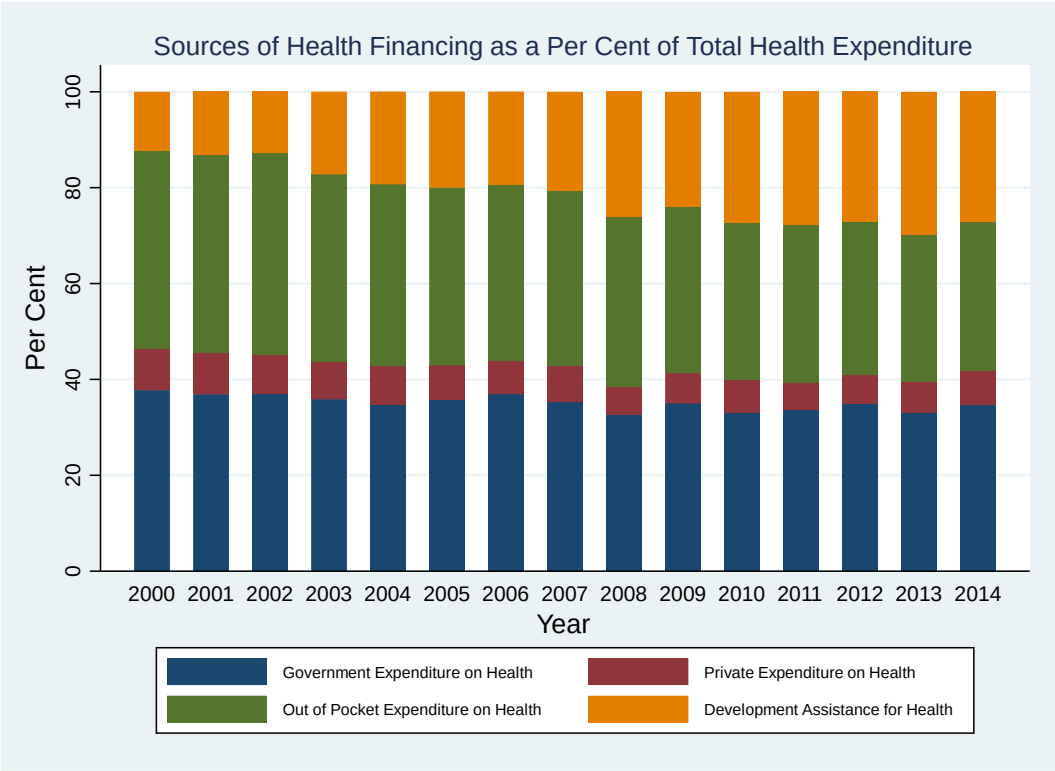
Table 5.21

Source of Health Expenditure by Year (%)

Year	Government Health Expenditure	Private Health Expenditure	Out of Pocket Health Expenditure	Development Assistance for Health
2000	37.74	8.75	41.21	12.31
2001	36.89	8.69	41.22	13.19
2002	37.07	8.08	42.06	12.79
2003	35.86	7.83	39.10	17.21
2004	34.74	8.03	37.95	19.27
2005	35.74	7.23	37.07	19.97
2006	36.94	7.03	36.59	19.43
2007	35.27	7.56	36.53	20.64
2008	32.57	5.97	35.34	26.12
2009	35.02	6.28	34.71	23.99
2010	33.04	6.94	32.73	27.28
2011	33.72	5.65	32.86	27.77
2012	34.93	6.11	31.81	27.16
2013	33.01	6.51	30.74	29.74
2014	34.63	7.20	31.00	27.17
All Years	**35.15**	**7.19**	**36.06**	**21.60**

Figure 5.18

Source of Health Expenditure by Year



The mean population with access to improved water source was 68.41%, with the lowest mean value 45.38% (Ethiopia) and the highest mean value 99.65% (Mauritius), and noting that the population with access to improved water source ranged from 32.70% (Ethiopia, 2000, 2001 and 2002) to 99.90% (Mauritius, 2013 and 2014). The mean prevalence of undernourishment was 27.55%, with the lowest mean value of 4.60% (South Africa) and the highest mean value 72.03% (Eritrea), and noting that the prevalence of undernourishment ranged from 4.30% (South Africa, 2004) to 76.50% (Eritrea, 2000 - 2003). The mean HIV prevalence was 5.41%, with the lowest mean value 0.10% (Comoros) and the highest mean value 26.66% (Swaziland), and noting that HIV prevalence ranged from 0.10% (Comoros, 2000-2014; and Sudan, 2000-2002) to 28.40% (Swaziland, 2013 and 2014). The mean years of schooling for females 25 years and older was 3.16 years, with the lowest mean value 0.00 years (Eritrea) and the highest mean 8.93 years (South Africa), and ranging from 0.00 years (Angola 2000-2013, Burkina Faso 2000-2004, Chad 2000-2009, Equatorial Guinea 2000-2009, Eritrea 2000-2014, Guinea-Bissau 2000-2011, Nigeria 2000-2004, South Sudan 2000-2009) to 9.90 years (South Africa, 2010). Refer to Tables 5.22 and 5.24.

Table 5.22

Mean Population with Access to Improved Water Source, Prevalence of Undernourishment, and HIV Prevalence by Country

Country	Population with Access to Improved Water Source (%)	Standard Deviation	Lowest Annual Population with Access to Improved Water Source (%)	Highest Annual Population with Access to Improved Water Source (%)	Prevalence of Under-nourishment (%)	Standard Deviation	Lowest Annual Prevalence of Under-nourishment (%)	Highest Annual Prevalence of Under-nourishment (%)	HIV Prevalence (%)	Standard Deviation	Lowest Annual HIV Prevalence	Highest Annual HIV Prevalence
Angola	47.07	1.13	45.70	49.00	49.29	13.86	27.00	71.50	1.53	0.30	1.00	1.90
Benin	73.33	3.65	67.70	77.90	14.47	3.95	9.60	22.70	1.23	0.14	1.10	1.40
Botswana	95.69	0.46	95.00	96.20	30.71	3.70	24.90	35.70	24.38	1.42	23.10	27.00
Burkina Faso	75.19	7.29	63.60	82.30	23.18	2.23	20.20	25.80	1.43	0.53	0.90	2.50
Burundi	74.30	1.26	72.40	75.90	66.47	2.78	62.10	68.50	2.08	0.78	1.20	3.50
Cabo Verde	88.03	2.87	83.70	91.70	15.21	1.50	13.30	17.90	0.77	0.11	0.60	0.90
Cameroon	70.54	4.33	63.80	75.60	17.25	7.94	6.50	30.80	4.73	0.32	4.10	5.10
Central African Republic	66.45	1.97	63.40	68.50	39.55	6.10	32.00	55.20	6.16	1.64	4.30	9.30
Chad	48.88	2.01	45.70	50.80	39.29	1.19	37.00	40.80	1.80	0.27	1.40	2.20
Comoros	90.10	0.00	90.10	90.10	62.65	3.98	58.60	67.10	0.10	0.00	0.10	0.10
Congo, Dem. Rep.	50.27	1.56	47.90	52.40	-	-	-	-	1.50	0.43	0.90	2.10
Congo, Rep.	73.59	2.26	70.10	76.50	32.38	0.49	31.90	33.00	3.49	0.37	3.20	4.30
Cote d'Ivoire	80.29	1.20	78.50	81.90	21.11	0.65	20.00	21.90	4.81	1.53	3.00	7.70
Equatorial Guinea	47.55	0.22	47.30	47.90	-	-	-	-	5.05	0.98	3.40	6.40
Eritrea	55.56	2.20	52.10	57.80	72.03	6.71	61.30	76.50	1.01	0.32	0.60	1.60
Ethiopia	45.38	8.52	32.70	57.30	37.47	8.19	24.70	52.00	1.99	0.78	1.10	3.40
Gabon	90.05	2.74	85.60	93.20	10.61	0.89	8.80	11.50	4.00	0.22	3.50	4.20

Gambia, The	87.89	2.44	84.00	90.20	12.05	2.31	9.10	15.10	2.00	0.20	1.50	2.20
Ghana	81.41	5.42	73.10	88.70	8.57	3.25	5.30	15.60	2.25	0.30	1.80	2.60
Guinea	71.40	4.31	64.80	76.80	20.38	3.39	16.80	26.30	1.69	0.08	1.60	1.80
Guinea-Bissau	67.64	8.23	55.50	79.30	23.89	1.06	22.20	25.70	3.68	0.45	2.60	4.10
Kenya	58.89	3.47	53.50	63.20	26.66	4.50	20.80	33.20	6.69	1.31	5.20	9.30
Lesotho	80.60	0.85	79.30	81.80	12.61	0.62	11.70	13.60	22.40	0.53	21.70	23.50
Liberia	69.87	3.72	64.20	75.60	38.39	1.45	36.50	40.70	2.59	0.84	1.60	4.20
Madagascar	45.69	4.13	39.60	51.50	34.49	2.25	31.80	38.40	0.20	0.00	0.20	0.20
Malawi	78.67	8.30	66.20	90.20	24.25	2.36	21.70	27.40	11.97	1.48	10.30	14.70
Mali	64.29	9.12	50.60	77.00	9.57	3.18	5.90	14.16	1.43	0.60	1.30	1.50
Mauritania	52.44	5.00	44.60	57.90	9.82	1.96	7.10	12.10	0.74	0.16	0.50	0.90
Mauritius	99.65	0.21	99.30	99.90	5.43	0.54	4.70	6.60	1.10	0.10	0.90	1.20
Mozambique	47.47	3.15	42.60	51.10	34.33	4.35	28.60	40.30	12.44	1.14	9.70	13.30
Namibia	86.06	3.72	80.30	91.00	29.35	4.86	24.30	37.40	13.55	0.72	12.60	14.60
Niger	52.57	4.52	45.70	58.20	14.21	3.68	10.20	21.60	0.56	0.12	0.40	0.70
Nigeria	61.84	4.97	54.20	68.50	7.20	1.20	6.00	9.30	3.37	0.27	2.90	3.70
Rwanda	72.15	2.92	67.70	76.10	40.90	7.28	31.60	55.60	3.60	0.66	2.90	5.00
Senegal	73.88	3.32	68.90	78.50	18.73	6.23	12.20	28.70	0.65	0.07	0.50	0.70
South Africa	90.51	2.02	87.40	93.20	4.60	0.26	4.30	5.30	16.88	1.63	13.40	18.70
South Sudan	58.70	0.00	58.70	58.70	32.59	3.96	29.50	38.90	2.73	0.21	2.20	2.90
Sudan	55.50	0.00	55.50	55.50	32.59	3.96	29.50	38.90	0.18	0.04	0.10	0.20
Swaziland	67.33	7.43	55.60	74.20	19.83	2.93	15.30	23.30	26.66	1.08	25.50	28.40
Tanzania	55.06	0.43	54.40	55.60	34.55	1.62	32.20	36.90	6.15	1.08	4.80	8.10
Togo	59.04	2.86	54.80	63.10	24.16	4.60	17.20	31.10	3.22	0.41	2.50	3.70
Uganda	70.29	6.97	59.60	79.00	28.81	3.58	23.70	35.50	6.60	0.17	6.40	7.00
Zambia	60.33	3.69	54.70	65.40	49.71	2.48	44.90	53.50	13.11	1.12	12.10	15.50
All Countries	**68.41**	**15.41**	**32.70**	**99.90**	**27.55**	**16.69**	**4.30**	**76.50**	**5.41**	**6.61**	**0.10**	**28.40**

The mean population with access to improved water source increased from 63.26% in 2000 to 72.68% in 2014. The prevalence of undernutrition decreased from 31.07% in 2000 to 25.40% in 2014. HIV prevalence decreased from 5.82% in 2000 to 5.09% in 2014. Mean years of schooling for females 25 years and older increased from 2.56 years in 2000 to 4.25 years in 2014. Refer to Tables 5.23 and 5.25.

Table 5.23

Mean Population with Access to Improved Water Source, Prevalence of Undernourishment and HIV Prevalence by Year

Year	**Population with Access to Improved Water Source (%)**	**Standard Deviation**	Lowest Annual Population with Access to Improved Water Source (%)	Highest Annual Population with Access to Improved Water Source (%)	**Prevalence of Under-nourishment (%)**	**Standard Deviation**	Lowest Annual Prevalence of Under-nourishment (%)	Highest Annual Prevalence of Under-nourishment (%)	**HIV Prevalence (%)**	**Standard Deviation**	Lowest Annual HIV Prevalence	Highest Annual HIV Prevalence
2000	63.26	15.91	32.70	99.30	31.07	17.40	5.00	76.50	5.82	6.73	0.10	27.00
2001	63.26	15.91	32.70	99.30	30.45	17.26	4.70	76.50	5.82	6.77	0.10	26.80
2002	63.26	15.91	32.70	99.30	30.00	17.08	4.60	76.50	5.77	6.74	0.10	26.30
2003	67.16	15.21	42.00	99.60	29.48	16.97	4.40	76.50	5.69	6.66	0.10	25.90
2004	67.16	15.21	42.00	99.60	28.75	16.77	4.30	75.60	5.57	6.59	0.10	25.70
2005	67.16	15.21	42.00	99.60	28.12	16.73	4.40	75.60	5.47	6.52	0.10	25.50
2006	67.16	15.21	42.00	99.60	27.62	16.72	4.50	75.60	5.38	6.50	0.10	25.60
2007	67.16	15.21	42.00	99.60	27.18	16.75	4.60	75.60	5.31	6.50	0.10	25.90
2008	71.04	14.94	47.70	99.80	26.76	16.76	4.60	75.60	5.27	6.54	0.10	26.30
2009	71.04	14.94	47.70	99.80	26.29	16.73	4.50	75.60	5.24	6.61	0.10	26.80
2010	71.04	14.94	47.70	99.80	25.83	16.68	4.40	75.60	5.21	6.67	0.10	27.40

2011	71.04	14.94	47.70	99.80	25.64	16.21	4.40	67.30	5.18	6.73	0.10	27.80
2012	71.04	14.94	47.70	99.80	25.37	16.22	4.50	67.30	5.16	6.81	0.10	28.20
2013	72.61	14.97	47.90	99.90	25.27	16.40	4.80	67.30	5.13	6.86	0.10	28.40
2014	72.68	14.98	47.90	99.90	25.40	16.77	5.30	67.30	5.09	6.88	0.10	28.40

Table 5.24

Mean Years of Education for Females 25 years and older by Country

Country	Mean Years of Education Females 25+ (years)	Standard Deviation	Lowest Annual Years of Education Females 25+ (years)	Highest Annual Years of Education Females 25+ (years)
Angola	0.26	1.01	0.00	3.90
Benin	1.71	0.18	1.50	2.10
Botswana	8.15	0.58	7.50	9.0
Burkina Faso	0.80	0.70	0.00	1.90
Burundi	1.82	0.51	1.30	2.60
Cabo Verde	4.24	0.79	3.40	5.50
Cameroon	4.27	0.33	3.90	4.60
Central African Republic	2.10	0.40	1.70	2.80
Chad	0.36	0.53	0.00	1.20
Comoros	2.72	0.63	2.20	3.70
Congo, Dem. Rep.	3.34	0.78	2.50	4.40
Congo, Rep.	5.27	0.31	4.90	5.80
Cote d'Ivoire	2.71	0.58	2.10	3.70
Equatorial Guinea	1.33	1.95	0.00	4.00
Eritrea	0.00	0.00	0.00	0.00
Ethiopia	1.18	0.23	0.90	1.50
Gabon	6.05	0.68	5.30	7.30
Gambia, The	1.69	0.48	1.20	2.60
Ghana	5.25	0.41	4.80	5.80
Guinea	0.99	0.24	0.80	1.50
Guinea-Bissau	0.28	0.58	0.00	1.40
Kenya	4.85	0.71	4.10	5.80
Lesotho	5.98	0.59	5.40	7.00
Liberia	2.23	0.44	1.80	3.00
Madagascar	6.11	0.44	5.60	6.70
Malawi	2.73	0.66	2.10	3.80
Mali	0.99	0.44	0.60	1.70
Mauritania	2.47	0.42	2.10	3.30
Mauritius	6.81	1.18	5.50	8.80
Mozambique	2.03	0.34	1.60	2.50
Namibia	6.04	0.49	5.50	6.90
Niger	0.75	0.26	0.50	1.30
Nigeria	2.99	2.20	0.00	4.90
Rwanda	2.62	0.67	1.90	3.70
Senegal	1.36	0.40	1.00	2.10
South Africa	8.93	0.56	8.50	9.90
South Sudan	1.33	1.95	0.00	4.00

Sudan	2.29	0.42	1.80	3.00
Swaziland	4.97	0.66	4.20	6.10
Tanzania	4.11	0.59	3.50	5.20
Togo	2.67	0.21	2.50	3.20
Uganda	3.53	0.55	2.90	4.40
Zambia	5.43	0.56	4.80	6.40
All Countries	**3.16**	**2.33**	**0.00**	**8.93**

Table 5.25

Mean Years of Education for Females 25 years and older by Year

Year	Mean Years of Education Females 25+ (years)	Standard Deviation	Lowest Annual Years of Education Females 25+ (years)	Highest Annual Years of Education Females 25+ (years)
2000	2.56	2.20	0.00	8.50
2001	2.56	2.20	0.00	8.50
2002	2.56	2.20	0.00	8.50
2003	2.56	2.20	0.00	8.50
2004	2.56	2.20	0.00	8.50
2005	3.04	2.32	0.00	8.60
2006	3.04	2.32	0.00	8.60
2007	3.04	2.32	0.00	8.60
2008	3.04	2.32	0.00	8.60
2009	3.04	2.32	0.00	8.60
2010	3.65	2.37	0.00	9.90
2011	3.72	2.35	0.00	9.40
2012	3.88	2.32	0.00	9.60
2013	3.97	2.35	0.00	9.70
2014	4.15	2.29	0.00	9.80

5.4 Correlation between Dependent and Independent Variables

If the explanatory variables are strongly correlated with each other, it increases the standard errors, widens the confidence intervals and lowers the test statistics which may affect conclusions around significance tests (Brooks, 2008). To detect possible multicollinearity, correlation matrices are constructed.

Table 5.26 shows very strong correlations between under-five, infant, neonatal and maternal mortality, as expected. There is a strong correlation between per capita out of pocket expenditure on health and per capita government expenditure on health; access to a safe water source and under-five, infant, and maternal mortality; GDP per capita and both per capita government expenditure on health and out of pocket expenditure on health; and mean number of years of schooling for females 25 years and older and both under five and infant mortality.

There is moderate correlation between per capita government expenditure on health and under-five, infant, neonatal and maternal mortality; per capita out of pocket expenditure on health and under-five, infant, neonatal and maternal mortality; and per capita private expenditure on health and neonatal and maternal mortality. GDP per capita is moderately correlated with under five, infant, neonatal and maternal mortality, and per capita private expenditure on health. Per capita private expenditure on health shows moderate correlation with per capita government expenditure on health and access to a safe water source. HIV prevalence has moderate correlations with per capita government expenditure on health, private expenditure on health and development assistance for health. Mean number of years of schooling for females 25 years and older is moderately correlated with neonatal and maternal mortality, and access to safe water.

Table 5.26

Correlation matrix for Variables

	logu5mr	logimr	lognnmr	logmmr	gheprcap	dahprcap	oopprcap	prvprcap	h2osafe	prevhiv	gdpprcap	meanedu
logu5mr	1.0000											
logimr	0.9831	1.0000										
lognnmr	0.8736	0.8825	1.0000									
logmmr	0.8483	0.8404	0.8025	1.0000								
gheprcap	-0.3361	-0.3118	-0.3795	-0.4744	1.0000							
dahprcap	-0.2403	-0.2197	-0.1785	-0.1342	0.1165	1.0000						
oopprcap	-0.4235	-0.4059	-0.3835	-0.4873	0.5420	-0.1710	1.0000					
prvprcap	-0.2470	-0.2579	-0.4304	-0.4036	0.4686	0.1713	0.0682	1.0000				
h2osafe	-0.5516	-0.5478	-0.4829	-0.5575	0.2642	0.2441	0.2511	0.3986	1.0000			
prevhiv	-0.0177	0.0011	-0.1496	-0.1127	0.4217	0.3695	-0.0511	0.4957	0.2396	1.0000		
gdpprcap	-0.3601	-0.3286	-0.3484	-0.4585	0.8997	0.0264	0.6646	0.3232	0.2359	0.2005	1.0000	
meanedu	-0.5333	-0.5160	-0.4000	-0.3758	0.2085	0.2379	0.2143	0.1100	0.3586	0.2096	0.2403	1.0000

If there are correlations, research indicates that random effects estimation is biased. Despite the bias, fixed effects may not be the superior estimation method as there is a trade-off between bias and precision of the method (Dieleman, 2013; Clark & Linzer, 2013; and Wooldridge, 2001). This should be kept in mind as a point estimate is selected.

The hypotheses on the relationship between under-five mortality and sources of health financing were tested according to Pearson's correlation model. Hypothesis 1a: It is expected that an increase in the source of health financing will decrease under-five mortality, and it is expected that government expenditure on health as a per cent of total health expenditure will show the largest decrease in under-five mortality. Pearson's correlation shows that an increase in any source of health financing (per capita) were related to decreases in under-five mortality rates, with the largest decrease resulting from per capita out of pocket expenditure on health followed by government expenditure on health (Table 5.27). All of the correlations were significant. Graphical representations of source of expenditure on health and under-five mortality are presented in Figures 5.19, 5.20, 5.21 and 5.22 respectively.

Table 5.27

Pearson's correlation model for per capita sources of health financing and under-five mortality

	Per capita Government Expenditure on Health	Per capita Development Assistance for Health	Per capita Out of Pocket Expenditure on Health	Per capita Private Expenditure on Health
Log U5MR	-0.3344***	-0.2461***	-0.4181***	-0.2466***

Figure 5.19

Relationship between Under-Five Mortality Rate and Mean Per Capita Government Expenditure on Health

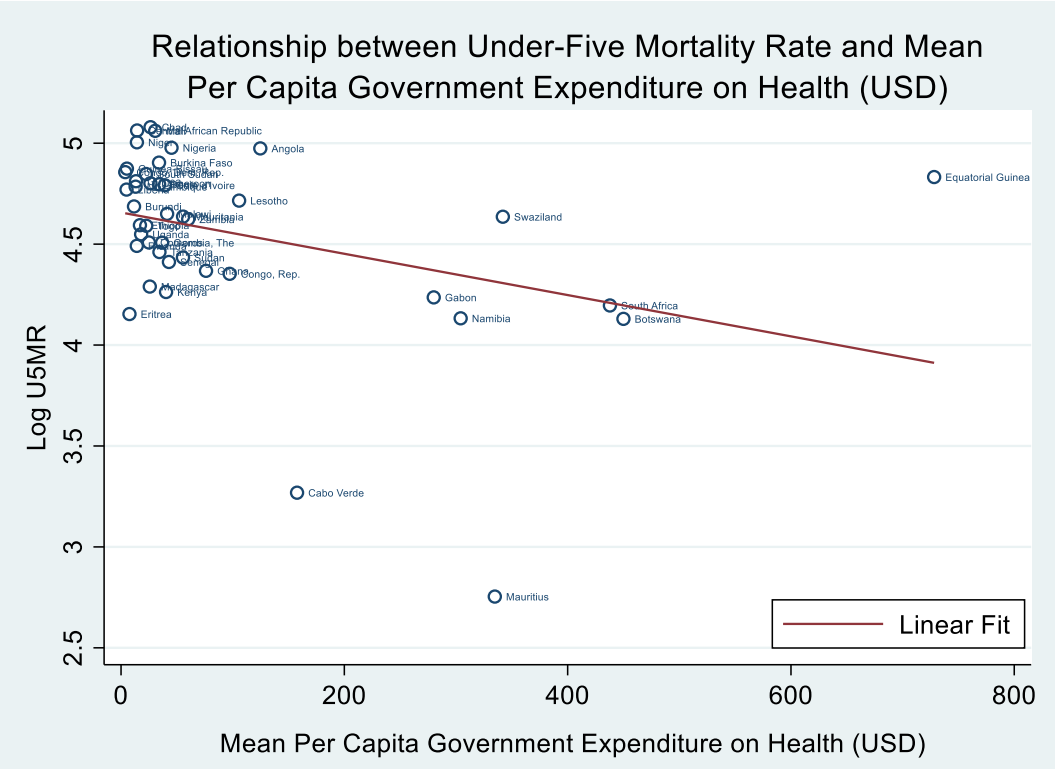


Figure 5.20

Relationship between Under-Five Mortality Rate and Mean Per Capita Development Assistance for Health

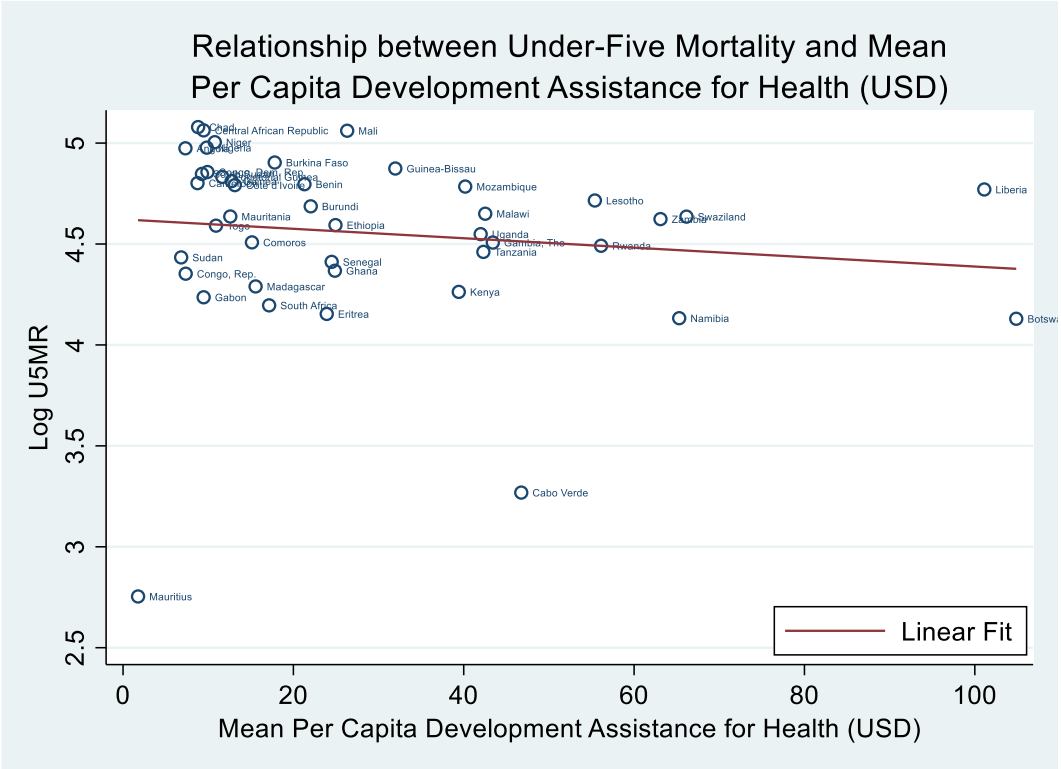


Figure 5.21

Relationship between Under-Five Mortality Rate and Mean Per Capita Out of Pocket Expenditure on Health

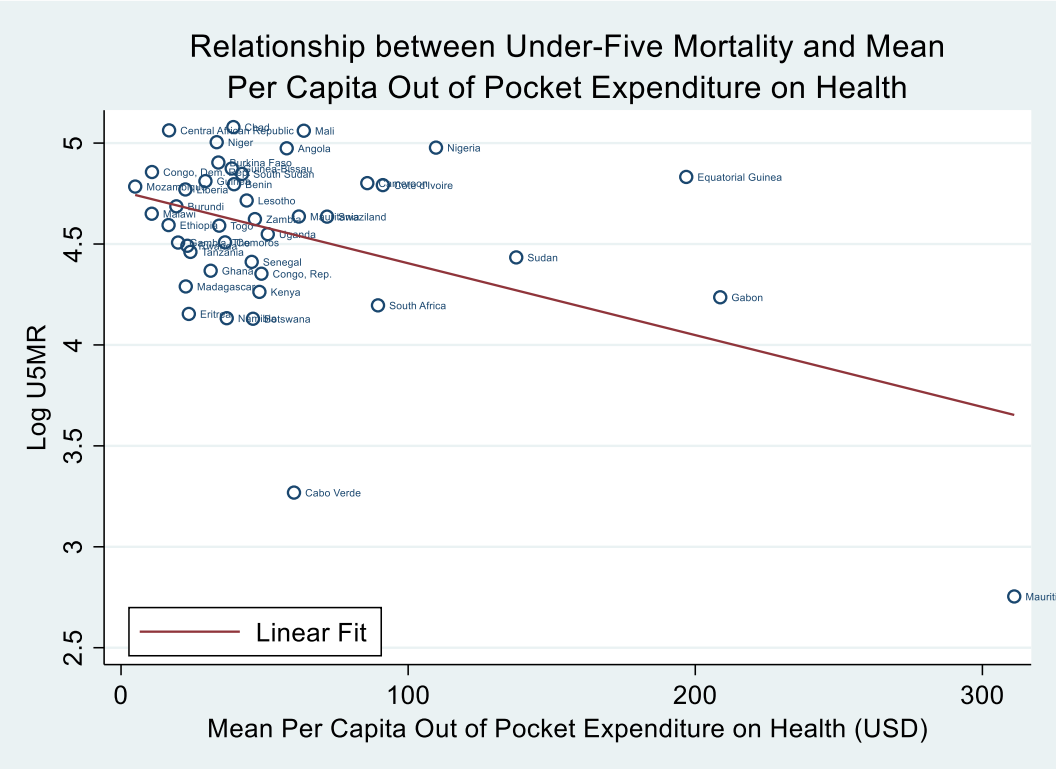
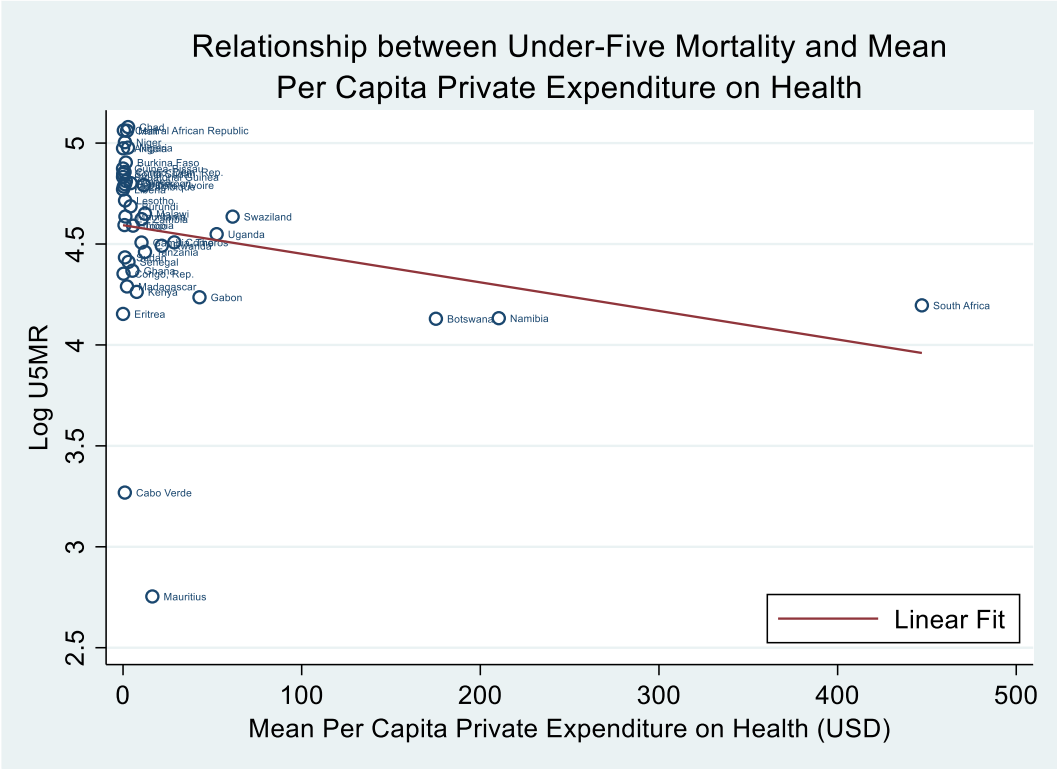


Figure 5.22

Relationship between Under-Five Mortality Rate and Mean Per Capita Private Expenditure on Health



The hypotheses on the relationship between infant mortality and sources of health financing were tested according to Pearson's correlation model. Hypothesis 1b: It is expected that an increase in the source of health financing will be associated with decreases in infant mortality, and it is expected that government expenditure on health as a per cent of total health expenditure will show the largest decrease in infant mortality. Increases in all sources of expenditure on health (per capita) were related to decreases in infant mortality, with the largest decrease resulting from per capita out of pocket expenditure on health followed by government expenditure on health (Table 5.28). All relationships were statistically significant. Graphical representations of the relationship of the source of expenditure on health and infant mortality are presented in Figures 5.23, 5.24, 5.25 and 5.26 respectively.

Table 5.28

Pearson's correlation model for sources of health financing and infant mortality

	Per Capita Government Expenditure on Health	Per Capita Development Assistance for Health	Per Capita Out of Pocket Expenditure on Health	Per Capita Private Expenditure on Health
Log IMR	-0.3105***	-0.2261***	-0.4008***	-0.2574***

Figure 5.23

Relationship between Infant Mortality Rate and Mean Per Capita Government Expenditure on Health

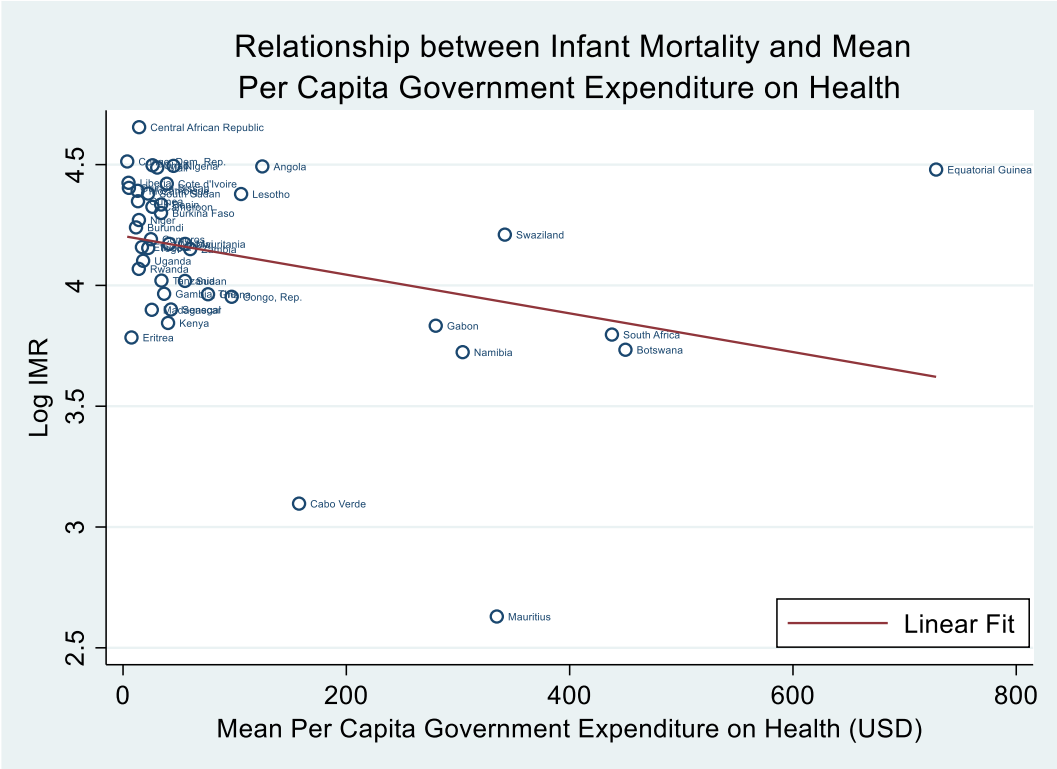


Figure 5.24

Relationship between Infant Mortality Rate and Mean Per Capita Development Assistance for Health

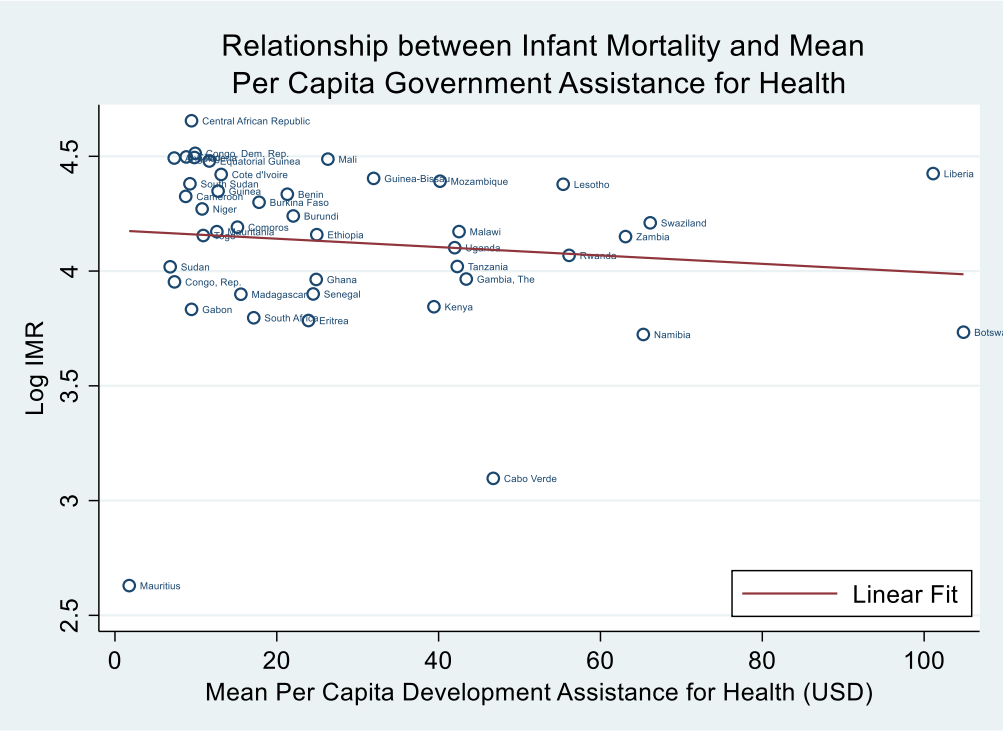


Figure 5.25

Relationship between Infant Mortality Rate and Mean Per Capita Out of Pocket Expenditure on Health

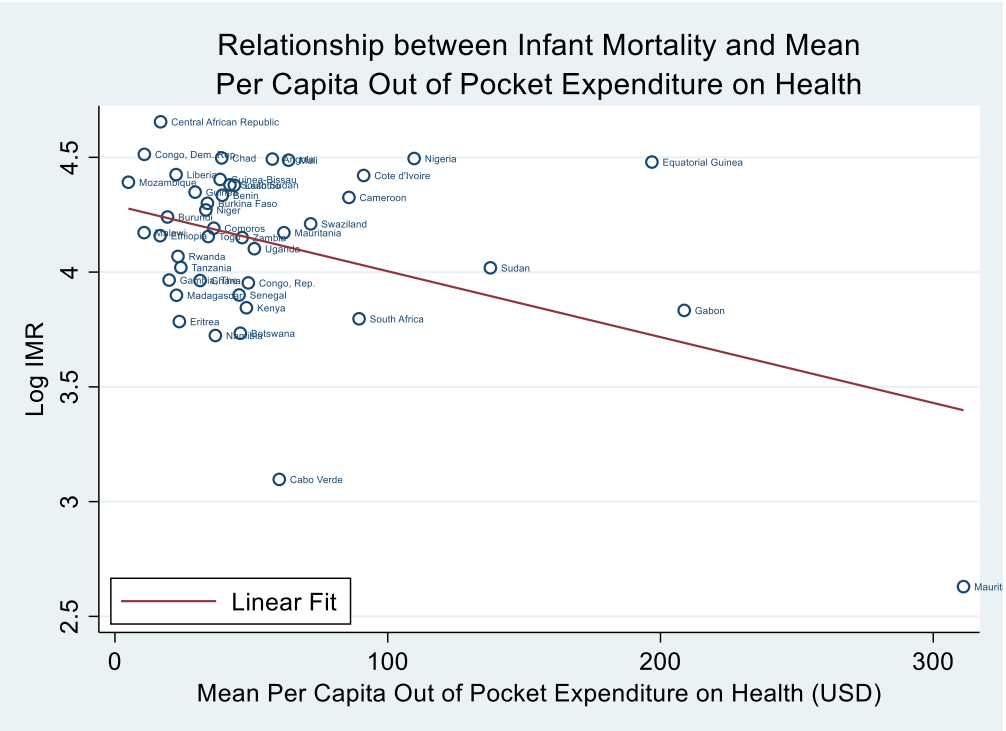
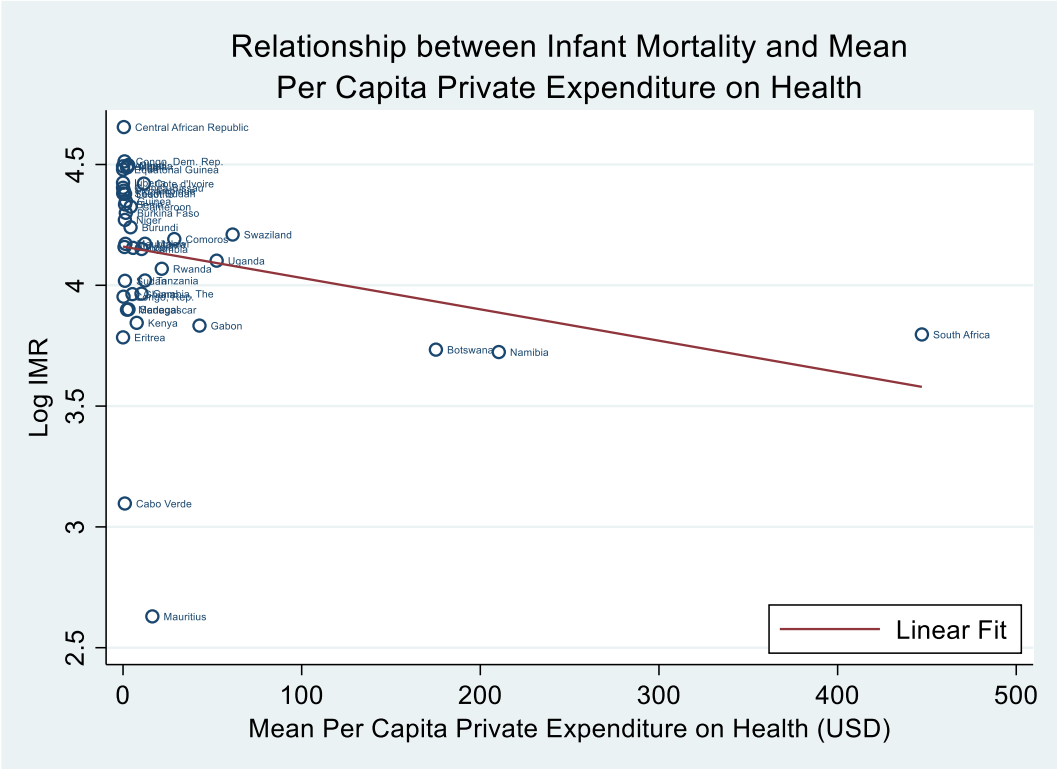


Figure 5.26

Relationship between Infant Mortality Rate and Mean Per Capita Private Expenditure on Health



The hypotheses on the relationship between neonatal mortality and sources of health financing were tested according to Pearson's correlation model. Hypothesis 1c: It is expected that an increase in the source of health financing will be associated with decreases in neonatal mortality, and it is expected that government expenditure on health will show the largest decrease in neonatal mortality. Increases the sources of health financing (per capita) were related to decreases in neonatal mortality, with the largest decrease resulting from per capita private expenditure on health followed by government expenditure on health (Table 5.29). All relationships were statistically significant. Graphical representations of the source of expenditure on health and neonatal mortality are presented in Figures 5.27, 5.28, 5.29 and 5.30 respectively.

Table 5.29

Pearson's correlation model for sources of health financing and neonatal mortality

	Per Capita Government Expenditure on Health	Per Capita Development Assistance for Health	Per Capita Out of Pocket Expenditure on Health	Per Capita Private Expenditure on Health
Log NNMR	-0.3775***	-0.1913***	-0.3768***	-0.4266***

Figure 5.27

Relationship between Neonatal Mortality Rate and Mean Per Capita Government Expenditure on Health

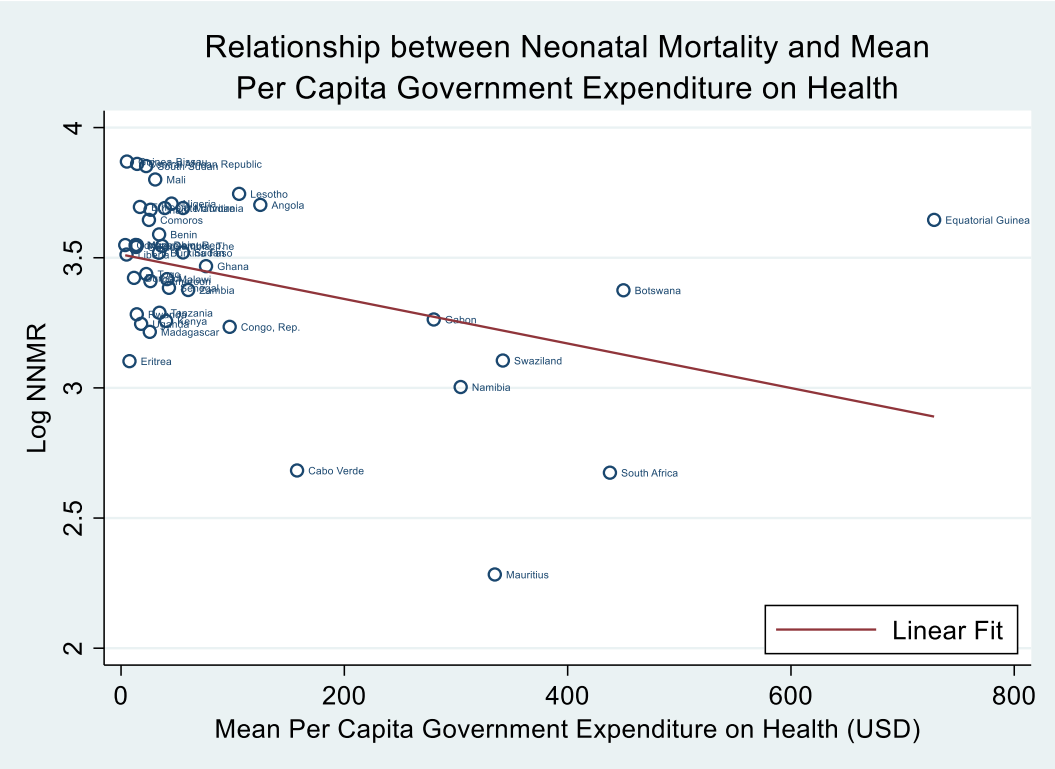


Figure 5.28

Relationship between Neonatal Mortality Rate and Mean Per Capita Development Assistance for Health

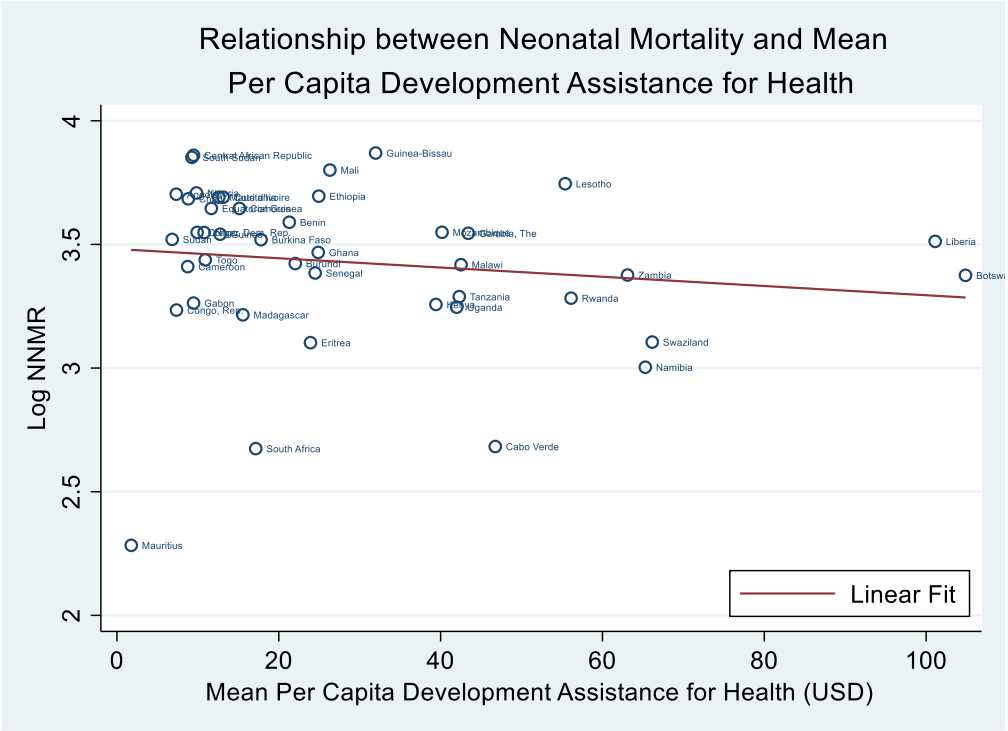


Figure 5.29

Relationship between Neonatal Mortality Rate and Mean Per Capita Out of Pocket Expenditure on Health

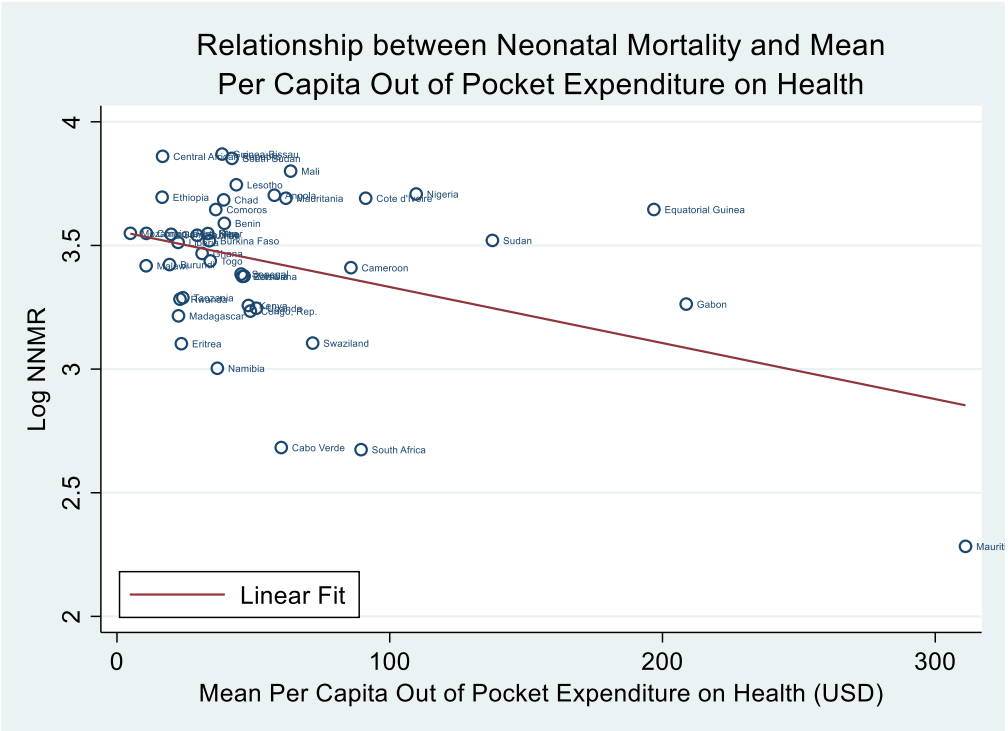
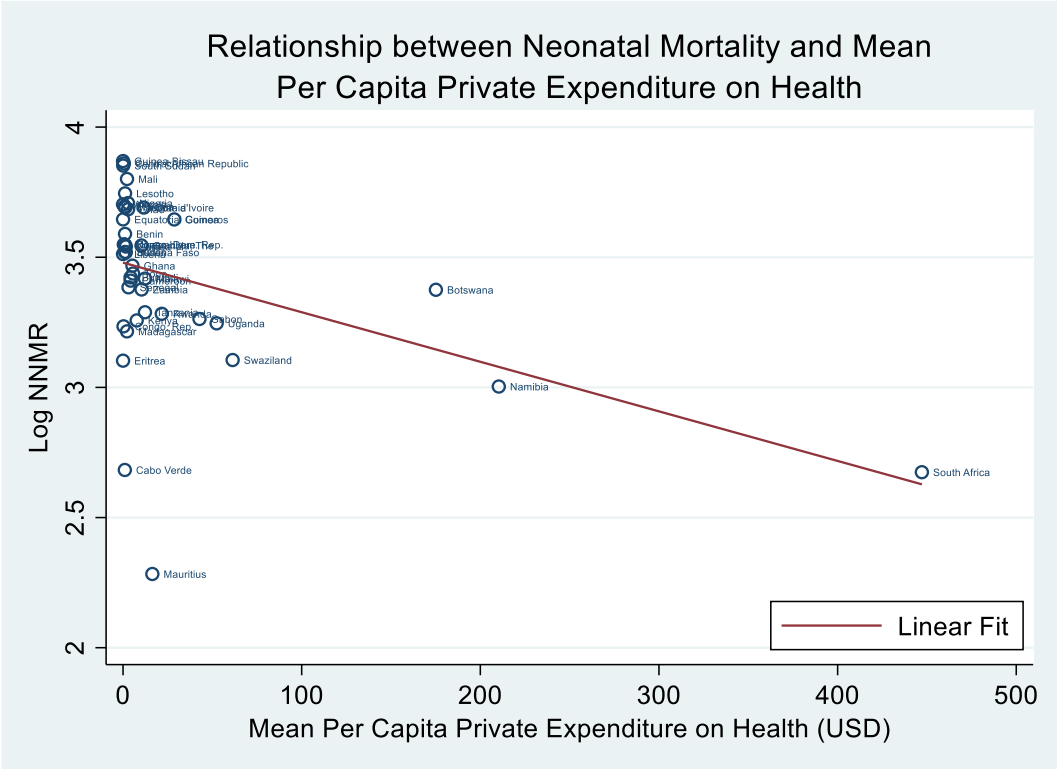


Figure 5.30

Relationship between Neonatal Mortality Rate and Mean Per Capita Private Expenditure on Health



The hypotheses on the relationship between maternal mortality and sources of health financing were tested according to Pearson's correlation model. Hypothesis 1d: It is expected that an increase in the source of health financing will be associated with a decrease in maternal mortality, and it is expected that per capita government expenditure on health will show the largest decrease in maternal mortality. Increases in the sources of health financing (per capita) were related to a decrease in maternal mortality, with the largest decrease resulting from out of pocket expenditure on health followed by government expenditure on health (Table 5.30). All relationships were statistically significant. Graphical representations of source of expenditure on health and maternal mortality are presented in Figures 5.31, 5.32, 5.33 and 5.34 respectively.

Table 5.30

Pearson's correlation model for sources of health financing and maternal mortality

	Per Capita Government Expenditure on Health	Per Capita Development Assistance for Health	Per Capita Out of Pocket Expenditure on Health	Per Capita Private Expenditure on Health
Log MMR	-0.4766***	-0.1470***	-0.4863***	-0.4053***

Figure 5.31

Relationship between Maternal Mortality Rate and Mean Per Capita Government Expenditure on Health

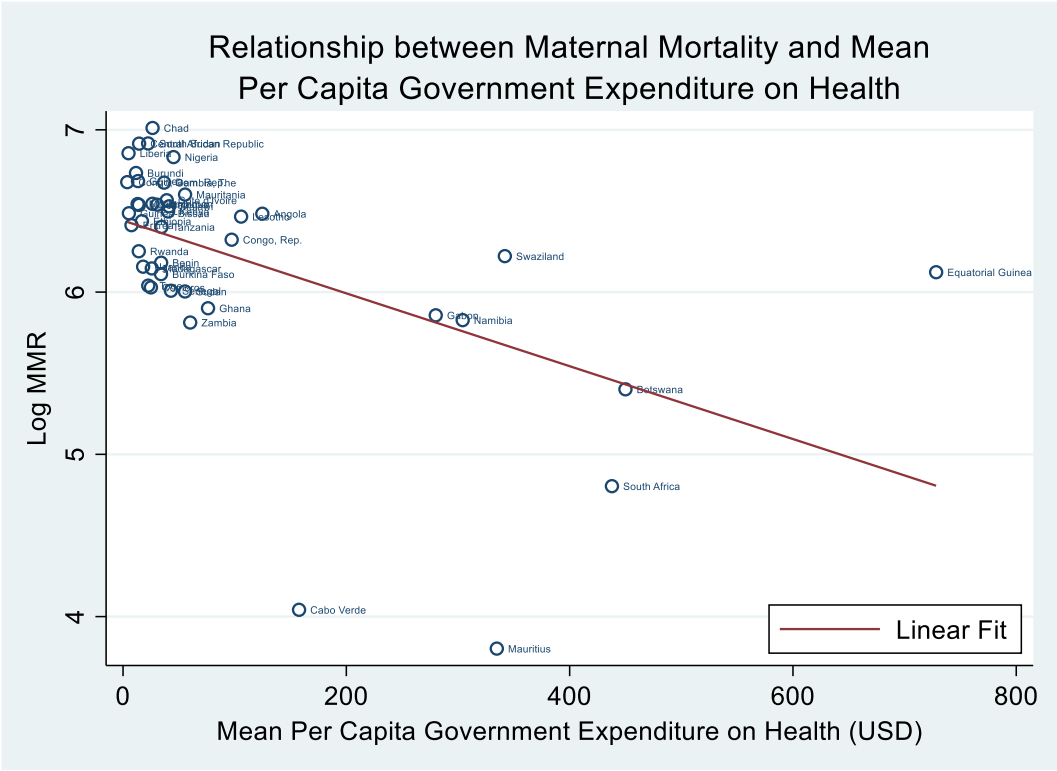


Figure 5.32

Relationship between Maternal Mortality Rate and Mean Per Capita Development Assistance for Health

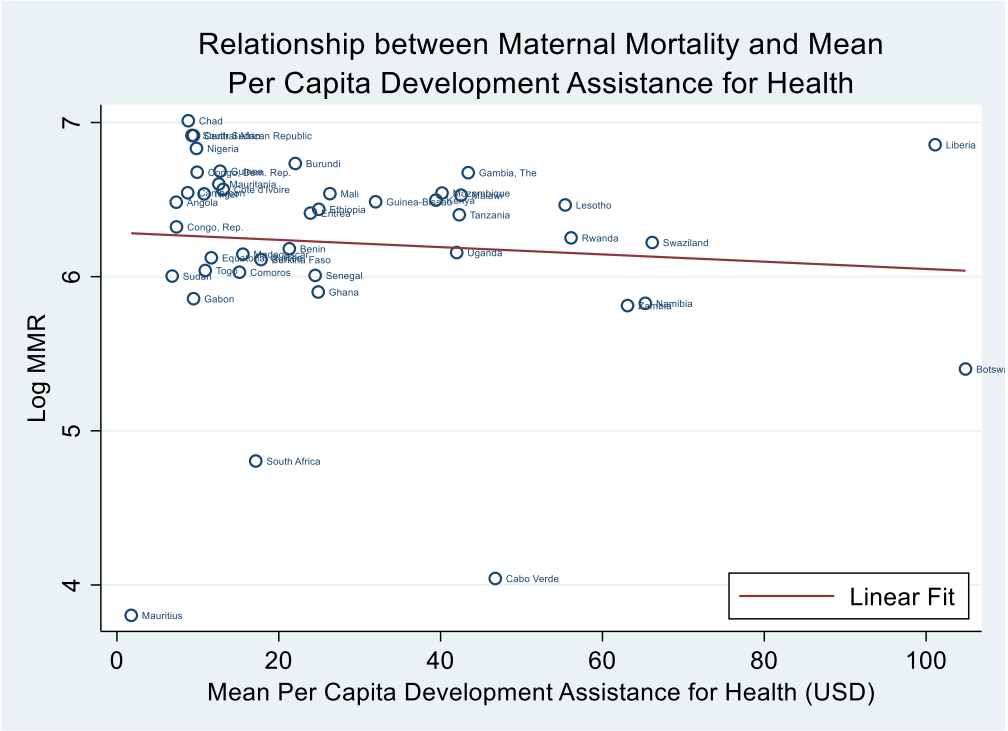


Figure 5.33

Relationship between Maternal Mortality Rate and Mean Per Capita Out of Pocket Expenditure on Health

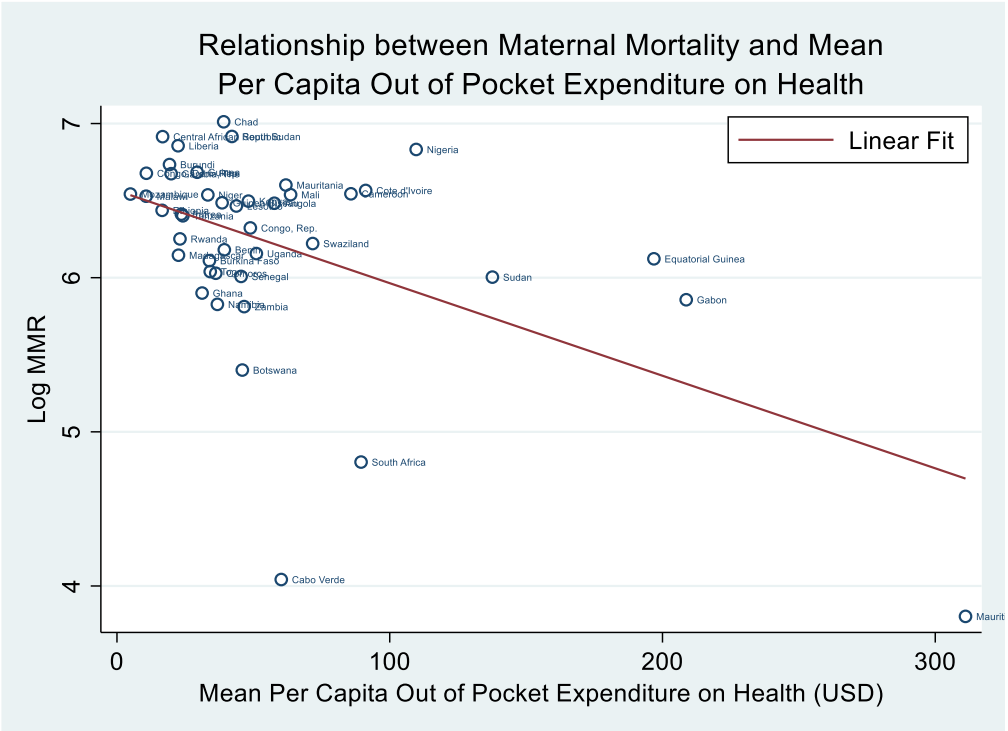
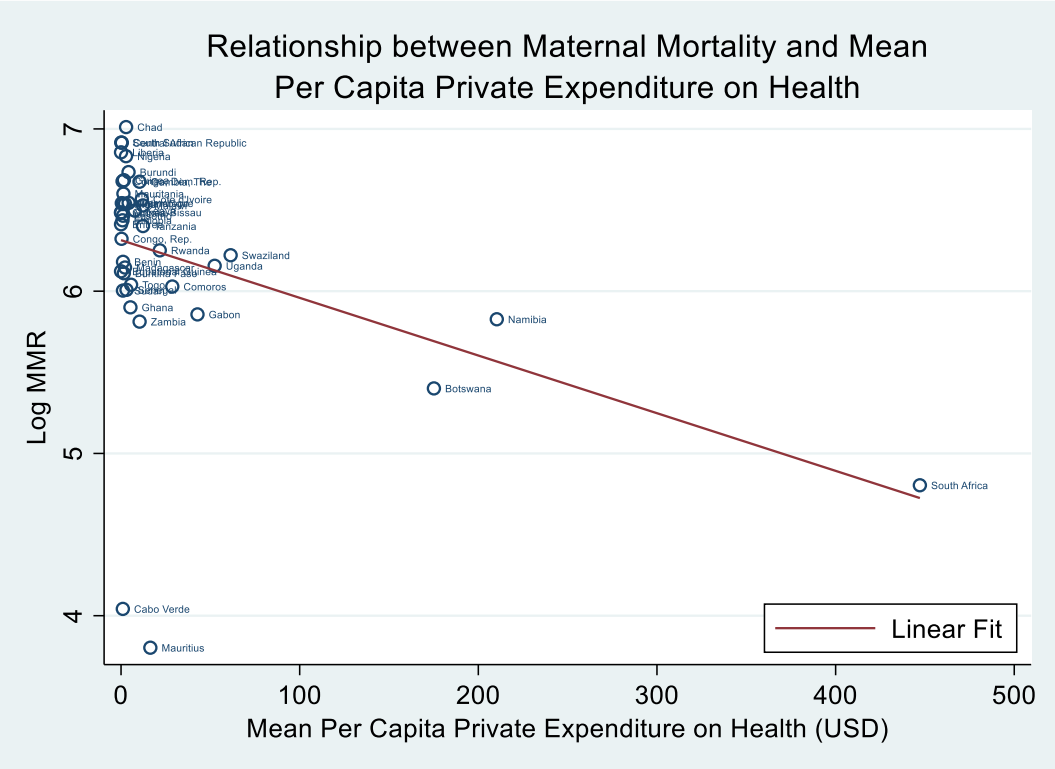


Figure 5.34

Relationship between Maternal Mortality Rate and Mean Per Capita Private Expenditure on Health



5.5 Summary

This chapter presented a descriptive analysis of the data for objectives 1 and 2. Data for the variables of interest were available for 43 sub-Saharan African countries between 2000 and 2014. Under-five mortality rates steadily decreased from 138.05 per 1,000 live births in 2000 to 75.44 in 2014; infant mortality steadily decreased from 84.07 per 1,000 live births in 2000 to 51.31 in 2014; neonatal mortality steadily decreased from 37.97 per 1,000 live births in 2000 to 27.39 in 2014; and maternal mortality steadily decreased from 716.84 per 100,000 live births in 2000 to 476.86 in 2014. Tabular and graphical representations of the distribution of under-five, infant, neonatal and maternal mortality were provided by country and by year.

Total health expenditure as a per cent of GDP increased steadily over the years in this work from 4.79% in 2000 to 7.16% in 2014. Liberia shows the highest per cent of total health expenditure as a factor of GDP at 16.83% and South Sudan has the lowest per

cent of total health expenditure as a factor of GDP at 2.77%. When looking at the dollar value of annual health expenditure (rounded to the nearest million), the country with the highest mean annual health expenditure was South Africa (US$49,200 million) and Comoros had the lowest mean annual health expenditure (US$70 million). In terms of per capita health expenditure, South Africa had the highest mean per capita health expenditure (US$991.68) and the Democratic Republic of Congo had the lowest (US$25.31).

Across all years, mean government health expenditure as a per cent of total health expenditure was 35.15% while the mean per capita government health expenditure was US$99.40. Mean private health expenditure as a percent of total health expenditure was 7.19%, while the mean per capita private health expenditure was US$27.11. Mean OOP expenditure as a percent of total health expenditure was 36.06% while mean per capita OOP was US$57.78. Development assistance for health expenditure as a percent of total health expenditure was 21.60% while mean per capita development assistance for health was US$28.71.

The distribution of source of financing changed substantially based on country income level. For low-income countries, government health expenditure as a per cent of total health expenditure was 27.67% and was approximately double for lower middle-income countries (45.74%) and upper middle-income countries (55.82%). Mean per capita government expenditure on health was highest for upper middle-income countries at US$466.18, followed by lower middle-income countries at US$127.10 and low-income countries at US$27.59. Private health expenditure as a percent of total health expenditure was 5.25% for low-income countries; 8.38% for lower middle-income countries; and 15.68% for upper middle-income countries. Mean per capita private health expenditure was highest for upper middle-income countries at US$136.30, followed by lower middle-income countries at US$31.29 and low-income countries at US$6.12. Out of pocket expenditure was highest for low-income countries at 38.69% and lowest for upper middle-income countries 24.96%. Mean per capita out of pocket expenditure on health was also highest for upper middle-income countries at US$170.42, followed by lower middle-income countries at US$59.64 and low-income countries at US$37.01. Development assistance for health was highest for low-income countries at 28.40% and lowest for upper middle-income countries at 3.53%.

Mean per capita development assistance for health was roughly the same across the different country income classifications with low-income countries at US$27.98, lower middle-income countries at US$30.65, and upper middle-income countries at US$29.98. Tabular and graphical representations of the distribution of sources of health financing were provided by country and by year.

The hypotheses were tested according to Pearson's correlation model to identify relationships. Increases in the sources of health expenditure (per capita) were related to decreases in under-five, infant, neonatal and maternal mortality rates. Graphical representations of sources of health financing and under-five, infant, neonatal and maternal mortality were provided.

Chapter 6: Results for source of health expenditure and their effect on health outcomes (under-five, infant, neonatal and maternal mortality)

6.1 Introduction

This section looks at the quantitative results for objective 1. Several estimation methods were used to assist in predicting the point estimate for the dependent and independent variables: OLS, RE, FE and GMM. This aligns with the research reviewed in Chapter 3, in which 11 out of 13 studies used one or more of these three estimation methods, and the methodology set out in Chapter 4 (refer to Table 4.1).

Of the four studies (Gottret & Schreiber, 2006; Bokhari et al., 2007; Achoki & Chansa, 2013; and Shaw et al., 2015) that examined the relationship between the source of health financing and health outcomes, as detailed in Chapter 3, three (Gottret & Schreiber, 2006; Bokhari et al., 2007; and Achoki & Chansa, 2013) show that government expenditure on health produces better health outcomes and/or coverage of health interventions than donor financing. Based on these findings, it was expected that increases in government or donor expenditure on health would decrease under-five, infant, neonatal and maternal mortality. It was also expected that expenditure sourced from government would show greater improvements in health outcomes than donor expenditure.

6.2 Empirical Analysis for Source of Health Expenditure and health outcomes

For each model, OLS, RE, FE and GMM estimation methods were run. These methods are relatively common (Kennedy, 2003). The main limitation of OLS regressions is the assumption that the relationships between the variables are constant over time and across the cross-sectional units (Brooks, 2008). Time dummies were included in the OLS estimation method to control for variables (whether observable or unobservable) that are constant across entities but vary over time; and the robust option was added to control for heteroscedasticity (Torres-Reyna, 2007).

FE and RE estimation methods were run for comparison as they address omitted variables bias (Snijders & Bosker, 2011; Greene, 2007; Gelman & Hill, 2006; Wooldridge, 2001; and Mundlak, 1978). GMM was run to control for endogeneity, omitted variable bias, unobserved panel heterogeneity and measurement errors, and short time period under review (Blundell & Bond, 1998; Arellano & Bover, 1995; and Arellano & Bond, 1991). Both difference and system GMM were run, using both one- and two-step, noting that the latter is considered more efficient and is thus considered a more robust estimation method (Roodman, 2009; Roodman, 2007; Blundell & Bond, 1998; Arellano & Bover, 1995; and Arellano & Bond, 1991).

In accordance with the literature review, all four estimation methods are analyzed in this work to help identify an appropriate point estimate, noting that there are advantages and disadvantages to each method (Bell & Jones, 2012; Snijders & Bosker, 2011; and Cameron & Trivedi, 2009).

The regressions ran for the "all countries" model with 601 observations for 41 groups/countries with the variable for prevalence of undernourishment, indicating that two countries were dropped from the analysis.

A summary of missing values was prepared and of the variables used for these regressions, the following were missing:

Variable	**Variable Code**	**No. of Missing Values**	**Details of Missing Values**
GDP per Capita	GDPPRCAP	14	Eritrea 2012 – 2014; South Sudan 2000 – 2010
Prevalence of Undernourishment	FOODSEC	30	DRC 2000 - 2014; Equatorial Guinea 2000 - 2014
Per Capita Total Health Expenditure	THEPRCAP	15	South Sudan 2000 - 2014

If the variable for prevalence of undernourishment is removed from the regressions, there are differences in the scale of the coefficients of the variables however the directional relationships and significance levels remain the same. Regressions were

run which included the variable for prevalence of undernourishment as well as without this variable. As including the variable prevalence of undernourishment caused two countries to be dropped from the analysis, one of which is important for the child health expenditure analysis, Democratic Republic of Congo, thus the variable prevalence of undernourishment was removed from the analysis. The regressions were run with and without the per capita total health expenditure variable. It was decided that this variable would be included in the models, thus the "all countries" model ran with 627 observations for 42 groups/countries, with South Sudan dropped from the analysis. The average number of observations per country was 14.9, with the number of observations per country ranging from a minimum 12 observations to a maximum of 15 observations per country. Difference GMM reduced the number of observations to 546, while system GMM reduced the number of observations to 585 because of missing variables.

Regressions for the low-income countries model had 402 observations for 28 countries with a range of observations from 4 to 15 observations per country. Difference GMM reduced the number of observations to 338, for 27 countries, while system GMM reduced the number of observations to 375 because of missing variables but included all 28 countries classified as low income countries. Regressions for the lower middle-income countries model had 150 observations for 10 countries, with all countries having 15 observations each. While both difference and system GMM included 10 countries in the regressions, the number of observations reduced to 130 and 140, respectively. Regressions for the upper middle-income model countries had 75 observations for 5 countries, with all countries having 15 observations each. While both difference and system GMM included 5 countries in the regressions, the number of observations reduced to 52 and 70, respectively. It is noted that the number of instructions used in the difference and system GMM regressions for lower middle- and upper middle-income countries were far above the number of groups/countries in each model which would make results misleading (Roodman, 2009).

The Hausman test was used to support decisions between random and fixed effects estimators (Clark & Linzer, 2013: Baum, 2013; Torres-Reyna, 2007; and Hausman, 1978). In a preliminary run of the data, an error was noted when running the Hausman test (Torres-Reyna, 2007). As the coefficient of a variable, in this case GDP per capita,

was very small, the statistical programme, Stata, considered this variable to be on a different scale and thus was incompatible with running the Hausman test (Rockefeller College University at Albany https://www.albany.edu/faculty/kretheme/PAD705/SupportMat/PanelData.pdf). To address the issue, the scale of the variable GDP per capita was adjusted (by dividing the variable by 1000).

The null hypothesis of the Hausman test was that the unique errors (υ_i) were not correlated with the regressors, and thus the random effects method was preferred (Clark & Linzer, 2013; Baum, 2013; Torres-Reyna, 2007; and Hausman, 1978). If the probability was less than 0.05, the test was significant thus the hypothesis was rejected, and fixed effects was the preferred method. If the probability was more than 0.05, the test was not significant thus the hypothesis was accepted. However, the Hausman test was neither necessary nor sufficient for choosing the fixed or the random effects model (Clark & Linzer 2013). Dieleman (2014) found that the Hausman test appropriately identified the estimation method with the smallest absolute error only 61% of the time. Thus, the Hausman test was used in this work as one means for guiding the use of an appropriate estimation method.

If the null hypothesis of the Hausman test was accepted, then the Breusch-Pagan Lagrange multiplier (BPLM) test was used to support decisions between the RE or OLS estimation methods. The null hypothesis in the BPLM test was that variances across entities is zero (i.e. there was no significant difference across units or in other words no panel effect) and therefore OLS was the preferred method. If the probability was less than 0.05, the test was significant, so the hypothesis was rejected, and random effects was considered the preferred method. If the probability was more than 0.05, the test was not significant, so the hypothesis was accepted and OLS was preferred ((Torres-Reyna, 2007; and Breusch & Pagan, 1980).

This work also shows results for FE regressions that control for variables that are constant across entities but vary over time. By including time dummies, cross-group action is absorbed, leaving only the within-group action. (Wooldridge, 2012; Torres-Reyna, 2007; and Murtazashvili & Wooldridge, 2008). This allowed for additional insight into the establishment of point estimates.

GMM estimation methods were also analyzed. If the difference GMM was close to or below the FE estimate, which suggests a downward bias, then system GMM was used (Bond, 2001). The Hansen (1982) J test was used to support to the choice of instruments. Both one step and two step difference and system GMM were run however as one step GMM estimations are considered less efficient, and the two step procedures tend to perform better than the one step, only the two step GMM estimation methods are shown in the tables below (Hwang & Sun, 2015).

The sections below look at the results generated from the above-mentioned tests.

6.2.1 Under-five Mortality Rate

The regression results using the various estimation methods for the "all countries" model are reported in Table 6.1 below. OLS, RE, and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was lowest for the OLS method at 60.92% increasing to 73.49% for the RE and 73.60% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 73% of the variation in under-five mortality (Pillai, 2017). These estimation methods were compared using the Hausman test, sigmamore. The Hausman test indicated that the null hypothesis should be rejected for the under-five mortality rate for the "all countries" model (Prob>chi2 of 0.0000) thus FE was preferred.

As per the literature (Bond 2001), the pooled OLS point estimate was considered the upper bound estimate while the FE point estimate was considered the lower bound estimate. In this model, both the difference and system GMM provided the same results. However, as the difference GMM coefficients are close to the FE, the system GMM is used. The system GMM is listed in the table and both one step and two step estimations are shown, noting that the two step system point estimates are used as they are considered more efficient. It was noted that the coefficients were the same between

the one step and two step system GMM however the significance level reduced in the two step GMM.

All sources of health expenditure (per capita) were associated with reducing under-five mortality however only per capita government expenditure on health and private expenditure on health were statistically significant at the 5% level. Per capita government health expenditure was shown to reduce under-five mortality with a coefficient of -0.0001 (p = 0.002), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.01% decrease in under-five mortality. Per capita development assistance for health expenditure was shown to reduce under-five mortality with a coefficient of -0.0002 (p = 0.325), indicating that a US$1 increase in per capita development assistance for health leads to a 0.02% reduction in under-five mortality. Per capita out of pocket expenditure on health was shown to be associated with reducing in under-five mortality with a coefficient of -0.0000 (p = 0.990) however the scale was small and insignificant. Per capita private expenditure on health was associated with reducing under-five mortality with a coefficient of -0.0001 (p = 0.041), indicating that a US$1 increase in private expenditure on health leads to a 0.01% reduction in under-five mortality.

Per capita government expenditure on health and private expenditure on health were statistically significant and had directional relationships in accordance with the hypothesis. This model showed that per capita government expenditure on health and private expenditure on health were associated with similar reductions in under-five mortality.

Proportion of the population with access to an improved water source was associated with an increase in under-five mortality with a coefficient of 0.0003 (p = 0.627). Prevalence of HIV was associated with reducing under-five mortality with a coefficient of -0.0025 (p = 0.318). Per capita total health expenditure was associated with increases in under-five mortality with a coefficient of 0.0001 (p = 0.004). GDP per capita was associated with increases in under-five mortality with a coefficient 0.0000 (p = 0.705) however the scale was small and insignificant. Mean years of schooling for females above 25 years of age was associated with an increase in under-

five mortality with a coefficient of 0.0005 (p = 0.727). Only the variable per capita total health expenditure showed statistical significance.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.1

Regression results under-five mortality (all countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0012***	-0.0000	0.0000	-0.0001**	-0.0001**
Per Capita Development Assistance for Health	-0.0023***	-0.0015***	-0.0013***	-0.0002*	-0.0002
Per Capita Out of Pocket Expenditure on Health	-0.0022***	0.0001	0.0002	0.0000	-0.0000
Per Capita Private Expenditure on Health	-0.0007***	-0.0011***	-0.0013***	-0.0002**	-0.0002*
Per Capita Total Health Expenditure	0.0004***	0.0000	-0.0000	0.0001**	0.0001**
GDP per Capita	0.0000**	-0.0000***	-0.0000**	0.0000	0.0000
Access to an Improved Water Source	-0.0078***	-0.0238***	-0.0259***	-0.0007	0.0003
HIV Prevalence	0.0242***	0.0298***	0.0268***	-0.0035	-0.0025
Years of Schooling (Female 25+)	-0.0977***	-0.0698***	-0.0677***	0.0016	0.0005
_cons	5.55***	6.32***	6.49***	0.00	0.03
N	627	627	627	585	585
r2	0.6092	0.7349	0.7360	.	.
Hansen	.	.	.	0.3679	0.3679
AR(2)	.	.	.	0.7212	0.7795

As per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data), this work looks at the regression results for under-five mortality rates by country income level. Private expenditure on health was omitted due to collinearity with out of pocket expenditure.

6.2.1.1 Low-income countries

The regression results using the various estimation methods for the "low-income countries" model are reported in Table 6.2 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods were appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, were examined. R squared was lowest for the OLS method at 58.38% increasing to 81.72% for the RE and 81.87% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 81% of the variation in under-five mortality (Pillai 2017). These estimation methods were compared using the Hausman test. The Hausman test indicated that the null hypothesis should be rejected for under-five mortality rate for the "low-income countries" model ($p = 0.0002$) thus FE was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the low-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, there seemed to be little variance in the variable coefficients. The figures generated in the revised models were not provided in this work as it changed the model, making it

difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method.

Per capita government health expenditure was associated with increases in under-five mortality with a coefficient of 0.0005 (p = 0.279), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.05% increase in under-five mortality. Per capita development assistance for health expenditure was shown to reduce under-five mortality with a coefficient of -0.0018 (p = 0.000), indicating that a US$1 increase in per capita development assistance for health expenditure leads to a 0.18% reduction in under-five mortality. Per capita out of pocket expenditure on health was related to decreases in under-five mortality with a coefficient of -0.0005 (p = 0.178), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.05% reduction in under-five mortality. Per capita private expenditure on health was associated with reductions in under-five mortality with a coefficient of -0.0011 (p = 0.035), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.11% reduction in under-five mortality.

Per capita development assistance for health and private expenditure on health were statistically significant and had directional relationships in accordance with the hypothesis. Per capita development assistance for health had a larger effect on reducing under-five mortality than private expenditure on health.

Per capita total health expenditure was associated with decreases in under-five mortality with a coefficient of -0.0004 (p = 0.006), indicating that a US$1 increase in per capita total health expenditure is associated with a 0.04% decrease in under-five mortality. GDP per capita was associated with decreases in under-five mortality with a coefficient -0.0001 (p = 0.006), indicating that a US$1 increase in GDP per capita is associated with a 0.01% decrease in under-five mortality.

Proportion of the population with access to an improved water source was shown to reduce under-five mortality with a coefficient of -0.0197 (p = 0.000), indicating that a

1% increase in the proportion of the population with access to an improved water source is associated with a 1.95% decrease in under-five mortality. The relationship of population with access to an improved water source with under-five mortality is surprising as access to an improved water source is known to reduce transmission of diseases that are major killers (cholera, diarrhoea, dysentery, hepatitis A, typhoid, and polio) (https://www.who.int/news-room/fact-sheets/detail/drinking-water).

Prevalence of HIV was shown to increase under-five mortality with a coefficient of 0.0263 (p = 0.001), indicating that a 1% increase in HIV prevalence is associated with a 2.66% increase in under-five mortality. The relationship between HIV prevalence and under-five mortality was as expected as HIV has been shown to account for approximately 3.6% of under-five deaths in sub-Saharan Africa (Stanecki et al. 2010).

Mean years of schooling for females above 25 years of age was associated with a decrease in under-five mortality with a coefficient of -0.0849 (p = 0.000), indicating that a 1-year increase in mean years of schooling for females is associated with an 8.14% decrease in under-five mortality.

Per capita total health expenditure, GDP per capita, proportion of the population with access to an improved water source, prevalence of HIV and mean years of schooling for females above 25 years of age all showed statistical significance.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.2

Regression results under-five mortality (low-income countries)

Variable	OLS	RE	FE	System GMM 2 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0017**	0.0005	0.0005	-0.0001	-0.0001
Per Capita Development	-0.0026***	-0.0020***	-0.0018***	0.0001*	0.0001**

Assistance for Health					
Per Capita Out of Pocket Expenditure on Health	-0.0006	-0.0004	-0.0005	0.0000	0.0000
Per Capita Private Expenditure on Health	-0.0037**	-0.0012*	-0.0011*	0.0000	0.0001
Per Capita Total Health Expenditure	0.0003***	-0.0003	-0.0004**	0.0000	0.0000
GDP per Capita	0.0000	-0.0001***	-0.0001**	-0.0000	-0.0000
Access to an Improved Water Source	0.0015	-0.0175***	-0.0197***	-0.0004	-0.0011
HIV Prevalence	0.0134***	0.0287***	0.0263**	-0.0001	0.0008
Years of Schooling (Female 25+)	-0.0746***	-0.0846***	-0.0849***	-0.0016	-0.0039
_cons	5.05***	6.06***	6.22***	-0.05	0.02
N	402	402	402	375	375
r2	0.5838	0.8172	0.8187	.	.
Hansen	.	.	.	0.8680	0.8680
AR(2)	.	.	.	0.9415	0.6637

6.2.1.2 Lower Middle-Income Countries

The regression results using the various estimation methods for the "lower middle-income countries" model are reported in Table 6.3 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS method was 83.86%, 67.44% for the RE and 79.22% for the FE methods, indicating that all methods explain more than 67% of the variation in under-five mortality (Pillai 2017). The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for under-five

mortality rate for the “lower middle-income countries” model (Prob>chi2 of 0.0000) thus the fixed effects was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. Despite the inappropriateness of the model due to the limited sample size for the lower middle-income countries model, the results were provided in the table below to enable visualization of the coefficients and significance levels across the estimation methods.

Based on the limitations with the GMM models, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, “the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation” so for the upper middle-income countries model, the RE estimators were preferred. The RE robust estimation method had a missing F-test value due to there being more variables than groups (in this case countries) in the model. Although the Hausman test favoured the FE estimation method, the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was used.

Per capita government health expenditure showed was shown to reduce under-five mortality with a coefficient of -0.0031 (p = 0.000), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.31% decrease in under-five mortality. Per capita development assistance for health was shown to increase under-five mortality with a coefficient of 0.0003 (p = 0.743), indicating that a US$1 increase in per capita development assistance for health expenditure leads to a 0.03% increase in under-five mortality. Per capita out of pocket expenditure on health was shown to be related to increases in under-five mortality with a coefficient of 0.0022 (p = 0.007), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.22% increase in under-five mortality. Per capita private expenditure on health was shown to be related to increases in under-five mortality with a coefficient of 0.0042 (p = 0.000), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.42% increase in under-five mortality.

Per capita government expenditure on health was statistically significant and had directional relationship in accordance with the hypothesis. Per capita private expenditure on health was statistically significant and had directional relationship which diverged with the hypothesis. Per capita development assistance for health was associated with reductions in under-five mortality whereas per capita private expenditure on health as associated with increases in under-five mortality.

Per capita total health expenditure was associated with decreases in under-five mortality with a coefficient of -0.0003 (p = 0.266), indicating that a US$1 increase in per capita total health expenditure is associated with a 0.03% decrease in under-five mortality. GDP per capita was associated with decreases in under-five mortality with a coefficient -0.0001 (p = 0.007), indicating that a US$1 increase in GDP per capita is associated with a 0.01% decrease in under-five mortality.

Proportion of the population with access to an improved water source reduced under-five mortality with a coefficient of -0.0251 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source is associated with a 0.01% decrease in under-five mortality. Prevalence of HIV was associated with increases in under-five mortality with a coefficient of 0.0252 (p = 0.000). Mean years of schooling for females above 25 years of age was associated with a decrease in under-five mortality with a coefficient of -0.0261 (p = 0.153), indicating that a 1-year increase in mean years of schooling for females is associated with a 2.58% decrease in under-five mortality.

GDP per capita was associated, proportion of the population with access to an improved water source and prevalence of HIV showed statistical significance.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.3

Regression results under-five mortality (lower middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0026***	-0.0031***	-0.0000	-0.0001	-0.0011**
Per Capita Development Assistance for Health	-0.0007	0.0003	0.0004*	-0.0003***	0.0003
Per Capita Out of Pocket Expenditure on Health	0.0017**	0.0022**	0.0042***	-0.0001*	0.0083***
Per Capita Private Expenditure on Health	0.0048***	0.0042***	0.0020**	-0.0002	0.0043***
Per Capita Total Health Expenditure	-0.0003	-0.0003	-0.0008**	-0.0001	-0.0010***
GDP per Capita	-0.0002***	-0.0001**	-0.0001***	-0.0000	0.0000
Access to an Improved Water Source	-0.0270---	-0.0251***	-0.0248***	-0.0005	-0.0492***
HIV Prevalence	0.026***	0.0252***	-0.0468	-0.0068	-0.0197
Years of Schooling (Female 25+)	-0.0292	-0.0261	-0.0498***	0.0040	-0.1150***
_cons	6.74***	6.58***	6.89***	0.43	0.00
N	150	150	150	140	140
r2	0.8386	0.6744	0.7922	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.3715	0.7005

6.2.1.3 Upper Middle-income Countries

The regression results using the various estimation methods for the "upper middle-income countries" model are reported in Table 6.4 below. OLS, RE and FE estimation

methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS method was 81.74%; 32.43% for the RE; and 94.65% for the FE methods, indicating that there may be issues with the FE estimation method (Pillai, 2017).

The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the under-five mortality rate for the "upper middle-income countries" model (Prob>chi2 of 0.0000) thus FE was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. Despite the inappropriateness of the model due to the limited sample size for the upper middle-income countries model, the results were provided in the table below to enable visualization of the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation". The RE robust estimation method had a missing F-test value due to there being more variables than groups (in this case countries) in the model. Although the Hausman test favoured the FE estimation method, the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was used.

Per capita government health expenditure was associated with reductions in under-five mortality with a coefficient of -0.0003 ($p = 0.570$), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.03% reduction in under-five mortality. Per capita development assistance for health was associated with reductions

under-five mortality with a coefficient of -0.0005 (p = 0.639), indicating that a US$1 increase in per capita development assistance for health expenditure leads to a 0.05% decrease in under-five mortality. Per capita out of pocket expenditure on health was associated with reductions in under-five mortality with a coefficient of -0.0011 (p = 0. 206), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.11% reduction in under-five mortality. Per capita private expenditure on health was shown to reduce under-five mortality with a coefficient of -0.0007 (p = 0.364), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.07% reduction in under-five mortality. None of the sources of health expenditure had statistical significance.

Per capita total health expenditure was associated with decreases in under-five mortality with a coefficient of -0.0007 (p = 0.422), indicating that a US$1 increase in per capita total health expenditure is associated with a 0.07% decrease in under-five mortality. GDP per capita was associated with reductions in under-five mortality with a coefficient of -0.0005, (p = 0.400), indicating that a US$1 increase in GDP per capita is associated with a 0.05% decrease in under-five mortality.

Proportion of the population with sccess to an improved water source was shown to reduce under-five mortality with a coefficient of -0.0336 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source is associated with a 3.30% decrease in under-five mortality. The relationship of the proportion of the population with access to an improved water source with under-five mortality is in line with evidence that access to an improved water source is known to reduce transmission of diseases that are major killers (cholera, diarrhoea, dysentery, hepatitis A, typhoid, and polio) (https://www.who.int/news-room/fact-sheets/detail/drinking-water).

HIV prevalence was shown to increase under-five mortality with a coefficient of 0.0395 (p = 0.001), indicating that a 1% increase in HIV prevalence is associated with a 4.03% increase in under-five mortality. Mean years of schooling for females above 25 years of age was associated with increases in under-five mortality with a coefficient of 0.0080 (p = 0.883), indicating that a 1-year increase in mean years of schooling for females is associated with a 0.80% increase in under-five mortality.

Only proportion of population with access to an improved water source and prevalence of HIV showed statistical significance at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.4

Regression results under-five mortality (upper middle-income countries)

Variable	OLS	RE	FE	Difference GMM 1 Step	Difference GMM 2 Step
Per Capita Government Expenditure on Health	0.0005	-0.0003	-0.0014***	-0.0005**	-0.0020***
Per Capita Development Assistance for Health	0.0000	-0.0005	-0.0014***	-0.0005***	-0.0012***
Per Capita Out of Pocket Expenditure on Health	-0.0010	-0.0011	-0.0012***	-0.0003**	0.0000
Per Capita Private Expenditure on Health	0.0014	-0.0007	-0.0029***	-0.0008***	-0.0044***
Per Capita Total Health Expenditure	-0.0016	-0.0005	0.0012***	0.0005**	0.0001
GDP per Capita	0.0000	0.0000	-0.0000***	-0.0000	0.0001***
Access to an Improved Water Source	-0.0575***	-0.0336***	-0.0261***	0.0026	0.0000
HIV Prevalence	0.0103	0.0395***	0.0585***	0.0122	0.0000
Years of Schooling (Female 25+)	0.2359*	0.0080	-0.0347***	0.0049	0.0000
_cons	8.29***	7.05***	6.39***	0.00	0.00
N	75	75	75	70	70
r2	0.8174	0.3243	0.9465	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.7739	0.2884

6.2.1.4 Summary of regression results for under-five mortality

One of the four models (all countries) used the system GMM two step estimation method; one model (low-income countries) used the fixed effects estimation method; and two models (lower middle- and upper middle-income countries) used the RE estimation method. The decision about which estimation method to use was informed by the Hansen test, Hausman test and the ability of the model to make the best use of the available data when there are small sample sizes.

In the all countries and lower middle-income countries models, per capita government health expenditure was shown to reduce under-five mortality and the directional relationships were in accordance with the hypothesis.

Per capita development assistance for health was shown to reduce under-five mortality for the low-income countries and the directional relationship was in accordance with the hypothesis.

Per capita out of pocket expenditure on health was associated with increases in under-five mortality in the lower middle-income countries model. The directional relationship diverged from the hypothesis.

Per capita private expenditure on health had statistically significant relationships with under-five mortality in the all, lower middle- and upper middle-income countries models. The directional relationship of per capita private expenditure on health depended on the country income classification model. Refer to Table 6.5 for a summary.

In the all countries model, per capita private expenditure on health had a slightly larger effect on reducing under-five mortality than per capita government expenditure on health. In the lower-middle income countries model, per capita government expenditure on health had the largest effect on reducing under-five mortality compared with the other two sources of health expenditure that showed statistical significance, per capita out of pocket expenditure on health and private expenditure on health. In the low-income countries model, per capita development assistance for health had the

largest effect on reducing under-five mortality compared to per capita private expenditure on health.

After separating the countries by income category, it seems that the relationship between source of funding and under-five mortality may be different for countries with different income levels, as per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005).

In three of the four models (low-income countries, lower middle-income countries and upper middle-income countries), proportion of the population with access to an improved water source was shown to reduce under-five mortality.

In three of the four models (low-income countries, lower middle-income countries and upper middle-income countries), HIV prevalence was shown to increase under-five mortality.

In one of the four models (low-income countries), mean years of schooling for females above 25 years was shown to be associated with decreases under-five mortality.

Table 6.5

Regression results under-five mortality

	All Countries	**Low-income Countries**	**Lower Middle-income Countries**	**Upper Middle-income Countries**
Estimation Method	**System GMM 2 Step**	**FE**	**RE**	**RE**
Per Capita Government Expenditure on Health	-0.0001**	0.0005	-0.0031***	-0.0003
Per Capita Development Assistance for Health	-0.0002	-0.0018***	0.0003	-0.0005
Per Capita Out of Pocket Expenditure on Health	-0.0000	-0.0005	0.0022**	-0.0011

Per Capita Private Expenditure on Health	-0.0002*	-0.0011*	0.0042***	-0.0007
Per Capita Total Health Expenditure	0.0001**	-0.0004**	-0.0003	-0.0005
GDP per Capita	0.0000	-0.0001**	-0.0001**	0.0000
Access to an Improved Water Source	0.0003	-0.0197***	-0.0251***	-0.0336***
HIV Prevalence	-0.0025	0.0263**	0.0252***	0.0395***
Years of Schooling (Female 25+)	0.0005	-0.0849***	-0.0261	0.0080
_cons	0.03	6.22***	6.58***	7.05***
N	585	402	150	75
r2	.	0.8187	0.6744	0.3243
Hansen	0.3679	.	.	.
AR(2)	0.7795	.	.	.

6.2.2 Infant Mortality Rate

The regression results using the various estimation methods for the "all countries" model are reported in Table 6.6 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was lowest for the OLS method at 58.70% increasing to 72.24% for the RE and 72.32% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 72% of the variation in infant mortality (Pillai, 2017). These estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the infant mortality rate "all countries" model (Prob>chi2 of 0.0003) thus the fixed effects was preferred.

As per the literature (Bond 2001), the pooled OLS point estimate was considered the upper bound estimate while the FE point estimate was considered the lower bound

estimate. In this model, both the difference and system GMM provided the same results. However, as the difference GMM coefficients are close to the FE, the system GMM is used. The system GMM is listed in the table and both one step and two step estimations are shown. As the two step is considered more efficient, this is the estimation method used.

Per capita government health expenditure was associated with reductions in infant mortality with a coefficient of -0.0001 (p = 0.000), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.01% reduction in infant mortality. Per capita development assistance for health was shown to reduce infant mortality with a coefficient of -0.0000 (p = 0.570), however the scale was small and insignificant. Per capita out of pocket expenditure on health was shown to increase infant mortality with a coefficient of 0.0000 (p = 0.731), however the scale was small and insignificant. Per capita private expenditure on health was shown to reduce infant mortality with a coefficient of -0.0001 (p = 0.018), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.01% reduction in infant mortality.

Per capita government and private expenditure on health were statistically significant at the 5% level and they had directional relationships in accordance with the hypothesis. The effects of both sources of health expenditure were similar.

Per capita total health expenditure was associated with increases in infant mortality with a coefficient of 0.0001 (p = 0.000), indicating that a US$1 increase in per capita total health expenditure is associated with a 0.01% increase in infant mortality. GDP per capita was associated with reductions in infant mortality with a coefficient of 0.0000, (p = 0.667), however the scale was small and insignificant.

Proportion of the population with access to an improved water source was associated with decreases in infant mortality with a coefficient of -0.0001 (p = 0.904), indicating that a 1% increase in the proportion of the population with access to an improved water source is associated with a 0.01% increase in infant mortality. Prevalence of HIV was associated with decreases in infant mortality with a coefficient of -0.0028 (p = 0.148), which was surprising given the global evidence that HIV increases mortality. Mean

years of schooling for females above 25 years of age was associated with increases in infant mortality with a coefficient of 0.0004 (p = 0.748).

Per capita total health expenditure was statistically significant.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.6

Regression results infant mortality (all countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0010***	0.0000	0.0001	-0.0001***	-0.0001***
Per Capita Development Assistance for Health	-0.0016**	-0.0010***	-0.0009***	-0.0000	-0.0000
Per Capita Out of Pocket Expenditure on Health	-0.0018***	0.0000	0.0001	0.0000	0.0000
Per Capita Private Expenditure on Health	-0.0008***	-0.0004*	-0.0005*	-0.0001***	-0.0001*
Per Capita Total Health Expenditure	0.0002***	-0.0000	-0.0001	0.0001***	0.0001***
GDP per Capita	0.0000***	-0.0000***	-0.0000**	0.0000	0.0000
Access to an Improved Water Source	-0.0069***	-0.0205***	-0.0222***	-0.0004	-0.0005
HIV Prevalence	0.0219***	0.020***	0.0191**	-0.0028	-0.0028
Years of Schooling (Female 25+)	-0.0764***	-0.0554***	-0.0542***	0.0009	0.0004
_cons	4.97***	5.64***	5.77***	0.00	0.00

N	627	627	627	585	585
r2	0.5870	0.7224	0.7232	.	.
Hansen	.	.	.	0.3335	0.3335
AR(2)	.	.	.	0.1935	0.2312

As per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data), this work looks at the regression results for infant mortality rates by country income level. Private expenditure on health was omitted due to collinearity with out of pocket expenditure.

6.2.2.1 Low-income Countries

The regression results using the various estimation methods for the "low-income countries" model are reported in Table 6.7 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was 80.14% for OLS, 64.55% for RE and 80.84% for the FE methods (Pillai, 2017). These estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for infant mortality rate for the "low-income countries" model ($p = 0.0000$) thus the FE method was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the low-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, there seemed to be little variance in the variable coefficients. The figures generated in the revised models were not provided in this work as it changed the model, making it

difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method.

Per capita government health expenditure was shown to increase infant mortality with a coefficient of 0.0005 (p = 0.190), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.05% increase in infant mortality. Per capita development assistance for health was shown to reduce infant mortality with a coefficient of -0.0016 (p = 0.000), indicating that a US$1 increase in per capita development assistance for health leads to a 0.16% reduction in infant mortality. Per capita out of pocket expenditure on health was associated with reducing in infant mortality with a coefficient of -0.0005 (p = 0.077), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.05% decrease in infant mortality. Per capita private expenditure on health was associated with reducing in infant mortality with a coefficient of -0.0009 (p = 0.028), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.09% decrease in infant mortality.

Per capita development assistance for health and private expenditure on health were statistically significant at the 5% level and they had directional relationships in accordance with the hypothesis. Per capita development assistance for health had a larger effect on reducing infant mortality than per capita private expenditure on health.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0004 (p = 0.006), indicating that a US$1 increase in per capita total health expenditure is associated with a 0.04% decrease in infant mortality. GDP per capita was associated with reductions in infant mortality with a coefficient of -0.0001, (p = 0.014), indicating that a US$1 increase in GDP per capita is associated with a 0.01% decrease in infant mortality.

Proportion of the population with access to an improved water source was shown to reduce infant mortality with a coefficient of -0.0165 (p = 0.000), indicating that a 1%

increase in the proportion of the population with access to an improved water source is associated with a 1.64% decrease in infant mortality in line with existing evidence that shows access to an improved water source is associated with decreased mortality. Prevalence of HIV showed a positive relationship with infant mortality with a coefficient of 0.0211 (p = 0.002), indicating that a 1% increase in HIV prevalence is associated with a 2.13% increase in infant mortality. Mean years of schooling for females above 25 years of age was associated with reducing infant mortality with a coefficient of -0.0666 (p = 0.000), indicating that a 1-year increase in mean years of schooling for females is associated with a 6.44% decrease in infant mortality.

Per capita total health expenditure, GDP per capita, proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females above 25 years of age were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.7

Regression results infant mortality (low-income countries)

Variable	OLS	RE	FE	Difference GMM 1 Step	Difference GMM 2 Step
Per Capita Government Expenditure on Health	-0.0032***	0.0004	0.0005	-0.0001	-0.0001
Per Capita Development Assistance for Health	-0.0020**	-0.0018***	-0.0016***	0.0001	0.0000
Per Capita Out of Pocket Expenditure on Health	-0.0018	-0.0005	-0.0005	0.0000	-0.0000
Per Capita Private Expenditure on Health	-0.0038**	-0.0011*	-0.0009*	0.0000	-0.0000
Per Capita Total Health Expenditure	0.0001	-0.0002*	-0.0004**	0.0000	0.0000

GDP per Capita	0.0001	-0.0001**	-0.0001*	0.0000	0.0000
Access to an Improved Water Source	0.0016	-0.0147***	-0.0165***	-0.0004	-0.0008
HIV Prevalence	0.0168***	0.0242***	0.0211**	-0.0004	0.0011
Years of Schooling (Female 25+)	-0.0425***	-0.0656***	-0.0666***	-0.0016	-0.0013
_cons	4.49***	5.37***	5.50***	0.00	0.24
N	402	402	402	375	375
r2	0.5366	0.8146	0.8158	.	.
Hansen	.	.	.	0.5683	0.5683
AR(2)	.	.	.	0.6933	0.9977

6.2.2.2 Lower Middle-income Countries

The regression results using the various estimation methods for the "lower middle-income countries" model are reported in Table 6.8 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS method was 80.14%, 64.55% for the RE and 80.84% for the FE methods, indicating that the OLS and FE methods seem to fit the data better as they are able to explain more than 80% of the variation in infant mortality (Pillai, 2017). The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for infant mortality rate for the "lower middle-income countries" model (Prob>chi2 of 0.0000) thus the FE estimation method was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the lower middle-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these

removed). While this reduced the number of instruments and improved the Hansen statistic, there seemed to be little variance in the variable coefficients. The figures generated in the revised models were not provided in this work as it changed the model, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation". Although the Hausman test favoured the FE estimation method, the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was used.

Per capita government health expenditure was associated with reducing infant mortality with a coefficient of -0.0029 ($p = 0.000$), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.29% decrease in infant mortality. Per capita development assistance for health expenditure was associated with increases in infant mortality with a coefficient of 0.0002 ($p = 0.778$), indicating that a US$1 increase in per capita development assistance for health expenditure leads to a 0.02% increase in infant mortality. Per capita out of pocket expenditure on health was shown to be associated with an increase in infant mortality with a coefficient of 0.0019 ($p = 0.011$), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.19% increase in infant mortality. Per capita private expenditure on health was shown to be associated with an increase in infant mortality with a coefficient of 0.0029 ($p = 0.000$), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.29% increase in infant mortality.

Per capita government expenditure on health, out of pocket expenditure on health and private expenditure on health were statistically significant at the 5% level. Only per capita government expenditure on health had a directional relationship in accordance with the hypothesis. Per capita government expenditure on health was the only source of health financing that reduced infant mortality.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0001 (p = 0.604), indicating that a US$1 increase in per capita total health expenditure is associated with a 0.01% decrease in infant mortality. GDP per capita was associated with reductions in infant mortality with a coefficient of -0.0000, (p = 0.062), however the scale was small and insignificant.

Proportion of the population with access to an improved water source showed a negative relationship with infant mortality with a coefficient of -0.0176 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source is associated with a 1.74% decrease in infant mortality. HIV prevalence was shown to increase infant mortality with a coefficient of 0.0262 (p = 0.000), indicating that a 1% increase in HIV prevalence is associated with a 2.65% increase in infant mortality. Mean years of schooling for females above 25 years of age was associated with reducing infant mortality with a coefficient of -0.0379 (p = 0.025), indicating that a 1-year increase in mean years of schooling for females is associated with a 3.72% decrease in infant mortality.

Proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females above 25 years of age were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.8

Regression results infant mortality (lower middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0026***	-0.0029***	0.0000	-0.0001	-0.0001
Per Capita Development	-0.0006	0.0002	0.0005	-0.0000	-0.0001

Assistance for Health					
Per Capita Out of Pocket Expenditure on Health	0.0015**	0.0019*	0.0030***	0.0000	-0.0001
Per Capita Private Expenditure on Health	0.0034***	0.0029***	0.0016**	-0.0002	0.0003
Per Capita Total Health Expenditure	-0.0001	-0.0001	-0.0004	0.0001*	0.0001
GDP per Capita	-0.0001**	-0.0000	-0.0001***	-0.0000	-0.0000
Access to an Improved Water Source	-0.0189***	-0.0176***	-0.0190***	-0.0006	-0.0007
HIV Prevalence	0.0252***	0.0262***	-0.0366	-0.0091	0.0047
Years of Schooling (Female 25+)	-0.0425*	-0.0379*	-0.0400***	0.0014	0.0042
_cons	5.73***	5.60***	5.95***	0.00	0.00
N	150	150	150	140	140
r2	0.8014	0.6455	0.8084	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.3233	0.1939

6.2.2.3 Upper Middle-income Countries

The regression results using the various estimation methods for the "upper middle-income countries" model are reported in Table 6.9 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS method was 85.57%; 30.18% for the RE; and 94.17% for the FE methods, indicating that there may be issues with the FE estimation method (Pillai, 2017). The RE and FE estimation methods were compared using the Hausman test. The Hausman test

indicates that the null hypothesis should be rejected for the infant mortality rate "upper middle-income countries" model (Prob>chi2 of 0.0000) thus the FE was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the upper middle-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, there seemed to be little variance in the variable coefficients. The figures generated in the revised models were not provided in this work as it changed the model, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation". Although the Hausman test favoured the FE estimation method, the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was used.

Per capita government health expenditure was shown to reduce infant mortality with a coefficient of -0.0005 (p = 0.291), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.05% reduction in infant mortality. Per capita development assistance for health was shown to reduce infant mortality with a coefficient of -0.0003 (p = 0.689), indicating that a US$1 increase in per capita development assistance for health leads to a 0.03% decrease in infant mortality. Per capita out of pocket expenditure on health was shown to reduce infant mortality with a coefficient of -0.0011 (p = 0.077), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.11% reduction in infant mortality. Per capita private expenditure on health was shown to increase infant mortality with a

coefficient of 0.0000 (p = 0.984), however the scale was small and insignificant. None of the sources of health expenditure were statistically significant at a 5% level.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0002 (p = 0.709), however the scale was small and insignificant. GDP per capita was associated with increases in infant mortality with a coefficient of 0.0000, (p = 0.411), however the scale was small and insignificant.

Proportion of the population with access to an improved water source was shown to reduce infant mortality with a coefficient of -0.0322 (p = 0.000) indicating that a 1% increase in the proportion of the population with access to an improved water source leads to a 3.17% reduction in infant mortality. HIV prevalence was shown to increase infant mortality with a coefficient of 0.0236 (p = 0.000), indicating that a 1% increase in HIV prevalence leads to a 2.39% increase in infant mortality. Mean years of schooling for females above 25 years of age was associated with increasing infant mortality with a coefficient of 0.0145 (p = 0.763), indicating that a 1-year increase in mean years of schooling for females leads to a 1.46% increase in infant mortality. Population with access to an improved water source and HIV prevalence were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.9

Regression results infant mortality (upper middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	0.0001	-0.0005	-0.0010***	-0.0002	-0.0013***
Per Capita Development Assistance for Health	0.0000	-0.0003	-0.0009***	-0.0002	0.0000
Per Capita Out of	-0.0011	-0.0011	-0.0009***	-0.0001	0.0437***

Pocket Expenditure on Health					
Per Capita Private Expenditure on Health	0.0015*	0.0000	-0.0015***	-0.0004**	-0.0108***
Per Capita Total Health Expenditure	-0.0009	-0.0002	0.0009***	0.0002	-0.0025***
GDP per Capita	0.0000	0.0000	-0.0000	-0.0000	-0.0000
Access to an Improved Water Source	-0.0495***	-0.0322***	-0.0237***	-0.0028	0.0000
HIV Prevalence	0.0030	0.0236**	0.0272***	-0.0035	0.0000
Years of Schooling (Female 25+)	0.1780*	0.0145	-0.0248***	-0.0023	0.0000
_cons	7.45***	6.54***	5.89***	1.16***	0.00
N	75	75	75	70	70
r2	0.8557	0.3018	0.9417	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.5569	0.1883

6.2.2.4 Summary of regression results for infant mortality

One of the four models (all countries) used the system GMM two step estimation method; one model (low-income countries) used the fixed effects estimation method; and two models (lower middle- and upper middle-income countries) used the RE estimation method. The decision about which estimation method to use was informed by the Hansen test, Hausman test and the ability of the model to make the best use of the available data when there are small sample sizes.

In the all countries and lower middle-income countries models, per capita government health expenditure was associated with reductions in infant mortality and the direction of the relationship was in accordance with the hypothesis.

Per capita development assistance for health was shown to reduce infant mortality for the low-income countries and the direction of the relationship was in accordance with the hypothesis.

Per capita out of pocket expenditure on health was associated with increases in infant mortality in the lower middle-income countries model, noting the direction of the relationship diverged from the hypothesis.

Per capita private expenditure on health had statistically significant relationships with infant mortality in the all countries, low-income and lower middle-income countries models. There is a noted change in directional relationship between the country income classification groupings

In the all countries model, per capita government expenditure on health had a similar effect on infant mortality as per capita private expenditure on health. In the low-income countries model, per capita development assistance for health had the largest effect on reducing infant mortality compared with per capita private expenditure on health. In the lower-middle income countries model, per capita government expenditure on health reduced infant mortality whereas per capita out of pocket expenditure on health and private expenditure on health were associated with increases in infant mortality.

After separating the countries by income category, it seems that the relationship between source of funding and infant mortality may be different for countries with different income levels, as per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005).

In three of the four models (low-income countries, lower middle-income countries and upper middle-income countries), proportion of the population with access to an improved water source was associated with decreases in infant mortality.

In three of the four models (low-income countries, lower middle-income countries and upper middle-income countries), HIV prevalence was associated with increases in infant mortality.

In two of the four models (low-income countries and lower middle-income countries), mean years of schooling for females above 25 years was associated with decreases infant mortality.

Refer to Table 6.10 for a detailed summary of the regression results by country income classification.

Table 6.10

Regression results infant mortality

Country Grouping	All Countries	Low-income Countries	Lower Middle-income Countries	Upper Middle-income Countries
Estimation Methodology	System GMM 2 Step	FE	RE	RE
Per Capita Government Expenditure on Health	-0.0001***	0.0005	-0.0029***	-0.0005
Per Capita Development Assistance for Health	-0.0000	-0.0016***	0.0002	-0.0003
Per Capita Out of Pocket Expenditure on Health	0.0000	-0.0005	0.0019*	-0.0011
Per Capita Private Expenditure on Health	-0.0001*	-0.0009*	0.0029***	0.0000
Per Capita Total Health Expenditure	0.0001***	-0.0004**	-0.0001	-0.0002
GDP per Capita	0.0000	-0.0001*	-0.0000	0.0000
Access to an Improved Water Source	-0.0005	-0.0165***	-0.0176***	-0.0322***
HIV Prevalence	-0.0028	0.0211**	0.0262***	0.0236**
Years of Schooling (Female 25+)	0.0004	-0.0666***	-0.0379*	0.0145

_cons	0.00	5.50***	5.60***	6.54***
N	585	402	150	75
r2	.	0.8158	0.6455	0.3018
Hansen	0.3335	.	.	.
AR(2)	0.2312	.	.	.

6.2.3 Neonatal Mortality Rate

The regression results using the various estimation methods for the "all countries" model are reported in Table 6.11 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was lowest for the OLS method at 49.54% increasing to 67.07% for the RE and 67.12% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 67% of the variation in neonatal mortality (Pillai, 2017). These estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the neonatal mortality rate "all countries" model (Prob>chi2 of 0.0009) thus the FE estimation method was preferred.

As per the literature (Bond 2001), the pooled OLS point estimate was considered the upper bound estimate while the FE point estimate was considered the lower bound estimate. In this model, both the difference and system GMM provided the same results. However, as the difference GMM coefficients are close to the FE, the system GMM is used. The system GMM is listed in the table and both one step and two step estimations are shown. As the two step is considered more efficient, this is the estimation method used.

Per capita government health expenditure was associated with decreases in neonatal mortality with a coefficient of -0.0000 ($p = 0.260$), however the scale was small and insignificant. Per capita development assistance for health was shown to increase neonatal mortality with a coefficient of 0.0000 ($p = 0.895$), however the scale was

small and insignificant. Per capita out of pocket expenditure on health was shown to increase neonatal mortality with a coefficient of 0.0001 (p = 0.181) indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.01% increase in neonatal mortality. Per capita private expenditure on health was associated with decreases in neonatal mortality with a coefficient of -0.0001 (p = 0.142), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.01% decrease in neonatal mortality. None of the sources of health expenditure had statistical significance.

Per capita total health expenditure was associated with increases in neonatal mortality with a coefficient of 0.0000 (p = 0.162), however the scale was small and insignificant. GDP per capita was associated with reductions in neonatal mortality with a coefficient of -0.0000, (p = 0.625), however the scale was small and insignificant.

Proportion of the population with access to an improved water source was shown to reduce neonatal mortality with a coefficient of 0.000 (p = 0.946). HIV prevalence was shown to increase neonatal mortality with a coefficient of 0.0004 (p = 0.804). Mean years of schooling for females above 25 years of age was associated with reducing neonatal mortality with a coefficient of 0.0005 (p = 0.684). None of these variables were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.11

Regression results neonatal mortality (all countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0009***	-0.0001	-0.0000	-0.0000	-0.0000
Per Capita Development Assistance for Health	-0.0010	-0.0005***	-0.0004	-0.0000	0.0000

Per Capita Out of Pocket Expenditure on Health	-0.0018***	-0.0001	-0.0001	0.0001*	0.0001
Per Capita Private Expenditure on Health	-0.0014***	-0.0001	0.0000	-0.0001	-0.0001
Per Capita Total Health Expenditure	0.0003***	0.0001	0.0001	0.0000	0.0000
GDP per Capita	0.0000**	-0.0000**	-0.0000	-0.0000	-0.0000
Access to an Improved Water Source	-0.0028***	-0.0143***	-0.0149***	0.0002	0.0000
HIV Prevalence	0.0112***	0.0069	0.0056	0.0007	0.0004
Years of Schooling (Female 25+)	-0.0552***	-0.0429***	-0.0430***	0.0011	0.0005
_cons	3.92***	4.52***	4.57***	0.08	0.00
N	627	627	627	585	585
r2	0.4954	0.6707	0.6712	.	.
Hansen	.	.	.	0.5635	0.5635
AR(2)	.	.	.	0.0580	0.0738

As per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data), this work looks at the regression results for neonatal mortality rates by country income level. Private expenditure on health was omitted due to collinearity with out of pocket expenditure.

6.2.3.1 Low-income Countries

The regression results using the various estimation methods for the "low-income countries" model are reported in Table 6.12 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the

data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was lowest for the OLS method at 49.30% increasing to 78.05% for the RE and 78.11% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 78% of the variation in neonatal mortality (Pillai, 2017). These estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for neonatal mortality rate for the "low-income countries" model (p = 0.0059) thus the FE method was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the low-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, there seemed to be little variance in the variable coefficients. The figures generated in the revised models were not provided in this work as it changed the model, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method.

Per capita government health expenditure was associated with increases in neonatal mortality with a coefficient of 0.0001 (p = 0.601), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.01% increase in neonatal mortality. Per capita development assistance for health was shown to reduce neonatal mortality with a coefficient of -0.0014 (p = 0.000), indicating that a US$1 increase in per capita development assistance for health expenditure leads to a 0.14% decrease in neonatal mortality. Per capita out of pocket expenditure on health was associated with increases in neonatal mortality with a coefficient of 0.0000 (p = 0.934), however the scale was small and insignificant. Per capita private expenditure on health was associated with decreases in neonatal mortality with a coefficient of -0.0001 (p =

0.730), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.01% decrease in neonatal mortality.

Only per capita development assistance for health was statistically significant. Per capita development assistance for health had a directional relationship in accordance with the hypothesis.

Per capita total health expenditure was associated with increases in neonatal mortality with a coefficient of 0.0001 (p = 0.529), indicating that a US$1 increase in per capita total health expenditure leads to a 0.01% increase in neonatal mortality. GDP per capita was associated with reductions in neonatal mortality with a coefficient of -0.0001, (p = 0.000), indicating that a US$1 increase in GDP per capita leads to a 0.01% decrease in neonatal mortality.

Proportion of the population with access to an improved water source was shown to reduce neonatal mortality with a coefficient of -0.0104 (p = 0.000). HIV prevalence was shown to increase neonatal mortality with a coefficient of 0.0099 (p = 0.041). Mean years of schooling for females above 25 years of age was associated with reducing neonatal mortality with a coefficient of -0.0532 (p = 0.000).

GDP per capita, proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling were statistically significant at the 5% level. The direction of the relationships of these variables were in accordance with existing evidence.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.12

Regression results neonatal mortality (low-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government	-0.0005	0.0002	0.0001	-0.0001	-0.0001

Expenditure on Health					
Per Capita Development Assistance for Health	-0.0016***	-0.0014***	-0.0014***	0.0001	0.0001
Per Capita Out of Pocket Expenditure on Health	-0.0001	0.0001	0.0000	0.0000	0.0000
Per Capita Private Expenditure on Health	-0.0036*	-0.0002	-0.0001	-0.0000	0.0000
Per Capita Total Health Expenditure	0.0001*	0.0001	0.0001	0.0000	0.0000
GDP per Capita	0.0001***	-0.0001***	-0.0001	-0.0000	-0.0000
Access to an Improved Water Source	0.0013	-0.0095***	-0.0104***	0.0001	-0.0001
HIV Prevalence	0.0040	0.0095*	0.0099*	0.0012	0.0013
Years of Schooling (Female 25+)	-0.0487***	-0.0550***	-0.0532***	0.0005	-0.0025
_cons	3.69***	4.28***	4.33***	0.00	0.00
N	402	402	402	375	375
r2	0.4930	0.7805	0.7811	.	.
Hansen	.	.	.	0.6355	0.6355
AR(2)	.	.	.	0.0152	0.7981

6.2.3.2 Lower Middle-income Countries

The regression results using the various estimation methods for the "lower middle-income countries" model are reported in Table 6.13 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared

for the OLS method was 80.14%, 64.55% for the RE and 80.84% for the FE methods, indicating that the OLS and FE methods fit the data better since they are able to explain more than 67% of the variation in neonatal mortality (Pillai, 2017). The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the neonatal mortality rate "lower middle-income countries" model (Prob>chi2 of 0.0000) thus the FE estimation method was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the lower middle-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, there seemed to be little variance in the variable coefficients. The figures generated in the revised models were not provided in this work as it changed the model, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation". Although the Hausman test favoured the FE estimation method, the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was used.

Per capita government health expenditure was shown to reduce neonatal mortality with a coefficient of -0.0034 (p = 0.000), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.34% decrease in neonatal mortality. Per capita development assistance for health was associated with increases in neonatal mortality with a coefficient of 0.0003 (p = 0.741), indicating that a US$1 increase in per capita development assistance for health leads to a 0.03% increase in neonatal

mortality. Per capita out of pocket expenditure on health was associated with an increase neonatal mortality with a coefficient of 0.0000 (p = 0.949), however the scale was small and insignificant. Private expenditure on health was associated with a decrease neonatal mortality with a coefficient of 0.0000 (p = 0.931), however the scale was small and insignificant.

The directional relationship of per capita government expenditure on health was in accordance with the hypothesis and was statistically significant at the 5% level.

Per capita total health expenditure was associated with increases in neonatal mortality with a coefficient of 0.0009 (p = 0.001), indicating that a US$1 increase in per capita total health expenditure leads to a 0.09% increase in neonatal mortality. GDP per capita was associated with reductions in neonatal mortality with a coefficient of -0.0000 (p = 0.561), however the scale was small and insignificant.

Proportion of the population with access to an improved water source was shown to reduce neonatal mortality with a coefficient of -0.0073 (p = 0.002). HIV prevalence was shown to increase neonatal mortality with a coefficient of 0.0244 (p = 0.000). Mean years of schooling for females above 25 years of age was associated with reducing neonatal mortality with a coefficient of -0.0642 (p = 0.000).

Per capita total health expenditure, proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.13

Regression results neonatal mortality (lower middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government	-0.0032***	-0.0034***	-0.0000	-0.0000	-0.0002**

Expenditure on Health					
Per Capita Development Assistance for Health	-0.0006	0.0003	0.0005*	-0.0000	0.0002
Per Capita Out of Pocket Expenditure on Health	-0.0003	0.0000	0.0021***	0.0001	0.0029***
Per Capita Private Expenditure on Health	0.0005	0.0000	0.0009*	-0.0000	0.0011***
Per Capita Total Health Expenditure	0.0010***	0.0009**	-0.0003	0.0001	-0.0001*
GDP per Capita	-0.0001*	-0.0000	-0.0001***	0.0000	0.0000
Access to an Improved Water Source	-0.0082**	-0.0073**	-0.0127***	0.0008	-0.0203***
HIV Prevalence	0.0244***	0.0244***	-0.0120	0.0010	-0.0008
Years of Schooling (Female 25+)	-0.0740***	-0.0642***	-0.0308***	-0.0007	-0.0964***
_cons	4.31***	4.20***	4.51***	0.07	0.00
N	150	150	150	140	140
r2	0.7043	0.4987	0.7566	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.1694	0.8051

6.2.3.3 Upper Middle-income Countries

The regression results using the various estimation methods for the "upper middle-income countries" model are reported in Table 6.14 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared

for the OLS method was 87.45%, 38.63% for the RE; and 89.94% for the FE methods. The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the neonatal mortality "upper middle-income countries" model (Prob>chi2 of 0.0000) thus the FE estimation method was preferred, noting that STATA indicated an error which was related with there being more variables than groups in the model.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the upper middle-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, the model was substantially changed, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation" hence the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was preferred. The RE robust estimation method had a missing F-test value due to there being more variables than groups (in this case countries) in the model.

Per capita government health expenditure was associated with a decrease in neonatal mortality with a coefficient of -0.0012 (p = 0.001), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.12% decrease in neonatal mortality. Per capita development assistance for health was associated with a decrease in neonatal mortality with a coefficient of -0.0006 (p = 0.371), indicating that a US$1 increase in per capita development assistance for health leads to a 0.06% decrease in neonatal mortality. Per capita out of pocket expenditure on health was associated with a decrease in neonatal mortality with a coefficient of -0.0021 (p = 0.000), indicating

that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.21% reduction in neonatal mortality. Per capita private expenditure on health was associated with a decrease in neonatal mortality with a coefficient of -0.0001 (p = 0.747), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.01% reduction in neonatal mortality.

Per capita government expenditure on health and out of pocket expenditure on health was statistically significant at the 5% level, and both variables had directional relationships in accordance with the hypothesis.

Per capita total health expenditure was associated with increases in neonatal mortality with a coefficient of 0.0007 (p = 0.050), indicating that a US$1 increase in per capita total health expenditure leads to a 0.07% increase in neonatal mortality. GDP per capita was associated with increases in neonatal mortality with a coefficient of 0.0000, (p = 0.372), however the scale was small and insignificant.

Proportion of the population with access to an improved water source was shown to reduce neonatal mortality with a coefficient of -0.0253 (p = 0.000). HIV prevalence was shown to increase neonatal mortality with a coefficient of 0.0155 (p = 0.025). Mean years of schooling for females above 25 years of age was associated with increases in neonatal mortality with a coefficient of 0.0333 (p = 0.297). Proportion of the population with access to an improved water source and HIV prevalence had statistical significance at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.14

Regression results neonatal mortality (upper middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0008*	-0.0012***	-0.0004*	0.0001	-0.0038***

Per Capita Development Assistance for Health	-0.0005	-0.0006	-0.0002	-0.0000	0.0000
Per Capita Out of Pocket Expenditure on Health	-0.0021***	-0.0021***	-0.0006***	0.0000	0.0000
Per Capita Private Expenditure on Health	0.0010	-0.0001	-0.0006***	-0.0002***	-0.0016***
Per Capita Total Health Expenditure	0.0001	0.0001	0.0003*	-0.0001	0.0013***
GDP per Capita	0.0000	0.0000	-0.0000	-0.0000**	0.0001***
Access to an Improved Water Source	-0.0394***	-0.0253***	-0.0173***	-0.0066**	0.0414***
HIV Prevalence	-0.0007	0.0155*	-0.0339***	-0.0143***	0.0000
Years of Schooling (Female 25+)	0.1629*	0.0333	-0.0188**	0.0049*	0.0000
_cons	6.08***	5.31***	5.11***	1.45***	0.00
N	75	75	75	70	70
r2	0.8745	0.3863	0.8994	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.1761	0.0000

6.2.3.4 Summary of regression results for neonatal mortality

One of the four models (all countries) used system GMM two step estimation method; one (low-income countries) used the fixed effects estimation method; and two models (lower middle- and upper middle-income countries) used the RE estimation method. The decision about which estimation method to use was informed by the Hansen test, Hausman test and the ability of the model to make the best use of the available data when there are small sample sizes.

Per capita government expenditure on health was associated statistically significant reductions in neonatal mortality in the lower middle- and upper middle-income countries models. The directional relationship of per capita government expenditure on health with neonatal mortality was in accordance with the hypothesis.

Per capita development assistance for health was shown to reduce neonatal mortality for the low-income countries model and the directional relationship was in accordance with the hypothesis.

Per capita out of pocket expenditure on health was associated with reducing neonatal mortality in the upper middle-income countries model and the directional relationship was in accordance with the hypothesis.

The relationship between per capita private expenditure on health and neonatal mortality was not statistically significant in any of the models.

After separating the countries by income category, it seems that the relationship between source of funding and neonatal mortality may be different for countries with different income levels, as per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005).

In three of the four models (low-, lower middle- and upper middle-income countries), proportion of the population with access to an improved water source was associated with reductions in neonatal mortality.

In three of the four models (low-, lower middle- and upper middle-income countries), HIV prevalence was associated with increases in neonatal mortality.

In two of the four models (low- and lower middle-income countries), mean years of schooling for females above 25 years was associated with decreases neonatal mortality.

Refer to Table 6.15 for a summary of the regressions results by country income classification.

Figure 6.15

Regression results for neonatal mortality

Country Grouping	All Countries	Low-income Countries	Lower Middle-income Countries	Upper Middle-income Countries
Estimation Method	System GMM 2 Step	FE	RE	RE
Per Capita Government Expenditure on Health	-0.0000	0.0001	-0.0034***	-0.0012***
Per Capita Development Assistance for Health	0.0000	-0.0014***	0.0003	-0.0006
Per Capita Out of Pocket Expenditure on Health	0.0001	0.0000	0.0000	-0.0021***
Per Capita Private Expenditure on Health	-0.0001	-0.0001	0.0000	-0.0001
Per Capita Total Health Expenditure	0.0000	0.0001	0.0009**	0.0001
GDP per Capita	-0.0000	-0.0001	-0.0000	0.0000
Access to an Improved Water Source	0.0000	-0.0104***	-0.0073**	-0.0253***
HIV Prevalence	0.0004	0.0099*	0.0244***	0.0155*
Years of Schooling (Female 25+)	0.0005	-0.0532***	-0.0642***	0.0333
_cons	0.00	4.33***	4.20***	5.31***
N	585	402	150	75
r2	.	0.7811	0.4987	0.3863
Hansen	0.5635	.	.	.
AR(2)	0.0738	.	.	.

6.2.4 Maternal Mortality Rate

The regression results using the various estimation methods for the "all countries" model are reported in Table 6.16 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was lowest for the OLS method at 55.03% increasing to 60.17% for the RE and 60.39% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 60% of the variation in maternal mortality (Pillai, 2017). These estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the maternal mortality rate "all countries" model ($p = 0.0001$) thus the FE estimation method was preferred.

In both difference and system GMM, the Hansen statistic and Arellano-Bond statistic indicate that GMM is not an appropriate method for this model. Thus, the FE estimation method is used.

Per capita government health expenditure was associated with decreases in maternal mortality with a coefficient of -0.0006 ($p = 0.000$), indicating that a US$1 increase in per capita government health expenditure leads to a 0.06% decrease in maternal mortality. Per capita development assistance for health was associated with decreases in maternal mortality with a coefficient of -0.0007 ($p = 0.001$), indicating that a US$1 increase in per capita development assistance for health leads to a 0.07% decrease in maternal mortality. Per capita out of pocket expenditure on health was shown to increase maternal mortality with a coefficient of 0.0006 ($p = 0.002$), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.06% increase in maternal mortality. Per capita private expenditure on health was associated with a decrease in maternal mortality with a coefficient of -0.0000 ($p = 0.917$), however the scale was small and insignificant.

Per capita government expenditure on health, development assistance for health and out of pocket expenditure on health showed statistical significance at the 5% level. Per capita government expenditure on health and development assistance for health had a directional relationship with maternal mortality in accordance with the hypothesis while per capita out of pocket expenditure on health had a directional relationship with maternal mortality that diverged from the hypothesis. Per capita development assistance for health had a slightly larger effect on reducing maternal mortality than per capita government expenditure on health.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0000 (p = 0.000). GDP per capita was associated with decreases in infant mortality with a coefficient of -0.0000, (p = 0.0000).

Proportion of the population with access to an improved water source was associated with decreases in maternal mortality with a coefficient of -0.0156 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source leads to a 1.55% decrease in maternal mortality. HIV prevalence was shown to increase maternal mortality with a coefficient of 0.0343 (p = 0.000), indicating that a 1% increase in HIV prevalence leads to a 3.49% increase in maternal mortality. Mean years of schooling for females above 25 years of age was associated with decreases in infant mortality with a coefficient of -0.0238 (p = 0.002), indicating that a 1-year increase in mean years of schooling for females leads to a 2.35% decrease in maternal mortality.

Per capita total health expenditure, GDP per capita, proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.16

Regression results maternal mortality (all countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0017***	0.0006***	0.0006***	-0.0001	-0.0000
Per Capita Development Assistance for Health	-0.0018*	-0.0007***	-0.0007***	-0.0001*	-0.0001
Per Capita Out of Pocket Expenditure on Health	-0.0033***	0.0005**	0.0006**	0.0001	0.0001
Per Capita Private Expenditure on Health	-0.0021***	-0.0003	-0.0000	-0.0003***	-0.0003**
Per Capita Total Health Expenditure	0.0002	-0.0007***	-0.0007***	0.0000	0.0000
GDP per Capita	0.0001*	-0.0000	-0.0000***	0.0000	0.0000
Access to an Improved Water Source	-0.0129***	-0.0163***	-0.0156***	0.0002	0.0004
HIV Prevalence	0.0273***	0.0262***	0.0343***	0.0057	0.0033
Years of Schooling (Female 25+)	-0.0671***	-0.0244**	-0.0238**	0.0056***	0.0041*
_cons	7.46***	7.37***	7.27***	0.00	0.38
N	627	627	627	585	585
r2	0.5503	0.6017	0.6039	.	.
Hansen	.	.	.	0.0160	0.0160
AR(2)	.	.	.	0.0304	0.0386

6.2.4.1 Low-income Countries

The regression results using the various estimation methods for the "low-income countries" model are reported in Table 6.17 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared was lowest for the OLS method at 37.33% increasing to 75.56% for the RE and 75.58% for the FE methods, indicating that the latter two methods fit the data better since they can explain more than 75% of the variation in maternal mortality (Pillai, 2017). These estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be accepted for the maternal mortality rate "low-income countries" model ($p = 0.2452$) thus the RE estimation method was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the low-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, the model was substantially changed, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, RE was the preferred estimation method.

Per capita government health expenditure was associated with increases in maternal mortality with a coefficient of 0.0008 ($p = 0.032$), indicating that a US$1 increase in per capita government health expenditure leads to a 0.08% increase in maternal mortality. Per capita development assistance for health was shown to reduce maternal mortality with a coefficient of -0.0013 ($p = 0.000$), indicating that a US$1 increase in

per capita development assistance for health leads to a 0.13% decrease in maternal mortality. Per capita out of pocket expenditure on health was shown to decrease maternal mortality with a coefficient of -0.0008 (p = 0.010), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.08% decrease in maternal mortality. Per capita private expenditure on health was shown to decrease maternal mortality with a coefficient of -0.0008 (p = 0.070), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.08% decrease in maternal mortality.

Per capita government expenditure on health, development assistance for health and out of pocket expenditure on health were statistically significant and had directional relationships with maternal mortality in accordance with the hypothesis. Per capita development assistance for health had a larger effect on reducing maternal mortality per capita out of pocket expenditure on health.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0006 (p = 0.000). GDP per capita was associated with decreases in infant mortality with a coefficient of -0.0002 (p = 0.000).

Proportion of the population with access to an improved water source was shown to reduce maternal mortality with a coefficient of -0.0105 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source leads to a 1.04% decrease in maternal mortality. HIV prevalence was shown to increase maternal mortality with a coefficient of 0.0109 (p = 0.083), indicating that a 1% increase in HIV prevalence leads to a 1.10% increase in maternal mortality. Mean years of schooling for females was associated with decreases in maternal mortality with a coefficient of -0.0242 (p = 0.008), indicating that a 1-year increase in mean years of schooling for females leads to a 2.39% decrease in maternal mortality. Proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females were statistically significant at the 5% level. The direction of the relationships of these variables were in accordance with existing evidence.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.17

Regression results maternal mortality (low-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0039***	0.0008*	0.0008*	0.0000	0.0001
Per Capita Development Assistance for Health	-0.0010	-0.0013***	-0.0012***	0.0002	0.0003
Per Capita Out of Pocket Expenditure on Health	-0.0011	-0.0008**	-0.0008**	0.0001	0.0002
Per Capita Private Expenditure on Health	-0.0042**	-0.0008	-0.0007	0.0001	0.0002
Per Capita Total Health Expenditure	-0.0000	-0.0006***	-0.0007***	0.0001	-0.0000
GDP per Capita	-0.0001	-0.0002***	-0.0002***	0.0000	0.0000
Access to an Improved Water Source	0.0011	-0.0105***	-0.0111***	0.0008	0.0012
HIV Prevalence	0.0030	0.0109	0.0100	0.0026	-0.0018
Years of Schooling (Female 25+)	-0.0235	-0.0242**	-0.0241*	0.0043	-0.0077
_cons	6.80***	7.35***	7.39***	-0.48	0.00
N	402	402	402	375	375
r2	0.3733	0.7556	0.7558	.	.
Hansen	.	.	.	0.8961	0.8961
AR(2)	.	.	.	0.0784	0.6682

6.2.4.2 Lower Middle-income Countries

The regression results using the various estimation methods for the "lower middle-income countries" model are reported in Table 6.18 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS method was 77.02%; and 51.75% for the RE and 82.20% for the FE methods. The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the maternal mortality rate "lower middle-income countries" model (Prob>chi2 of 0.0000) thus the FE estimation method was preferred, noting that STATA indicated an error which was related with there being more variables than groups in the model.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the lower middle-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, the model was substantially changed, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation" hence the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was preferred.

Per capita government health expenditure was shown to decrease maternal mortality with a coefficient of -0.0039 (p = 0.000), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.39% decrease in maternal mortality. Per capita development assistance for health expenditure was associated with increases maternal mortality with a coefficient of 0.0014 (p = 0.410), indicating that a US$1 increase in per capita development assistance for health leads to a 0.14% increase in maternal mortality. Per capita out of pocket expenditure on health was associated with increases in maternal mortality with a coefficient of 0.0021 (p = 0.158), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.21% increase in maternal mortality. Per capita private expenditure on health was associated with increases in maternal mortality with a coefficient of 0.0079 (p = 0.000) indicating that a US$1 increase in per capita private expenditure on health leads to a 0.79% increase in maternal mortality.

Per capita government expenditure on health and private expenditure on health had statistically significant relationships with maternal mortality. Per capita government expenditure on health had a directional relationship in accordance with the hypothesis while per capita private expenditure on health had a directional relationship that diverged from the hypothesis.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0018 (p = 0.002), indicating that a US$1 increase in per capita total health expenditure leads to a 0.18% decrease in maternal mortality. GDP per capita was associated with decreases in infant mortality with a coefficient of -0.0000 (p = 0.405), however the scale is small and insignificant.

Proportion of the population with access to an improved water source was associated with decreases in maternal mortality with a coefficient of -0.0431 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source leads to a 4.22% decrease in maternal mortality. HIV prevalence was associated with increases in maternal mortality with a coefficient of 0.0288 (p = 0.001), indicating that a 1% increase in HIV prevalence leads to a 2.92% increase in maternal mortality. Mean years of schooling for females was associated with increases to maternal mortality with a coefficient of 0.0951 (p = 0.005), indicating

that a 1-year increase in mean years of schooling for females leads to a 9.98% increase in maternal mortality.

Per capita total health expenditure, GDP per capita, proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females were statistically significant at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.18

Regression results maternal mortality (lower middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	-0.0026**	-0.0039***	-0.0000	-0.0002**	-0.0019***
Per Capita Development Assistance for Health	-0.0017	0.0014	-0.0001	-0.0003***	-0.0004
Per Capita Out of Pocket Expenditure on Health	0.0006	0.0021	0.0014**	0.0003	0.0100***
Per Capita Private Expenditure on Health	0.0098***	0.0079***	0.0018***	-0.0001	0.0023
Per Capita Total Health Expenditure	-0.0018***	-0.0018**	-0.0006**	0.0000	-0.0005
GDP per Capita	-0.0003***	-0.0000	-0.0001***	0.0000	0.0001***
Access to an Improved Water Source	-0.0483***	-0.0431***	-0.0088***	0.0013	-0.0271***
HIV Prevalence	0.0247**	0.0288***	-0.0506**	0.0018	0.0492

Years of Schooling (Female 25+)	0.0851*	0.0951**	-0.0372***	-0.0033	-0.1510***
_cons	9.68***	9.26***	7.39***	0.00	0.00
N	150	150	150	140	140
r2	0.7702	0.5175	0.8220	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.1782	0.5743

6.2.4.3 Upper Middle-income Countries

The regression results using the various estimation methods for the "upper middle-income countries" model are reported in Table 6.19 below. OLS, RE and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS method was 71.34%, 18.56% for the RE; and 83.29% for the FE methods. The RE and FE estimation methods were compared using the Hausman test. The Hausman test indicates that the null hypothesis should be rejected for the maternal mortality rate "upper middle-income countries" model (Prob>chi2 of 0.0000) thus the FE estimation method was preferred, noting that STATA indicated an error which was related with there being more variables than groups in the model.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. The model for the upper middle-income countries was run with fewer variables (removing private expenditure on health per capita, total per capita expenditure on health, and GDP per capita, or just one or two of these removed). While this reduced the number of instruments and improved the Hansen statistic, the model was substantially changed, making it difficult to visualize the coefficients and significance levels across the estimation methods.

Based on the limitations with GMM, along with the findings from the Hausman test, FE was the preferred estimation method. However, with the low number of observations, the FE estimators are less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation" hence the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was preferred.

Per capita government health expenditure was associated with increases in maternal mortality with a coefficient of 0.0004 (p = 0.670), indicating that a US$1 increase in per capita government expenditure on health leads to a 0.04% increase in maternal mortality. Per capita development assistance for health was associated with increases in maternal mortality with a coefficient of 0.0012 (p = 0.468), indicating that a US$1 increase in per capita development assistance for health leads to a 0.12% increase in maternal mortality. Per capita out of pocket expenditure on health was associated with decreases in maternal mortality with a coefficient of -0.0006 (p = 0.634), indicating that a US$1 increase in per capita out of pocket expenditure on health leads to a 0.06% decrease in maternal mortality. Per capita private expenditure on health was associated with decreases in maternal mortality with a coefficient of -0.0018 (p = 0.090), indicating that a US$1 increase in per capita private expenditure on health leads to a 0.18% decrease in maternal mortality. None of the sources of health expenditure had statistical significance.

Per capita total health expenditure was associated with decreases in infant mortality with a coefficient of -0.0020 (p = 0.030), indicating that a US$1 increase in per capita total health expenditure leads to a 0.20% decrease in maternal mortality. GDP per capita was associated with increases in infant mortality with a coefficient of 0.0000 (p = 0.272), however the scale is small and insignificant.

Proportion of the population with access to an improved water source was associated with decreases in maternal mortality with a coefficient of -0.0562 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source leads to a 5.46% decrease in maternal mortality. HIV prevalence was associated with increases in maternal mortality with a coefficient of

0.0378 (p = 0.031), indicating that a 1% increase in HIV prevalence leads to a 3.85% increase in maternal mortality. Mean years of schooling for females was associated with increases in maternal mortality with a coefficient of 0.1952 (p = 0.015), indicating that a 1-year increase in mean years of schooling for females leads to a 21.56% increase in maternal mortality.

Per capita total health expenditure, proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females had statistical significance at the 5% level.

The regression results for all estimation methods are included in the table below to enable further insight into the point estimate.

Table 6.19

Regression results maternal mortality (upper middle-income countries)

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Health	0.0008	0.0004	0.0026***	-0.0006	0.0015***
Per Capita Development Assistance for Health	0.0002	0.0012	0.0023***	-0.0006**	0.0028***
Per Capita Out of Pocket Expenditure on Health	-0.0009	-0.0006	0.0040***	-0.0005	0.0000
Per Capita Private Expenditure on Health	-0.0009	-0.0018	-0.0004	-0.0006***	-0.0009***
Per Capita Total Health Expenditure	-0.0028*	-0.0020*	-0.0029***	0.0006	-0.0016***
GDP per Capita	0.0000	0.0000	-0.0000	-0.0000	-0.0000
Access to an Improved	-0.0774***	-0.0562***	0.0115	-0.0173	0.0000

Water Source					
HIV Prevalence	0.0234	0.0378*	0.0137	0.0556***	0.0000
Years of Schooling (Female 25+)	0.3598	0.1952*	0.0062	-0.0016	0.0000
_cons	11.01***	9.76***	4.12***	0.00	0.00
N	75	75	75	70	70
r2	0.7134	0.1856	0.8329	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.1723	0.0797

6.2.4.4 Summary of regression results for maternal mortality

One of the four models (all countries) used the FE estimation method. Three of the four models (low-income, lower middle- and upper middle-income countries) used RE estimation methods to determine the point estimates. The decision about which estimation method to use was informed by the Hausman test as well as the sample size of the model as small sample sizes require a more efficient estimator.

Per capita government health expenditure was associated with increases in maternal mortality for the all countries and low-income countries models while per capita government health expenditure was associated with decreases in maternal mortality for the lower middle-income countries model.

Per capita development assistance for health was associated with decreases in maternal mortality in the all countries and low-income countries models, and the directional relationships were in accordance with the hypothesis

Per capita out of pocket expenditure on health was associated with an increase in maternal mortality for the all countries model and decreases in maternal mortality in the low-income countries model.

Per capita private expenditure on health was associated with an increase in maternal mortality in the lower middle-income countries model. The directional relationship diverged from the hypothesis.

After separating the countries by income category, it seems that the relationship between source of funding and maternal mortality may be different for countries with different income levels, as per the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

In all four models, proportion of the population with access to an improved water source was associated with decreases in maternal mortality, in accordance with existing evidence.

In all four models, HIV prevalence was associated with an increase in maternal mortality, in accordance with existing evidence.

In two of the four models (all countries and low-income countries), mean years of schooling for females 25 years and above was associated with decreases in maternal mortality whereas in the other two models (lower middle- and upper middle-income countries), mean years of schooling for females was associated with increases in maternal mortality.

A summary of results, by country income classification, is presented in Table 6.20.

Table 6.20

Regression results maternal mortality

Country Grouping	All Countries	Low-income Countries	Lower Middle-income Countries	Upper Middle-income Countries
Estimation Method	FE	RE	RE	RE

Per Capita Government Expenditure on Health	0.0006***	0.0008*	-0.0039***	0.0004
Per Capita Development Assistance for Health	-0.0007***	-0.0013***	0.0014	0.0012
Per Capita Out of Pocket Expenditure on Health	0.0006**	-0.0008**	0.0021	-0.0006
Per Capita Private Expenditure on Health	-0.0000	-0.0008	0.0079***	-0.0018
Per Capita Total Health Expenditure	-0.0007***	-0.0006***	-0.0018**	-0.0020*
GDP per Capita	-0.0000***	-0.0002***	-0.0000	0.0000
Access to an Improved Water Source	-0.0156***	-0.0105***	-0.0431***	-0.0562***
HIV Prevalence	0.0343***	0.0109	0.0288***	0.0378*
Years of Schooling (Female 25+)	-0.0238**	-0.0242**	0.0951**	0.1952*
_cons	7.27***	7.35***	9.26***	9.76***
N	627	402	150	75
r2	0.6039	0.7556	0.5175	0.1856
Hansen	.	.	.	.
AR(2)	.	.	.	.

6.3 Summary

Several estimation methods (OLS, RE, FE, difference GMM and system GMM) were used to assist in predicting the point estimates. The first hypothesis was that all sources of health financing would improve health outcomes by decreasing under-five, infant, neonatal and maternal mortality. The second hypothesis was that expenditure sourced from government (per capita) would show greater improvements in health outcomes than donor expenditure. The decision about which estimation method to use was informed by the Hausman test, Hansen test and the sample size.

Per capita government expenditure on health was associated with decreases in under-five and infant mortality (all countries and lower middle-income countries models); decreases in neonatal mortality in the lower middle and upper middle-income countries models; and decreases in maternal mortality in the lower middle-income countries model. This evidence is in accordance with the hypothesis. Per capita government expenditure on health was associated with increases in maternal mortality in the all countries and low-income countries models.

Per capita development assistance for health was associated with decreases in under-five, infant, neonatal and maternal mortality in the low-income countries model.

While per capita out of pocket expenditure on health was associated with decreases in neonatal mortality in the upper middle-income countries model and maternal mortality in the low-income countries model, which was aligned with the hypothesis, per capita out of pocket expenditure on health was also associated with increases in under-five and infant mortality in the lower middle-income countries model and maternal mortality in the all counties model, a divergence from the hypothesis.

Per capita private expenditure on health was associated with increases in under-five, infant and maternal mortality in the lower middle-income countries model while per capita private expenditure on health was associated with decreases in under-five and infant mortality in the all countries and low-income countries models.

After separating the countries by income category, it seems that the relationship between source of funding and health outcome differs, supporting the earlier work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

In examining the scale of improvements in health outcomes, it was difficult to compare the various sources as not all sources of health expenditure were statistically significant.

Per capita private expenditure on health showed a larger effect on under-five, infant and neonatal mortality than per capita government expenditure on health in the all countries model. Development assistance for health had a larger effect in reducing under-five and infant mortality than private expenditure on health in the low-income countries model while in the lower middle-income countries model, per capita government expenditure on health reduced under-five and infant mortality whereas out of pocket expenditure on health and private expenditure on health were associated with increases in under-five mortality. Per capita out of pocket expenditure on health had a larger effect on neonatal mortality than per capita government expenditure on health in the upper middle-income countries model.

Per capita development assistance for health reduced maternal mortality whereas per capita government expenditure on health and out of pocket expenditure on health were associated with increases in maternal mortality in the all countries model. Per capita development assistance for health had a larger effect on reducing maternal mortality than per capita out of pocket expenditure on health, as well as per capita government expenditure on health which actually increased maternal mortality, in the low-income countries model. Per capita government expenditure on health was associated with reductions in maternal mortality while per capita private expenditure on health were associated with increases in maternal mortality in the lower middle-income countries model.

Chapter 7: Results for source of child health expenditure and their effect on health outcomes (under-five, infant and neonatal mortality)

7.1 Introduction

This chapter presents a descriptive analysis of the data obtained for objective 2. The data were analyzed in terms of measures of central tendency (mean) and measures of variability (standard deviation) to illustrate the basic characteristics of the data set for source of health expenditure and health outcomes; and show the distribution of the data. The empirical analysis for objective 2 uses several estimation methods to assist in predicting the point estimate for the dependent and independent variables: OLS, FE and RE. This aligns with the research reviewed in Chapter 3, in which 11 out of 13 studies used one or more of these three estimation methods, and the methodology set out in Chapter 4 (refer to Table 4.1). GMM was not considered a good estimator as the number of countries in the sample was smaller than the time period in this work however GMM results were shown for demonstration purposes only.

Of the four studies (Gottret & Schreiber, 2006; Bokhari et al., 2007; Achoki & Chansa, 2013; and Shaw et al., 2015) that examined the relationship between the source of health financing and health outcomes, as detailed in Chapter 3, three (Gottret & Schreiber, 2006; Bokhari et al., 2007; and Achoki & Chansa 2013) show that government expenditure on health produces better health outcomes and/or coverage of health interventions than donor financing. Based on these findings, it is expected that both government and donor expenditure on child health would have a negative relationship with health outcomes, meaning that when government or donor expenditure on child health increases, under-five, infant and neonatal mortality decrease. It is also expected that expenditure sourced from government would show greater improvements in health outcomes than donor expenditure.

This chapter presents a descriptive analysis of the data obtained through the data collection for objective 2; summarizes the empirical analysis; and details the regression results.

7.2 Descriptive statistics for source of child health expenditure on health outcomes

Data for child health expenditure were available for 8 sub-Saharan African countries between 2000 and 2014. The number of observations ranged for each variable and thus the data set is unbalanced.

The mean under-five, infant and neonatal mortality are provided in Table 7.1 for the countries included in this sub-set of work. The mean under-five mortality was 111.89 per 1,000 live births, higher than the mean for all the countries included under the objective 1 model (104.57 per 1,000 live births), noting that the lowest mean value was for Tanzania (89.01 per 1,000 live births) and the highest mean value was for the Democratic Republic of Congo (129.99 per 1,000 live births). Under-five mortality ranged from 44.70 (Rwanda, 2014) to 186.20 (Nigeria, 2000).

Table 7.1

Mean Under 5, Infant and Neonatal Mortality Rates by Country

Country	U5MR	Standard Deviation	Lowest annual U5MR	Highest annual U5MR	IMR	Standard Deviation	Lowest annual IMR	Highest annual IMR	NNMR	Standard Deviation	Lowest annual NNMR	Highest annual NNMR
Congo, Dem. Rep.	129.99	19.61	101.00	161.30	91.72	10.14	76.10	107.50	34.88	2.87	30.40	38.80
Cote d'Ivoire	121.53	16.16	97.70	146.80	83.69	9.58	69.50	98.70	40.21	3.31	35.20	45.40
Ethiopia	101.64	24.56	67.50	142.60	65.33	13.79	46.10	88.20	40.60	5.49	31.90	48.70
Malawi	108.90	32.40	65.70	171.90	66.86	17.44	44.10	101.10	30.75	4.14	25.00	39.40
Nigeria	146.98	24.34	111.60	186.20	90.45	13.24	71.00	111.60	40.98	4.25	34.90	48.10
Rwanda	98.70	45.44	44.70	181.40	62.86	24.81	33.00	107.70	27.43	6.80	18.20	38.80
Tanzania	89.01	22.02	61.30	130.40	56.79	11.85	42.40	79.50	26.99	3.24	22.50	32.70
Uganda	98.4	28.53	59.00	146.00	62.29	15.67	41.00	88.40	25.76	1.96	22.40	29.40
Countries in cohort	**111.89**	**32.70**	**44.70**	**186.20**	**72.50**	**19.72**	**33.00**	**111.60**	**33.45**	**7.41**	**18.20**	**48.70**

The mean infant mortality was 72.50 per 1,000 live births, higher than the mean for all the countries included in the objective 1 model (66.44 per 1,000 live births), with the lowest mean value for Tanzania (56.79 per 1,000 live births) and the highest mean value for the Democratic Republic of Congo (91.72 per 1,000 live births). Infant mortality ranged from 33.00 (Rwanda, 2014) to 111.60 (Nigeria, 2000).

The mean neonatal mortality was 33.45 per 1,000 live births, higher than the mean for all the countries included in this work (32.44 per 1,000 live births), with the lowest mean value for Uganda (25.76 per 1,000 live births) and the highest mean value for the Democratic Republic of Congo (40.98 per 1,000 live births). Neonatal mortality ranged from 18.20 (Rwanda, 2014) to 48.70 (Ethiopia, 2000).

The mean under-five, infant and neonatal mortalities steadily decreased from year 2000 to 2014. Under-five mortality decreased from 158.33 per 1,000 live births in 2000 to 76.06 per 1,000 live births in 2014. Infant mortality decreased from 97.84 per 1,000 live births in 2000 to 52.90 per 1,000 live births in 2014. Neonatal mortality decreased from 40.16 per 1,000 live births in 2000 to 27.56 per 1,000 live births in 2014. Refer to Table 7.2 and Figures 7.1, 7.2 and 7.3. Graphical representations of the distribution of under-five, infant and neonatal mortality by country can be found in Appendix 4.

Table 7.2

Mean Under 5, Infant and Neonatal Mortality Rates by Year

Year	U5MR	Standard Deviation	Lowest annual U5MR	Highest annual U5MR	IMR	Standard Deviation	Lowest annual IMR	Highest annual IMR	NNMR	Standard Deviation	Lowest annual NNMR	Highest annual NNMR
2000	158.33	20.05	130.40	186.20	97.84	11.40	79.50	111.60	40.16	6.96	29.40	48.70
2001	150.99	18.88	122.60	180.60	93.88	11.48	75.10	108.60	39.10	6.97	28.50	47.70
2002	143.13	18.23	114.70	174.90	89.60	11.88	70.60	105.60	38.00	7.03	27.70	46.70
2003	135.21	18.34	107.20	169.10	85.30	12.56	66.50	102.50	36.94	7.05	27.10	45.70
2004	127.50	19.02	100.50	163.20	81.03	13.41	62.70	99.40	35.89	7.06	26.60	44.50
2005	120.33	20.01	94.30	157.30	77.09	14.23	59.30	96.30	34.91	6.97	26.30	43.30
2006	113.99	20.85	89.30	151.50	73.64	14.81	56.80	93.90	33.99	6.86	26.10	42.10
2007	108.20	21.54	84.70	145.70	70.44	15.30	54.20	91.60	33.16	6.73	25.90	40.80
2008	102.68	22.13	79.20	140.10	67.36	15.62	51.90	89.20	32.35	6.60	25.20	39.70
2009	97.66	22.54	71.30	134.70	64.79	15.78	48.20	87.00	31.55	6.51	23.80	38.80
2010	92.95	22.95	64.40	129.60	62.21	16.03	44.50	84.80	30.75	6.46	22.50	38.00
2011	88.21	23.52	57.50	124.70	59.55	16.40	40.40	83.50	29.93	6.42	21.20	37.20
2012	83.55	23.93	52.20	119.90	57.03	16.61	37.50	80.40	29.13	6.42	20.00	36.50
2013	79.60	24.09	48.00	115.60	54.85	16.64	35.00	78.30	28.34	6.41	19.00	35.90
2014	76.06	23.98	44.70	111.60	52.90	16.53	33.00	76.10	27.56	6.39	18.20	35.20
All years	**111.89**	**32.70**	**44.70**	**186.20**	**72.50**	**19.72**	**33.00**	**111.60**	**33.45**	**7.41**	**18.20**	**48.70**

Figure 7.1

Objective 2 Cohort of Countries: Under Five Mortality by Year

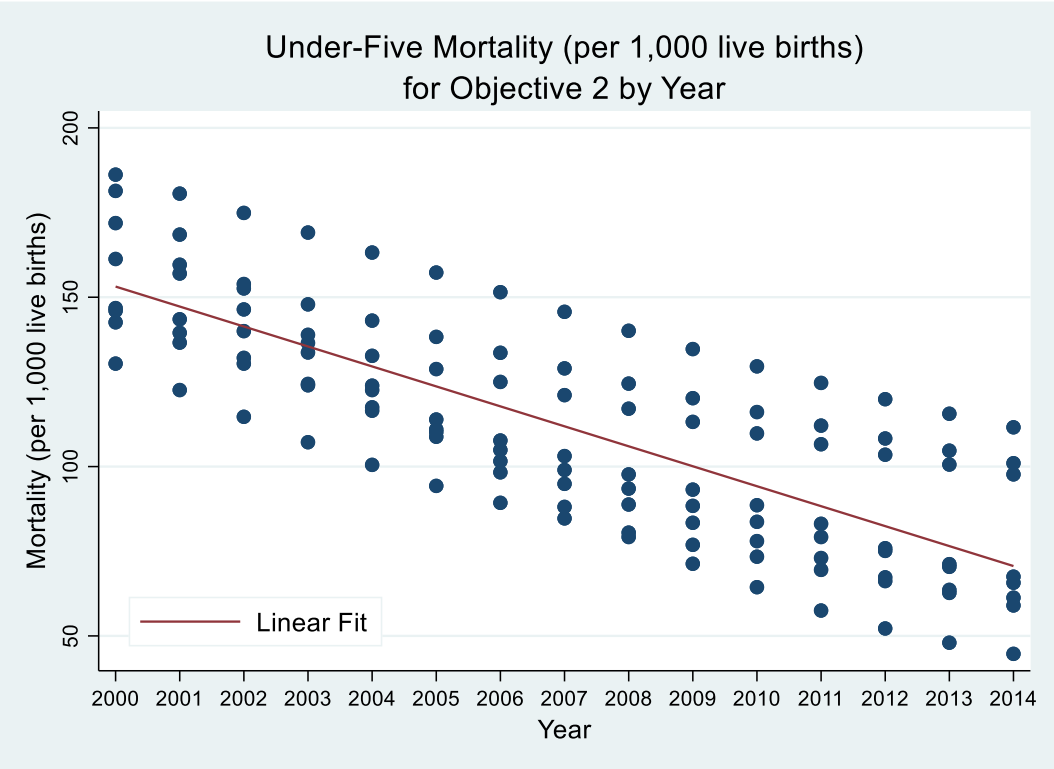


Figure 7.2

Objective 2 Cohort of Countries: Infant Mortality by Year

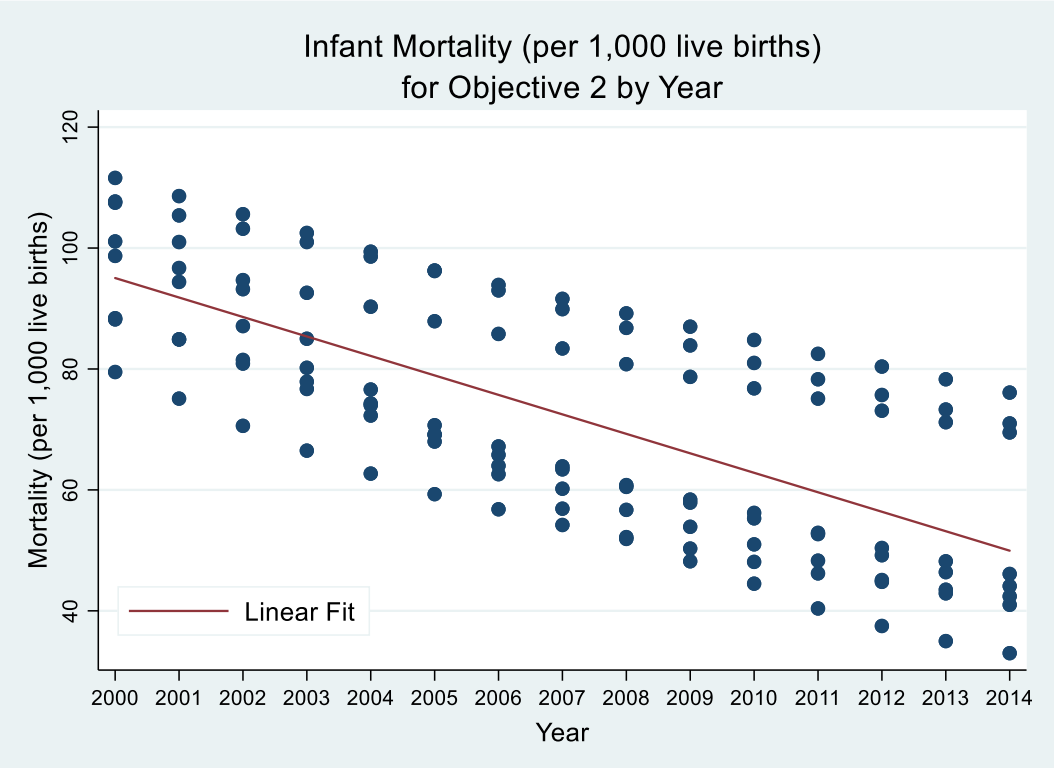
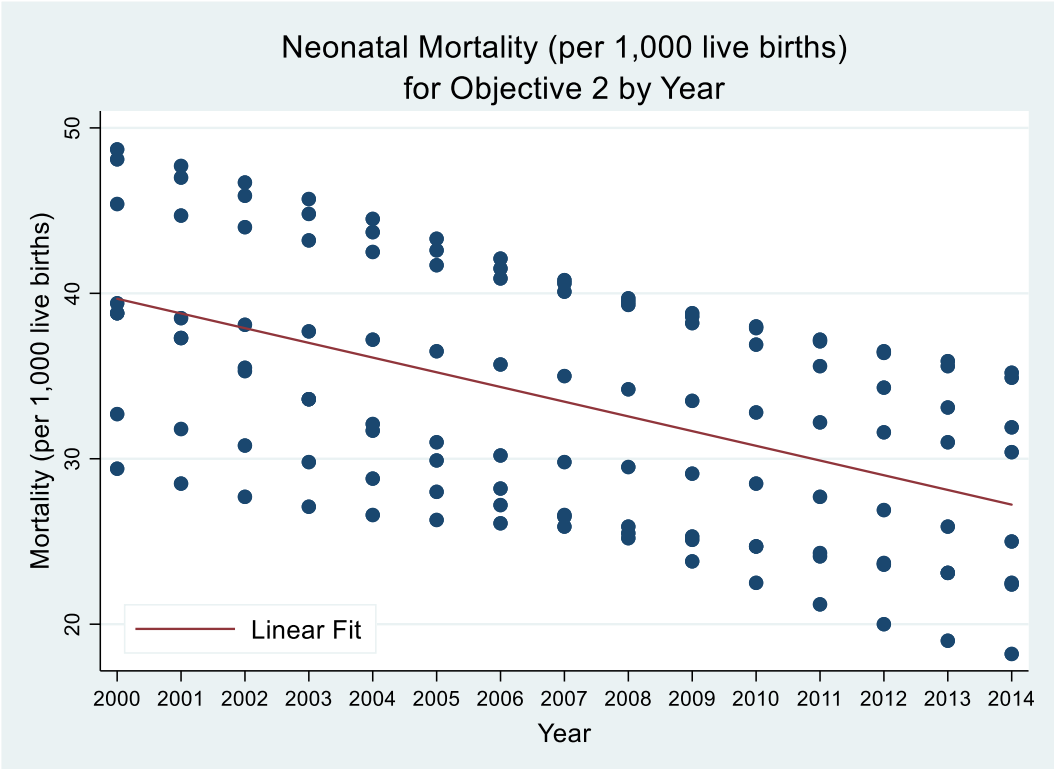


Figure 7.3

Neonatal mortality rate by year



The countries included in this cohort include 7 low-income countries and 1 lower-middle-income country. Two countries had a change in income classification during the period of this work. To adjust for this, an average GNI was taken for the 15 years included in this work. Based on the average GNI, the country was classified based on the World Bank definition. Table 7.3 indicates the classification, noting that the countries with an asterisk (*) are the countries that had at least one change in income classification during the period of this work.

Table 7.3

Average GNI per Capita (US$) and Country Income Classification

Country	Average GNI per capita	Country Income Classification
Congo, Dem. Rep.	266.67	Low-income
Cote d'Ivoire*	974.67	Low-income
Ethiopia	266.00	Low-income
Malawi	314.00	Low-income
Nigeria*	1,580.00	Lower middle
Rwanda	416.67	Low-income
Tanzania	588.67	Low-income
Uganda	415.33	Low-income

Across the years included in this work, the mean GDP per capita was US$648.95, with the lowest mean value US$276.79 (Ethiopia) and the highest mean value US$1,760.95 (Nigeria). GDP per capita ranged from US$111.36 (Ethiopia, 2002) to US$3,221.68 (Nigeria, 2014) (refer to table 7.4). It is noted that the mean GDP per capita for this cohort is smaller than the mean for all the countries included in the objective 1 model (US$1,748.75).

Table 7.4

Mean GDP per Capita (US$)

Country	Mean GDP per Capita	Standard Deviation	Lowest Annual GDP per Capita	Highest Annual GDP per Capita
Congo, Dem. Rep.	305.42	109.79	153.70	487.08
Cote d'Ivoire	1,058.87	277.67	642.25	1,568.63
Ethiopia	276.79	155.56	111.36	571.16
Malawi	323.34	99.90	146.76	512.17
Nigeria	1,760.95	900.03	567.61	3,221.68
Rwanda	426.68	197.13	196.52	706.60
Tanzania	607.43	200.40	398.07	985.23
Uganda	432.11	172.22	234.98	702.80
All countries	**648.95**	**598.09**	**111.36**	**3,221.68**

The mean total health expenditure as a per cent of GDP is 6.73%, with the lowest mean THE as a per cent of GDP 3.76% (Nigeria) and the highest mean THE as a per cent of GDP 10.26% (Uganda). Total health expenditure ranged from 1.54% (Democratic Republic of Congo, 2000) to 18.08 (Uganda, 2014). Mean total health expenditure as a per cent of GDP by country is shown in Table 7.5.

Table 7.5

Mean Total Health Expenditure as a per cent of GDP by Country

Country	THE as a % of GDP	Standard Deviation	Lowest Annual THE as a % of GDP	Highest Annual THE as a % of GDP
Congo, Dem. Rep.	3.84	1.12	1.54	6.07
Cote d'Ivoire	5.43	0.74	4.07	6.29
Ethiopia	6.01	1.08	4.64	8.46
Malawi	10.01	2.82	5.23	13.63
Nigeria	3.76	0.57	2.50	4.54
Rwanda	8.99	2.57	4.83	12.10
Tanzania	5.49	1.29	2.97	7.92
Uganda	10.26	2.61	7.47	18.08
All countries	**6.73**	**3.05**	**1.54**	**18.08**

Overall, there was an increase in total health expenditure as a per cent of GDP over the years in this work from 4.58% in 2000 to 8.24% in 2014, ranging from 1.54% in the Democratic Republic of Congo in 2000 to 18.08% in Uganda in 2014 (refer to Table 7.6). Graphical representations of total health expenditure as a per cent of GDP for each country are contained in Appendix 6.

Table 7.6

Total Health Expenditure as a Per Cent of GDP by Year

Year	Total Health Expenditure as a per cent of GDP	Standard Deviation	Lowest Annual THE as a % of GDP	Highest Annual THE as a % of GDP
2000	4.58	1.98	1.54	7.47
2001	4.71	1.59	2.75	7.97
2002	4.56	1.79	2.50	8.15
2003	5.55	1.80	3.35	8.31
2004	6.13	2.47	3.48	10.50
2005	6.61	2.72	3.50	11.11

2006	7.56	3.24	3.66	11.69
2007	7.53	3.19	3.73	11.47
2008	7.69	3.13	4.13	12.07
2009	7.62	2.85	4.41	11.23
2010	7.95	3.39	3.54	12.10
2011	7.72	3.46	3.74	13.63
2012	7.43	3.17	3.39	13.37
2013	7.01	2.82	3.78	12.24
2014	8.24	4.98	3.75	18.08
All years	**6.73**	**3.05**	**1.54**	**18.08**

The mean total health expenditure (rounded to the nearest millionth) across all years was US$6,010, compared to US$3,300 for the all countries objective 1 model, with the lowest mean THE US$1,150 (Rwanda) and the highest mean THE US$25,700 (Nigeria). Total health expenditure ranged from US$344 (Rwanda, 2000) to US$40,000 (Nigeria, 2014) (refer to Table 7.7).

Table 7.7

Mean Total Health Expenditure, rounded to the nearest million (US$, in millions)

Country	Mean Total Health Expenditure	Standard Deviation	Lowest Annual THE	Highest Annual THE
Congo, Dem. Rep.	1,610	880	423	3,420
Cote d'Ivoire	2,980	671	2,010	3,950
Ethiopia	5,020	2,660	1,990	8,640
Malawi	1,520	691	547	2,470
Nigeria	25,700	10,800	8,310	40,000
Rwanda	1,150	562	344	1,790
Tanzania	4,960	2,300	1,510	8,610
Uganda	5,170	2,680	2,120	13,200
All countries	**6,010**	**8,630**	**344**	**40,000**

The mean total health expenditure per capita across all years was US$113.20, lower than the mean total health expenditure per capita of US$213.01 for the all countries objective 1 model. The lowest mean THE per capita US$25.31 (Democratic Republic of Congo) and the highest mean THE per capita US$167.50 (Nigeria). Total health expenditure per capita ranged from US$8.75 (Democratic Republic of Congo, 2000) to US$347.18 (Uganda, 2014) (refer to Table 7.8).

Table 7.8

Mean Total Health Expenditure per Capita (US$)

Country	Total Health Expenditure per Capita	Standard Deviation	Lowest Annual THE per Capita	Highest Annual THE per Capita
Congo, Dem. Rep.	25.31	10.54	8.75	45.64
Cote d'Ivoire	155.11	22.91	117.22	178.90
Ethiopia	59.23	25.52	29.99	95.46
Malawi	106.77	38.34	47.09	159.16
Nigeria	167.50	58.12	64.24	228.48
Rwanda	115.02	48.23	43.14	169.57
Tanzania	113.14	40.38	44.15	166.41
Uganda	163.51	62.05	88.87	347.18
All Countries	**113.20**	**62.44**	**8.75**	**347.18**

Across all years, child health expenditure as a per cent of total health expenditure for the eight countries with some child health financial data was an average of 18.34%, with the lowest mean child health expenditure as a per cent of total health expenditure was 5.15% (Rwanda) and the highest mean child health expenditure as a per cent of total health expenditure was 36.36% (Democratic Republic of Congo). Child health expenditure as a per cent of total health expenditure ranged from 2.10% (Rwanda, 2003) to 45.20% (Democratic Republic of Congo, 2013). For low-income countries, the mean child health expenditure as a per cent of THE was 17.46%, after Nigeria is dropped as a lower middle-income country. Refer to Table 7.9.

Table 7.9

Child Health Expenditure as a Per Cent of Total Health Expenditure

Country	Child Health Expenditure as a % of THE	Standard Deviation	Lowest Annual Child Health Expenditure as a % of THE	Highest Annual Child Health Expenditure as a % of THE
Congo, Dem. Rep.	36.36	8.42	23.90	45.20
Cote d'Ivoire	22.13	15.21	9.20	39.45
Ethiopia	13.33	4.93	10.00	19.00
Malawi	13.10	4.04	6.90	18.40
Nigeria	24.90	0.00	24.90	24.90
Rwanda	5.15	3.39	2.10	9.80
Tanzania	15.70	6.25	9.40	21.90
Uganda	14.00	0.00	14.00	14.00
All countries with child health expenditure data	18.34	11.28	2.10	45.20
Low-income countries	17.46	11.75	2.10	45.20

Mean per capita total child health expenditure was US$5.84, with the lowest per capita government child health expenditure US$0.85 (Rwanda) and the highest mean per capita government health expenditure US$13.37 (Nigeria). The highest annual per capita government child health expenditure was US$70.45 (Cote d'Ivoire, 2014). When Nigeria is removed from the sample as the only non-low-income country, the mean per capita government child health expenditure drops to US$ 0.79. Refer to the summary in Table 7.10.

Table 7.10

Per Capita Child Health Expenditure

Country	Per Capita Child Health Expenditure	Standard Deviation	Lowest Annual Per Capita Child Health Expenditure	Highest Annual Per Capita Child Health Expenditure
Congo, Dem. Rep.	4.53	7.21	0.00	18.12
Cote d'Ivoire	10.45	21.85	0.00	70.45
Ethiopia	1.64	3.49	0.00	10.50
Malawi	9.14	9.13	0.00	27.89
Nigeria	13.37	23.21	0.00	56.89
Rwanda	0.85	1.63	0.00	4.51
Tanzania	3.85	9.12	0.00	32.78
Uganda	3.67	9.72	0.00	29.75
All countries with child health expenditure data	5.84	13.18	0.00	70.45
Low-income countries	4.88	10.94	0.00	70.43

Mean government child health expenditure as a per cent of total child health expenditure was 22.95% for countries with child health expenditure data, with the lowest mean government child health expenditure reported at 6.37% (DRC) and the highest mean government child health expenditure reported at 52.18% (Rwanda). The lowest annual government child health expenditure as a per cent of total child health expenditure was 0.20% (DRC, 2009) and the highest annual government child health expenditure as a per cent of total child health expenditure was 63.50% (Rwanda, 2002). For the low-income countries, Nigeria is removed as a lower middle-income country, mean government child health expenditure increases to 23.38%.

Mean per capita government child health expenditure was US$1.02, with the lowest per capita government child health expenditure US$0.26 (Cote d'Ivoire) and the highest mean per capita government health expenditure US$2.65 (Nigeria). The highest annual per capita government child health expenditure was US$12.03 (Tanzania, 2006). When Nigeria is removed from the sample as the only non-low-income country, the mean per capita government child health expenditure drops to US$ 0.79.

Mean development assistance for child health as a per cent of total child health expenditure was 32.91%, with the lowest mean development assistance for child health reported at 4.90% (Nigeria) and the highest mean development assistance for child health as a per cent of total child health expenditure reported at 52.01% (Malawi). The lowest annual development assistance for child health as a per cent of total child health expenditure was reported as 3.50% (Nigeria, 2006) and the highest annual development assistance for child health as a per cent of total child health expenditure was reported as 72.60% (Malawi, 2012). For low-income countries, Nigeria is removed as a lower middle-income country, the mean development assistance for child health as a per cent of total child health expenditure increases to 37.06%.

Mean per capita development assistance for child health was US$1.25, with the lowest per capita development assistance for child health US$0.11 (Rwanda) and the highest mean per capita development assistance for child health US$5.06 (Malawi). The highest annual per capita development assistance for child health was US$20.25 (Malawi, 2012). When Nigeria is removed from the sample as the only non-low-income country, the mean per capita development assistance for child health increases to US$1.33.

Mean private child health expenditure as a per cent of total child health expenditure was 45.86%, with the lowest mean private child health expenditure as a per cent of total child health expenditure was reported as 23.58% (Malawi) and the highest mean private child health expenditure as a per cent of total child health expenditure was reported as 79.47% (Cote d'Ivoire). The lowest annual private child health expenditure as a per cent of total child health expenditure was reported as 11.90% (Malawi, 2012) and the highest annual private child health expenditure as a per cent of total child

health expenditure was reported as 80.24% (Cote d'Ivoire, 2010). For the low-income countries, Nigeria is removed as a lower middle-income country, the mean private child health expenditure as a per cent of total child health expenditure decreased to 42.07%.

Mean per capita private child health expenditure was US$2.67, with the lowest per capita private child health expenditure US$0.31 (Rwanda) and the highest mean private child health expenditure US$10.05 (Nigeria). The highest annual per capita private child health expenditure was US$42.16 (Nigeria, 2009). When Nigeria is removed from the sample as the only non-low-income country, the mean per capita private child health expenditure drops to US$1.61.

Refer to Tables 7.11 and 7.12 for summaries of sources of health expenditure as a per cent of total health expenditure and per capita expenditure by source respectively.

Table 7.11

Source of Child Health Expenditure as a Per Cent of Total Child Health Expenditure

Country	Mean Government Child Health Expenditure as % of Total Child Health Expenditure	Standard Deviation	Lowest Annual Government Child Health Expenditure as a % of Total Child Health Expenditure	Highest Annual Government Child Health Expenditure as a % of Total Child Health Expenditure	Mean Private Child Health Expenditure as % of Total Child Health Expenditure	Standard Deviation	Lowest Annual Private Child Health Expenditure as a % of Total Child Health Expenditure	Highest Annual Private Child Health Expenditure as a % of Total Child Health Expenditure	Mean DAH for Children as % of Total Child Health Expenditure	Standard Deviation	Lowest Annual DAH for Children as a % of Total Child Health Expenditure	Highest Annual DAH for Children as a % of Total Child Health Expenditure
Congo, Dem. Rep.	6.37	3.25	0.20	9.00	55.17	8.64	46.00	64.00	38.50	10.48	27.00	54.00
Cote d'Ivoire	11.90	0.13	11.81	11.99	79.47	1.09	78.70	80.24	8.65	1.20	7.80	9.49
Ethiopia	19.93	6.93	12.00	24.80	38.30	11.89	25.00	47.90	41.70	18.86	27.10	63.00
Malawi	24.41	8.24	15.30	41.00	23.58	9.14	11.90	40.80	52.01	9.89	39.00	72.60
Nigeria	19.83	1.43	18.70	21.90	75.30	1.92	73.30	77.40	4.90	1.62	3.50	7.20
Rwanda	52.18	13.57	36.20	63.50	38.18	11.18	29.60	54.40	19.30	21.07	4.40	34.20
Tanzania	29.23	6.80	23.40	36.70	46.33	11.52	36.70	59.10	24.47	10.17	13.40	33.40
Uganda	20.00	4.24	17.00	23.00	48.83	15.80	35.10	63.00	23.50	4.95	20.00	27.00
All countries	**22.95**	**14.68**	**0.20**	**63.50**	**45.86**	**20.21**	**11.90**	**80.24**	**32.91**	**19.59**	**3.50**	**72.60**
Low-income countries	**23.38**	**15.63**	**0.20**	**63.50**	**42.07**	**18.22**	**11.90**	**80.24**	**37.06**	**17.43**	**4.40**	**72.60**

Table 7.12

Per Capita Source of Child Health Expenditure

Country	Mean Per Capita Government Child Health Expenditure	Standard Deviation	Lowest Annual Per Capita Government Child Health Expenditure	Highest Annual Per Capita Government Child Health Expenditure	Mean Per Capita Private Child Health Expenditure	Standard Deviation	Lowest Annual Per Capita Private Child Health Expenditure	Highest Annual Per Capita Private Child Health Expenditure	Mean Per Capita DAH for Children	Standard Deviation	Lowest Annual Per Capita DAH for Children	Highest Annual Per Capita DAH for Children
Congo, Dem. Rep.	0.34	0.53	0.00	1.48	2.69	4.48	0.00	11.23	1.50	2.27	0.00	5.80
Cote d'Ivoire	0.26	0.70	0.00	2.00	1.77	4.66	0.00	13.31	0.19	0.51	0.00	1.60
Ethiopia	0.34	0.80	0.00	2.60	0.66	1.52	0.00	5.03	0.63	1.33	0.00	3.86
Malawi	2.18	2.18	0.00	6.37	1.90	1.64	0.00	3.59	5.06	5.88	0.00	20.25
Nigeria	2.65	4.61	0.00	11.00	10.05	17.41	0.00	42.16	0.67	1.27	0.00	4.10
Rwanda	0.43	0.85	0.00	2.87	0.31	0.59	0.00	1.65	0.11	0.39	0.00	1.53
Tanzania	1.23	3.19	0.00	12.03	1.66	3.67	0.00	12.03	0.97	2.41	0.00	8.72
Uganda	0.74	2.02	0.00	6.84	2.29	6.07	0.00	18.44	0.85	2.26	0.00	6.84
All countries	**1.02**	**2.40**	**0.00**	**20.25**	**2.67**	**7.45**	**0.00**	**42.16**	**1.25**	**2.94**	**0.00**	**20.25**
Low-income countries	**0.79**	**1.81**	**0.00**	**12.03**	**1.61**	**3.71**	**0.00**	**18.44**	**1.33**	**3.11**	**0.00**	**20.25**

When the sources of child health expenditure (as a per cent of total child health expenditure or per capita) are examined by year, it was noted that there were several years with no or one observation. Moreover, there is no discernable pattern in any of these variables, likely due to the low sample size and the unbalanced data set (i.e. data were not available for each year included in this work). Refer to Tables 7.13 and 7.14.

Table 7.13

Source of Child Health Expenditure as a Per Cent of Total Child Health Expenditure by Year

Year	Government Child Health Expenditure as % of Total Child Health Expenditure	Standard Deviation	Lowest Annual Government Child Health Expenditure as a % of Total Child Health Expenditure	Highest Annual Government Child Health Expenditure as a % of Total Child Health Expenditure	Mean Private Child Health Expenditure as % of Total Child Health Expenditure	Standard Deviation	Lowest Annual Private Child Health Expenditure as a % of Total Child Health Expenditure	Highest Annual Private Child Health Expenditure as a % of Total Child Health Expenditure	Mean DAH for Children as % of Total Child Health Expenditure	Standard Deviation	Lowest Annual DAH for Children as a % of Total Child Health Expenditure	Highest Annual DAH for Children as a % of Total Child Health Expenditure
2000	45.60	-	45.60	45.60	54.40	-	54.40	54.40	0.00	0.00	0.00	0.00
2001*	.	.	.	.	.	.	.	.	.	.	.	.
2002	63.50	-	63.50	63.50	36.50	-	36.50	36.50	0.00	0.00	0.00	0.00
2003	42.60	20.05	23.40	63.40	31.80	11.61	20.00	43.20	25.60	18.57	4.40	39.00
2004	28.00	-	28.00	28.00	23.00	-	23.00	23.00	49.00	-	49.00	49.00
2005	26.50	4.95	23.00	30.00	31.50	14.85	21.00	42.00	42.00	9.90	35.00	49.00
2006	30.67	10.02	19.10	36.70	47.90	25.79	29.60	77.40	21.43	15.99	3.50	34.20
2007	17.95	2.33	16.30	19.60	58.60	25.17	40.80	76.40	23.55	27.51	4.10	43.00
2008	17.70	5.12	12.00	21.90	42.60	26.68	25.00	73.30	39.70	30.79	4.80	63.00
2009	13.32	7.87	0.20	18.90	58.90	19.32	32.70	78.70	29.22	21.57	7.20	54.00
2010	18.88	7.96	9.00	27.60	53.35	23.19	17.40	80.24	28.80	21.90	7.80	59.80
2011	20.00	11.39	7.00	28.20	36.75	15.14	15.90	48.00	42.70	14.59	27.10	56.00
2012	12.15	4.45	9.00	15.30	37.95	36.84	11.90	64.00	49.80	32.24	27.00	72.60
2013	6.00	-	6.00	6.00	62.00	-	62.00	62.00	32.00	-	32.00	32.00
2014	7.00	-	7.00	7.00	49.05	19.73	35.10	63.00	30.00	-	30.00	30.00
All Years	**22.95**	**14.68**	**0.20**	**63.50**	**45.86**	**20.21**	**11.90**	**80.24**	**32.91**	**19.59**	**3.50**	**72.60**

* No child health expenditure was reported in any country in 2001 so these are missing values

Table 7.14

Per capita Source of Child Health Expenditure by Year

Year	Mean Per Capita Government Child Health Expenditure	Standard Deviation	Lowest Annual Per Capita Government Child Health Expenditure	Highest Annual Per Capita Government Child Health Expenditure	Mean Per Capita Private Child Health Expenditure	Standard Deviation	Lowest Annual Per Capita Private Child Health Expenditure	Highest Annual Per Capita Private Child Health Expenditure	Mean Per Capita DAH for Children	Standard Deviation	Lowest Annual Per Capita DAH for Children	Highest Annual Per Capita DAH for Children
2000	0.13	0.38	0.00	1.06	0.16	0.45	0.00	1.27	0.00	0.00	0.00	0.00
2001*	.	.	.	.	.	.	.	.	.	.	.	.
2002	0.36	1.01	0.00	2.87	0.21	0.58	0.00	1.65	0.00	0.00	0.00	0.00
2003	1.03	1.71	0.00	4.50	0.99	1.87	0.00	5.22	1.05	1.92	0.00	4.28
2004	0.42	1.19	0.00	3.37	0.35	0.98	0.00	2.77	0.74	2.09	0.00	5.90
2005	0.78	1.59	0.00	4.39	0.80	1.48	0.00	3.32	1.24	2.58	0.00	7.16
2006	2.65	4.60	0.00	12.03	5.50	10.98	0.00	30.64	1.45	3.01	0.00	8.72
2007	1.49	3.69	0.00	10.54	5.56	14.40	0.00	41.08	0.72	1.39	0.00	3.57
2008	1.75	3.82	0.00	11.00	5.23	12.83	0.00	36.82	1.55	2.36	0.00	6.12
2009	2.37	3.68	0.00	10.64	9.36	14.73	0.00	42.16	2.21	2.77	0.00	6.84
2010	2.14	2.51	0.00	6.84	5.71	6.89	0.00	18.44	2.84	3.80	0.00	10.83
2011	1.20	2.28	0.00	6.37	1.60	2.25	0.00	5.03	2.43	4.42	0.00	12.66
2012	0.72	1.52	0.00	4.27	1.73	3.73	0.00	10.51	3.09	7.11	0.00	20.25
2013	0.14	0.38	0.00	1.09	1.40	3.97	0.00	11.23	0.72	2.05	0.00	5.80
2014	0.15	0.44	0.00	1.24	1.39	3.94	0.00	11.16	0.66	1.88	0.00	5.31
All Years	**1.02**	**2.40**	**0.00**	**20.25**	**2.67**	**7.45**	**0.00**	**42.16**	**1.25**	**2.94**	**0.00**	**20.25**

* No child health expenditure was reported in any country in 2001 so these are missing values

The mean population with access to an improved water source was 64.24%, with the lowest mean population with access to an improved water source was 45.38% (Ethiopia) and the highest mean population with access to an improved water source was 80.29% (Cote d'Ivoire). The lowest annual population with access to an improved water source was 32.70% (Ethiopia, 2000 - 2002) and the highest annual population with access to an improved water source at was 90.20% (Malawi, 2013 - 2014).

The mean prevalence of undernourishment was 27.77%, with the lowest mean prevalence of undernourishment at 7.20 (Nigeria) and the highest mean prevalence of undernourishment at 40.98% (Rwanda). The lowest annual prevalence of undernourishment was 6.00% (Nigeria, 2007 - 2008) and the highest annual prevalence of undernourishment was 55.60% (Rwanda, 2000).

The mean HIV prevalence was 5.00%, with the lowest mean HIV prevalence of 1.50% (DRC) and the highest mean HIV prevalence of 11.97% (Malawi). The lowest annual HIV prevalence was 0.90% (DRC, 2013 - 2014) and the highest annual HIV prevalence was 14.70% (Malawi, 2000). Refer to Table 7.15.

The mean years of schooling for females 25 years and above was 2.90 years, with the lowest mean 1.18 years (Ethiopia) and the highest mean 4.11 years (Tanzania). The lowest annual years of schooling for females 25 years and above was 0.00 years (Nigeria 2000-2004) and the lowest annual years of schooling for females 25 years and above was 5.2 years (Tanzania, 2014). Refer to Table 7.16.

Table 7.15

Mean Population with Access to Improved Water Source, Prevalence of Undernourishment, and HIV Prevalence by Country

Country	Mean Population with Access to Improved Water Source (%)	Standard Deviation	Lowest Annual Population with Access to Improved Water Source (%)	Lowest Annual Population with Access to Improved Water Source (%)	Prevalence of Under-nourishment (%)	Standard Deviation	Lowest Annual Prevalence of Under-nourishment (%)	Highest Annual Prevalence of Under-nourishment (%)	HIV Prevalence (%)	Standard Deviation	Lowest Annual HIV Prevalence (%)	Highest Annual HIV Prevalence (%)
Congo, Dem. Rep.	50.27	1.56	47.90	52.40	-	-	-	-	1.50	0.43	0.90	2.10
Cote d'Ivoire	80.29	1.20	78.50	81.90	21.11	0.65	20.00	21.90	4.81	1.53	3.00	7.70
Ethiopia	45.38	8.52	32.70	57.30	37.47	8.19	24.70	52.00	1.99	0.78	1.10	3.40
Malawi	78.67	8.30	66.20	90.20	24.25	2.36	21.70	27.40	11.97	1.48	10.30	14.70
Nigeria	61.84	4.97	54.20	68.50	7.20	1.20	6.00	9.30	3.37	0.27	2.90	3.70
Rwanda	72.15	2.92	67.70	76.10	40.98	7.28	31.60	55.60	3.60	0.66	2.90	5.00
Tanzania	55.06	0.43	54.40	55.60	34.55	1.62	32.20	26.90	6.15	1.08	4.80	8.10
Uganda	70.29	6.97	59.60	79.00	28.81	3.58	23.70	35.50	6.60	0.17	6.40	7.00
All Countries	**64.24**	**13.37**	**32.70**	**90.20**	**27.77**	**11.57**	**6.00**	**55.60**	**5.00**	**3.27**	**0.90**	**14.70**

Table 7.16

Mean Years of Education for Females 25 years and older by Country

Country	Mean Years of Education Females 25+ (years)	Standard Deviation	Lowest Annual Years of Education Females 25+ (years)	Highest Annual Years of Education Females 25+ (years)
Congo, Dem. Rep.	3.34	0.78	2.50	4.40
Cote d'Ivoire	2.71	0.58	2.10	3.70

Ethiopia	1.18	0.23	0.90	1.50
Malawi	2.73	0.66	2.10	3.80
Nigeria	2.99	2.20	0.00	4.90
Rwanda	2.62	0.67	1.90	3.70
Tanzania	4.11	0.59	3.50	5.20
Uganda	3.53	0.55	2.90	4.40
All Countries	**3.16**	**2.33**	**0.00**	**8.93**

The mean population with access to improved water source increased from 57.65% in 2000 to 70.13% in 2014. The prevalence of undernutrition decreased from 32.66% in 2000 to 25.26% in 2014. HIV prevalence decreased from 6.45% in 2000 to 4.05% in 2014. Mean years of schooling for females 25 years and above increased from 1.99 years in 2000 to 3.91 years in 2014. Refer to Tables 7.17 and 7.18.

Table 7.17

Mean Population with Access to Improved Water Source, Prevalence of Undernourishment and HIV Prevalence by Year

Year	Mean Population with Access to Improved Water Source (%)	Standard Deviation	Lowest Annual Population with Access to Improved Water Source (%)	Highest Annual Population with Access to Improved Water Source (%)	Prevalence of Under-nourishment (%)	Standard Deviation	Lowest Annual Prevalence of Under-nourishment (%)	Highest Annual Prevalence of Under-nourishment (%)	HIV Prevalence (%)	Standard Deviation	Lowest Annual HIV Prevalence	Highest Annual HIV Prevalence
2000	57.65	13.90	32.70	78.50	32.66	16.67	9.30	55.60	6.45	3.98	2.10	14.70
2001	57.65	13.90	32.70	78.50	31.46	14.87	9.00	50.00	6.21	3.86	2.10	14.30
2002	57.65	13.90	32.70	78.50	30.51	13.61	9.00	46.70	5.95	3.76	2.00	13.90
2003	62.60	13.18	42.00	79.80	29.76	13.32	8.30	45.40	5.66	3.59	1.90	13.30
2004	62.60	13.18	42.00	79.80	28.87	13.26	7.40	45.50	5.40	3.50	1.80	12.80

2005	62.60	13.18	42.00	79.80	28.01	13.05	6.50	45.30	5.15	3.34	1.70	12.20
2006	62.60	13.18	42.00	79.80	27.47	12.61	6.10	44.00	4.95	3.28	1.60	11.80
2007	62.60	13.18	42.00	79.80	27.17	12.02	6.00	42.00	4.78	3.21	1.50	11.40
2008	67.49	13.42	51.40	84.70	26.91	11.42	6.00	39.50	4.65	3.16	1.40	11.10
2009	67.49	13.42	51.40	84.70	26.49	10.78	6.10	36.90	4.55	3.18	1.30	11.00
2010	67.49	13.42	51.40	84.70	26.07	10.35	6.20	35.00	4.45	3.19	1.20	10.90
2011	67.49	13.42	51.40	84.70	25.60	9.87	6.50	33.60	4.34	3.17	1.10	10.70
2012	67.49	13.42	51.40	84.70	25.23	9.54	6.70	33.00	4.24	3.18	1.00	10.60
2013	70.13	13.88	52.40	90.20	25.06	9.33	7.10	33.70	4.15	3.17	0.90	10.50
2014	70.13	13.88	52.40	90.20	25.26	9.35	7.80	35.50	4.05	3.12	0.90	10.30
All Years	**64.24**	**13.37**	**32.70**	**90.20**	**27.77**	**11.57**	**6.00**	**55.60**	**5.00**	**3.27**	**0.90**	**14.70**

Table 7.18

Mean Years of Education for Females 25 years and older by Year

Year	Mean Years of Education Females 25+ (years)	Standard Deviation	Lowest Annual Years of Education Females 25+ (years)	Highest Annual Years of Education Females 25+ (years)
2000	1.99	1.11	0.00	3.50
2001	1.99	1.11	0.00	3.50
2002	1.99	1.11	0.00	3.50
2003	1.99	1.11	0.00	3.50
2004	1.99	1.11	0.00	3.50
2005	2.98	0.99	1.20	4.30
2006	2.98	0.99	1.20	4.30

2007	2.98	0.99	1.20	4.30
2008	2.98	0.99	1.20	4.30
2009	2.98	0.99	1.20	4.30
2010	3.60	1.02	1.40	4.50
2011	3.63	1.01	1.40	4.50
2012	3.70	1.11	1.40	4.90
2013	3.85	1.12	1.50	5.00
2014	3.91	1.14	1.50	5.20

7.3 Empirical Analysis for Child Health Expenditure

For each model, OLS, RE, FE and GMM estimation methods were run. These methods are relatively common (Kennedy, 2003). The main limitation of OLS regressions is the assumption that the relationships between the variables are constant over time and across the cross-sectional units (Brooks, 2008). Time dummies were included in the OLS estimation method to control for variables (whether observable or unobservable) that are constant across entities but vary over time; and the robust option was added to control for heteroscedasticity (Torres-Reyna, 2007). Fixed effects and the random effects estimation methods were run for comparison as they address omitted variables bias (Snijders & Bosker, 2011; Greene, 2007; Gelman & Hill, 2006; Wooldridge, 2001; and Mundlak, 1978). In accordance with the literature review, all four estimation methods are analyzed in this work to help identify an appropriate point estimate, noting that there are advantages and disadvantages to each method (Bell & Jones, 2012; Snijders & Bosker, 2011; and Cameron & Trivedi, 2009).

The Hausman test was used to decide between random and fixed effects estimators (Clark & Linzer, 2013: Baum, 2013; Torres-Reyna, 2007; and Hausman, 1978). In a preliminary run of the data, several errors were noted when running the Hausman test (Torres-Reyna 2007). As the coefficient of a variable, in this case GDP per capita, was very small, the statistical programme, Stata, considered this variable to be on a different scale and thus was incompatible with running the Hausman test (Rockefeller College University at Albany https://www.albany.edu/faculty/kretheme/PAD705/SupportMat/PanelData.pdf).

The null hypothesis of the Hausman test is that the unique errors (υ_i) are not correlated with the regressors, and thus the random effects method is preferred (Clark & Linzer, 2013; Baum, 2013; Torres-Reyna, 2007; and Hausman, 1978). If the probability less than 0.05, the test is significant thus the hypothesis is rejected, and fixed effects is the preferred method. If the probability more than 0.05, the test is not significant thus the hypothesis is accepted. However, the Hausman test is neither necessary nor sufficient for choosing the fixed or the random effects model (Clark & Linzer 2013). It is used in this work as one means for guiding the use of an appropriate estimation method.

In some cases, the Hausman test showed that V_b-V_B is not positive definite which means that the estimates from the RE regression are not smaller than the estimates from the FE regression and thus some of the variables are linear combinations of one another. In these cases, the statistical programme, Stata, indicates that the Hausman test may not have resulted in the best possible value and the results are questionable. To address the issue, Hausman sigmamore (or sigmaless) was used when comparing fixed-effects and random-effects linear regression because they are much less likely to produce a non–positive-definite-differenced covariance matrix, noting that the tests are considered equivalent) (Stata https://www.stata.com/manuals13/rhausman.pdf; and Rockefeller College University at Albany https://www.albany.edu/faculty/kretheme/PAD705/SupportMat/PanelData.pdf). In this research, the sigmamore option for the Hausman test was used to specify that covariance matrices, a measure of how variables vary together, are based on the same estimate of the error term for both models.

If the null hypothesis of the Hausman test was accepted, then the BPLM test was used to decide between the RE or OLS estimation methods. The null hypothesis in the BPLM test is that variances across entities is zero (i.e. there is no significant difference across units or in other words no panel effect) and therefore OLS is the preferred method. If the probability less than 0.05, the test is significant, so the hypothesis is rejected and random effects is considered the preferred method. If the probability more than 0.05, the test is not significant, so the hypothesis is accepted and OLS is used ((Torres-Reyna 2007; and Breusch & Pagan 1980).

This work also shows results for FE regressions that control for variables that are constant across entities but vary over time. By including time dummies, cross-group action is absorbed, leaving only the within-group action, what is desired. (Wooldridge, 2012; Torres-Reyna, 2007; and Murtazashvili & Wooldridge, 2008). This allows for additional insight into the establishment of point estimates.

GMM was run to control for endogeneity, omitted variable bias, unobserved panel heterogeneity and measurement errors, and given that the time period under review is short (Blundell & Bond, 1998; Arellano & Bover, 1995; and Arellano & Bond, 1991). Both difference and system GMM were run, using both one- and two-step, noting that

the latter is considered more efficient and is thus considered a more robust estimation method (Roodman, 2009; Roodman, 2007; Blundell & Bond, 1998; Arellano & Bover, 1995; and Arellano & Bond, 1991). As the sample was smaller than the time period in this work, GMM was not a good estimation method for any of the models and is only shown for demonstration purposes.

This was an unbalanced panel data set. Eight countries have some data on child health expenditure however data were not available for all indicators over the period of this work: there are only 32 observations for per capita government child health expenditure, 32 observations for per capita development assistance for child health, and 32 observations for per capita private child health expenditure. If the variable for prevalence of undernourishment was included in the regressions, then one country (Democratic Republic of Congo) was dropped leaving only 27 observations for 7 countries, with the number of observations per country ranging from 2 observations to 9 observations per country and averaging 3.6 observations per country. If the variable for prevalence of undernourishment was dropped, Democratic Republic of Congo remains in the regression results thereby increasing the number of observations to 32 for 8 countries, and the average increasing to 3.9 observations per country. For the purposes of this research, the prevalence of undernourishment variable was dropped as this allows for maximizing the number of countries in this section of the work and it addresses that issue that there are more variables than groups which was causing an error in the Hausman test.

A summary of missing values was prepared and of the variables used for these regressions, the following were missing:

Variable	**Variable Code**	**No. of Missing Values**	**Details**
Per Capita Government Expenditure on Child Health	GHECHPRCAP	88	Only the following values are available: DRC 2010 - 2014 Cote d'Ivoire 2009 – 2010 Ethiopia 2005, 2008 and 2011

			Malawi 2003 – 2005 and 2007 – 2012 Nigeria 2006 – 2009 Rwanda 2000, 2002-2003 and 2006 Tanzania 2003, 2006 and 2010 Uganda 2009 - 2010
Per Capita Development Assistance for Child Health	DAHCHPRCAP	88	Only the following values are available: DRC 2010 - 2014 Cote d'Ivoire 2009 – 2010 Ethiopia 2005, 2008 and 2011 Malawi 2003 – 2005 and 2007 – 2012 Nigeria 2006 – 2009 Rwanda 2000, 2002-2003 and 2006 Tanzania 2003, 2006 and 2010 Uganda 2009 - 2010
Per Capita Private Expenditure on Child Health	PRVCHPRCAP	88	Only the following values are available: DRC 2009 - 2014 Cote d'Ivoire 2009 – 2010 Ethiopia 2005, 2008 and 2011 Malawi 2003 – 2005 and 2007 – 2012 Nigeria 2006 – 2009 Rwanda 2000, 2002-2003 and 2006 Tanzania 2003, 2006 and 2010 Uganda 2009 – 2010 and 2014
Prevalence of Undernourishment	FOODSEC	15	DRC 2000-2014 is missing

It should be noted that child health expenditure data lumps private expenditure on child health and out of pocket expenditure on child health together under the term private expenditure on child health. That being said, the National Health Accounts indicate the majority of the expenditure under this title is out of pocket expenditure on child health. For this research, the term private expenditure on child health is

maintained. The sections below look at the results generated from the above-mentioned tests.

Seven of the eight countries in the sample were classified as low-income countries; while one country was classified as lower middle-income. In the child health expenditure analyses shown below, all eight countries were shown despite country income classification to maximize the number of observations. If a variable shows statistical significance, the coefficient for the low-income grouping is discussed.

7.3.1 Under-Five Mortality Rate

The regression results using the various estimation methods for the "child health expenditure" model are reported in Table 7.19 below. OLS, RE, and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007).

R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS estimation method was 80.19%, 58.93% for the RE method, and 75.13% for the FE method. These estimation methods were compared using the Hausman test. The Hausman test indicated that the null hypothesis should be rejected for the under-five mortality rate for the "all countries" model (Prob>chi2 of 0.0000) thus the fixed effects was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. Despite the inappropriateness of the model due to the limited sample size, the results were provided in the table below to enable visualization of the coefficients and significance levels across the estimation methods.

Although FE was preferred, the low number of observations make the FE estimators less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias

of the RE estimation" hence the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was utilized.

Per capita government expenditure on child health was associated with decreases in under-five mortality with a coefficient of -0.0244 (p = 0.335), indicating that a US$1 increase in per capita government expenditure on child health leads to a 2.41% decrease in under-five mortality. Per capita development assistance for child health was associated with decreases in under-five mortality with a coefficient of -0.0103 (p = 0.386), indicating that a US$1 increase in per capita development assistance for child health leads to a 1.02% decrease in under-five mortality. Per capita private expenditure on child health was associated with increases in under-five mortality with a coefficient of 0.0126 (p = 0.095), indicating that a US$1 increase in per capita private child health expenditure leads to a 1.27% increase in under-five mortality. None of the sources of health expenditure showed statistical significance.

Proportion of the population with access to an improved water source was associated with decreases in under-five mortality with a coefficient of -0.0091 (p = 0.000), indicating that a 1% increase in proportion of the population with access to an improved water source is associated with a 0.91% decrease in under-five mortality. Prevalence of HIV was associated with increases in under-five mortality with a coefficient of 0.0368 (p = 0.000), indicating that a 1% increase in prevalence of HIV is associated with a 3.75% increase in under-five mortality. Mean years of schooling for females was associated with decreases in under-five mortality with a coefficient of -0.1395 (p = 0.000), indicating that a 1-year increase in mean years of schooling for females was associated with a 13.02% decrease in under-five mortality. Proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females showed statistical significance at the 5% level.

Table 7.19:

Regression results under-five mortality

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Child Health	-0.0632	-0.0244	0.0148	0.0012	0.1849***
Per Capita Development Assistance for Child Health	0.0278**	-0.0103	-0.0020	-0.0002	0.0056**
Per Capita Private Expenditure on Child Health	0.0126**	0.0126	-0.0025	-0.000	-0.0293***
Per Capita Total Child Health Expenditure	0.0039***	0.0019	0.0015	-0.0002**	-0.0026***
GDP per Capita	0.0002***	0.0002***	0.0001	0.0000	0.0011***
Access to an Improved Water Source	-0.0009	-0.0091***	-0.0222***	-0.0004	0.0723***
HIV Prevalence	-0.0088	0.0368***	0.1048***	-0.0071*	0.2969***
Years of Schooling (Female 25+)	-0.0253	-0.1395***	-0.0897**	0.0003	-0.7874***
_cons	5.14***	5.35***	5.78***	0.00	0.00
N	120	120	120	112	112
r2	0.8019	0.5893	0.7513	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.3890	.

7.3.2 Infant Mortality Rate

The regression results using the various estimation methods for the "child health expenditure" model are reported in Table 7.20 below. OLS, RE, and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than

zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007). R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS estimation method was 74.14%, 51.30% for the RE method, and 76.04% for the FE method. These estimation methods were compared using the Hausman test. The Hausman test indicated that the null hypothesis should be rejected for the infant mortality rate for the "child health expenditure" model (Prob>chi2 of 0.0000) thus the fixed effects was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. Despite the inappropriateness of the model due to the limited sample size, the results were provided in the table below to enable visualization of the coefficients and significance levels across the estimation methods.

Although FE was preferred, the low number of observations make the FE estimators less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias of the RE estimation" hence the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was utilized.

Per capita government expenditure on child health was associated with decreases in infant mortality with a coefficient of -0.0359 ($p = 0.147$), indicating that a US$1 increase in per capita government expenditure on child health leads to a 3.53% decrease in infant mortality. Per capita development assistance for child health was associated with decreases in infant mortality with a coefficient of -0.0058 ($p = 0.616$), indicating that a US$1 increase in per capita development assistance for child health leads to a 0.58% decrease in infant mortality. Per capita private expenditure on child health was associated with increases in infant mortality with a coefficient of 0.0134 ($p = 0.069$), indicating that a US$1 increase in per capita private child health expenditure leads to a 1.35% increase in infant mortality. None of the sources of child health expenditure were statistically significant at the 5% level.

Proportion of the population with access to an improved water source was associated with a decrease in infant mortality with a coefficient of -0.0070 (p = 0.002), indicating that a 1% increase in the proportion of the population with access to an improved water source is associated with a 0.70% decrease in infant mortality. Prevalence of HIV was shown to increase infant mortality with a coefficient of 0.0214 (p = 0.024), indicating that a 1% increase in prevalence of HIV is associated with a 2.16% increase in infant mortality. Mean years of schooling for females was associated with decreases in infant mortality with a coefficient of -0.1167 (p = 0.000), indicating that a 1-year increase in mean years of schooling for females was associated with a 11.01% decrease in infant mortality. Proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females showed statistical significance at the 5% level.

Table 7.20

Regression results infant mortality

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure on Child Health	-0.0720***	-0.0359	0.0100	0.0012	0.1349***
Per Capita Development Assistance for Child Health	0.0302**	-0.0058	-0.0011	-0.0003	0.0122***
Per Capita Private Expenditure on Child Health	0.0136**	0.0134	-0.0016	-0.0001	-0.0207
Per Capita Total Child Health Expenditure	0.0043***	0.0025	0.0013	-0.0002*	-0.0014***
GDP per Capita	0.0002***	0.0001**	0.0000	-0.0000	0.0009***
Access to an Improved Water Source	0.0007	-0.0070**	-0.0194***	-0.0004	0.0646***

HIV Prevalence	-0.0218**	0.0214*	0.0896***	-0.0074**	0.2702***
Years of Schooling (Female 25+)	-0.0092	-0.1167***	-0.0690**	0.0011	-0.6784***
_cons	4.64***	4.83***	5.20***	0.00	0.00
N	120	120	120	112	112
r2	0.7414	0.5130	0.7604	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.6406	.

7.3.3 Neonatal Mortality Rate

The regression results using the various estimation methods for the "child health expenditure" model are reported in Table 7.21 below. OLS, RE, and FE estimation methods had F-tests, a test to see if all the coefficients in the model are different than zero, that were significant ($p < 0.001$) indicating that the estimation methods are appropriate (Torres-Reyna, 2007).

R squared, a statistical measure of how close the data are to the fitted regression line or in other words the percentage of variability of the response variable explained by the model, was examined. R squared for the OLS estimation method was 75.74%, 44.73% for the RE method, and 74.83% for the FE method. These estimation methods were compared using the Hausman test. The Hausman test indicated that the null hypothesis should be rejected for the neonatal mortality rate for the "child health expenditure" model (Prob>chi2 of 0.0000) thus the fixed effects was preferred.

In both difference and system GMM, the number of instruments exceeded the number of groups, despite collapsing the instrument set, indicating that GMM is not an appropriate method for this model. Despite the inappropriateness of the model due to the limited sample size, the results were provided in the table below to enable visualization of the coefficients and significance levels across the estimation methods.

Although FE was preferred, the low number of observations make the FE estimators less reliable. Research by Dieleman (2014) indicated that in a poorly fit model, "the imprecision of the FE…estimation tends to mislead the researcher more than the bias

of the RE estimation" hence the small sample size for this model necessitated a more efficient estimator which is why the RE estimation method was utilized.

Per capita government expenditure on child health was associated with decreases in neonatal mortality with a coefficient of -0.0265 (p = 0.057), indicating that a US$1 increase in per capita government expenditure on child health leads to a 2.62% decrease in neonatal mortality. Per capita development assistance for child health was associated with increases in neonatal mortality with a coefficient of 0.0042 (p = 0.518), indicating that a US$1 increase in per capita development assistance for child health leads to a 0.42% increase in neonatal mortality. Per capita private child health expenditure was associated with increases in neonatal mortality with a coefficient of 0.0076 (p = 0.066), indicating that a US$1 increase in per capita private child health expenditure leads to a 0.76% increase in neonatal mortality. None of the sources of child health expenditure were statistically significant at the 5% level.

Proportion of the population with access to an improved water source was shown to decrease neonatal mortality with a coefficient of -0.0063 (p = 0.000), indicating that a 1% increase in the proportion of the population with access to an improved water source is associated with a 0.63% decrease in neonatal mortality. Prevalence of HIV was shown to increase neonatal mortality with a coefficient of -0.0105 (p = 0.048), indicating that a 1% increase in prevalence of HIV is associated with a 1.06% increase in neonatal mortality. Mean years of schooling for females was associated with decreases in neonatal mortality with a coefficient of -0.1486 (p = 0.000), indicating that a 1-year increase in mean years of schooling for females was associated with a 13.81% decrease in neonatal mortality. Proportion of the population with access to an improved water source, HIV prevalence and mean years of schooling for females showed statistical significance at the 5% level.

Table 7.21

Regression results neonatal mortality

Variable	OLS	RE	FE	System GMM 1 Step	System GMM 2 Step
Per Capita Government Expenditure	-0.0452***	-0.0265	0.0070	-0.0011	0.0000

on Child Health					
Per Capita Development Assistance for Child Health	0.0175**	0.0042	-0.0002	0.0008***	0.0007
Per Capita Private Expenditure on Child Health	0.0089***	0.0076	-0.0016	0.0002	0.0004
Per Capita Total Child Health Expenditure	0.0037***	0.0027	0.0008	-0.0000	-0.0002
GDP per Capita	0.0002***	0.0002***	-0.0000	0.0000	0.0000
Access to an Improved Water Source	-0.00345**	-0.0063***	-0.0075***	0.0003	-0.0001
HIV Prevalence	-0.0040	0.0105*	0.0650***	-0.0052	-0.0037
Years of Schooling (Female 25+)	-0.1146***	-0.1486***	-0.0377*	0.0004	-0.0066
_cons	4.06***	4.12***	3.75***	0.03	0.00
N	120	120	120	112	112
r2	0.7574	0.4473	0.7483	.	.
Hansen	.	.	.	1.00	1.00
AR(2)	.	.	.	0.1017	0.2168

7.4 Summary for child health expenditure

Several estimation methods (OLS, RE, FE and GMM) were used to assist in predicting the point estimates. The first hypothesis was that both per capita government and donor expenditure on child health would be shown to improve health outcomes, meaning that when per capita government or donor expenditure on child health increases, under-five, infant and neonatal mortality decreases. The second hypothesis was that child health expenditure sourced from government would show greater improvements in health outcomes than donor expenditure on child health. The decision about which

estimation method to use was informed by the Hausman test, Hansen test and the sample size.

It is noted that the countries included in the child health expenditure analysis were self-selected because they had generated data on child health expenditure which introduces bias to the analysis. Being able to generate such data, shows strong capacity to record, manage and analyze health expenditures which suggests stronger overall planning, implementation and monitoring of health programmes which in turn would influence health outcomes of the population. It is noted that these countries are some of the largest in the sub-Saharan Africa region, they have more access to resources, and there is likely greater investment in public services/goods which also influences health outcomes of the population.

Per capita government expenditure on child health was associated with decreases in under-five, infant and neonatal mortality however none of these results had statistical significance.

While per capita development assistance for child health was associated with decreases in under-five and infant mortality, it was associated with increases in neonatal mortality however none of these results had statistical significance.

Per capita private expenditure on child health was associated with increases in under-five, infant and neonatal mortality however none of these results had statistical significance.

It was noted that per capita government expenditure on child health seemed to have a larger impact on reducing under-five, infant and neonatal mortality than other sources of child health expenditure however none of the results had statistical significance.

Proportion of the population with access to an improved water source and mean years of school for females over 25 were associated with decreasing under-five, infant and neonatal mortality. HIV prevalence was associated with increasing under-five, infant and neonatal mortality.

Table 7.22

Regression results for child health expenditure

	Under-Five Mortality	Infant Mortality	Neonatal Mortality
Variable	**RE**	**RE**	**RE**
Per Capita Government Expenditure on Child Health	-0.0244	-0.0359	-0.0265
Per Capita Development Assistance for Child Health	-0.0103	-0.0058	0.0042
Per Capita Private Expenditure on Child Health	0.0126	0.0134	0.0076
Per Capita Total Child Health Expenditure	0.0019	0.0025	0.0027
GDP per Capita	0.0002***	0.0001**	0.0002***
Access to an Improved Water Source	-0.0091***	-0.0070**	-0.0063***
HIV Prevalence	0.0368***	0.0214*	0.0105*
Years of Schooling (Female 25+)	-0.1395***	-0.1167***	-0.1486***
_cons	5.35***	4.83***	4.12***
N	120	120	120
r2	0.5893	0.5130	0.4473
Hansen	.	.	.
AR(2)	.	.	.

Chapter 8: Case Studies

8.1 Introduction

This chapter reviews the health financing mix in two sub-Saharan African countries using a case study approach. The two countries examined in the case studies, Malawi and Mozambique, were purposively selected based on maximum variation (Palinkas et al, 2015).

Mozambique had the second highest development assistance for health as a per cent of total health expenditure at 66.65%, after Liberia. Liberia was not selected as there was conflict in the country during the period reviewed which may introduce additional bias in the analysis. Malawi had the highest government expenditure on health as a per cent of total health expenditure (39.84%) for a low-income country from the Southern Africa region, third highest of all the countries included in this research. Although Ghana and Mauritania had more government expenditure on health as a per cent of total health expenditure, they were not selected as Mauritania financed almost 50% of health expenditure from out of pocket and private expenditures, and Ghana had almost triple the out of pocket expenditure of health of Mozambique. The high out of pocket expenditures in these countries may hamper the analysis of government and donor investments and the health outcomes. Moreover, the GDP of Ghana (US$1,024.86) and Mauritania (US$943.39) were substantially higher than Mozambique (US$420.15), and these countries changed income classification, which may influence the types of investments made in these countries.

Also contributing to the selection of Malawi and Mozambique were the following:

1. They had the lowest combined amounts of private and out of pocket expenditure on health as percentages of THE so they rely more on government and development assistance for health and thus the effects of government and development assistance for health may be easier to identify.
2. They have similar mean total health expenditure ranking 26th and 28th highest out of the countries included in this research;
3. Neither experienced conflicts during the period included in this research;
4. They have the same low-income country classification; and

5. They are from the same region.

8.2 Country Background

Malawi

Malawi is a relatively small and densely populated country. In 2014, Malawi had a population of over 17.1 million, of which 50.49% were female (World Bank). It is a very young population, with 44.97% of the population below 14 years of age (World Bank). The majority of the population (83.87%) lives in rural communities (World Bank). The country experiences periodic natural disasters and economic instability.

The economy is agriculturally based, with over 80% of the population engaged in subsistence farming (African Development Bank, 2018; and ActionAid, 2006). Malawi has an estimated GNI per capita of US$493.73 (constant 2010 US$) in 2014, thus the country is categorized as a low-income country (World Bank). With 29.40% of the population living on less than US$1.90 per day (World Bank), it is one of the least developed countries in the world, ranking 171 out of 189 countries on the Human Development Index (UNDP, 2018).

The literacy rate is 62% with female literacy at 55% (World Bank, 2015). The fertility rate is 4.2%, the mean HIV prevalence over the period of this study was 11.97% and it has high malaria transmission.

Mozambique

Mozambique endured 15 years of civil war, drought and economic devastation following its independence in 1975 (Government of Mozambique, 2014; INGC, 2009; and Pavignani & Colombo 2001). Mozambique has been peaceful since 1992 however it continues to endure periodic natural disasters. In 2014, Mozambique had a population of over 27.2 million, of which 51.27% were female (World Bank). It is a very young population, with 45.39% of the population below 14 years of age (World Bank). The majority of the population (66.12%) lives in rural communities across the country's vast territory (World Bank).

The economy is agriculture-based, with over 80% of the population engaged in subsistence farming (IFAD, 2010). Mozambique has an estimated GNI per capita of US$503.79 (constant 2010 US$) in 2014, thus the country is categorized as a low-income country (World Bank). With 27.50% of the population living on less than US$1.90 per day (World Bank), it is one of the least developed countries in the world, ranking 180 out of 189 countries on the Human Development Index (UNDP, 2018).

The literacy rate is 61% with female literacy at 50% (World Bank). The fertility rate is 4.9%, the mean HIV prevalence over the period of this study was 12.44% and it has high malaria transmission.

Table 8.1

Summary of country background statistics

	Country	
Indicator	**Malawi**	**Mozambique**
Population (2014)	17.1 million	27.2 million
Child (0 – 14 years) population as a % of total population (2014)	44.97%	45.39%
Rural population as a % of total population (2014)	83.87%	66.12%
Gross National Income (GNI) per Capita (2014)	US$493.73	US$503.79
Country Income Level	Low-income	Low-income
Population living on less than US$1.90 per day	29.40% (2016)	27.50% (2014)
Human Development Index rating	171	180

Source: World Bank (https://data.worldbank.org/)

8.3 Health System Background

Malawi

Malawi uses a mix of public, private not for profit and private for profit providers to deliver health services (Sanders, 2012, p. 1). The majority (60%) of health care is provided by the public sector, followed by the not-for-profit private sector (37%) and

the remainder by for-profit private providers (Ranchod et al., 2016, p. 28; and Abiiro et al., 2014, p. 2). The public sector provides services free of charge and includes all facilities under the Ministry of Health, the Ministry of Local Government and Rural Development, the Ministry of Forestry, the Police, the Prisons and the Army (Government of the Republic of Malawi, 2017, p. 1-3).

The largest private non-profit provider is the Christian Health Association of Malawi (CHAM). CHAM operates 172 facilities (comprising 20 major hospitals, 30 community hospitals, 10 training institutions, and 112 health centres) primarily in rural areas (Sanders, 2012, p. 4). Since 2006, the Ministry of Health has contracted with CHAM to provide an essential package of health services, including maternal and child health care, free of charge to users in areas where the Government does not have sufficient coverage and the Government reimburses CHAM for the services provided (Manthalu et al., 2016, p. 1184-6; and Sanders 2012, p. 6). CHAM is the second biggest provider of health services after MOH, providing 29-37% of health services (Government of the Republic of Malawi, 2017, p. 1-3; and Ministry of Health, 2014, p. 64).

Malawi has a three-tier public health care delivery system:

- Primary health care consists of community initiatives, heath posts, dispensaries, maternity units, health centres and community and rural hospitals (Makwero, 2018, p. 1-3). These facilities provide a link between facility-based and community-based activities.
- Secondary care is provided at 26 district hospitals with each district hospital acting as a referral centre for approximately 11 to 40 primary care facilities (Government of the Republic of Malawi, 2017, p. 1-3). District hospitals provide specialized services to patients referred from the primary health care level with the support of laboratory, diagnostic, blood bank, rehabilitation and physiotherapy services.
- Tertiary health care is provided at four tertiary hospitals. These hospitals provide highly specialized services for specific disease conditions or specific groups of patients (WHO African Health Observatory, 2013, section 4.7) referred from the district hospitals. However, the majority of services (70%)

provided are for conditions that should have been treated at the lower tiers (Government of the Republic of Malawi, 2017, p. 1-3).

Malawi has approximately 33,470 health workers and they tend to be concentrated in urban areas (Africa Health Workforce Observatory, 2009, p. 8). Health surveillance assistants (HSAs) are a community level workforce providing health promotion and preventive health care through door-to-door visitations and outreach clinics. HSAs constitute approximately 30% of all the staff working in the sector. Each HSA is responsible for about 1,500 people (Government of the Republic of Malawi, 2017b, p. 2-3).

In 2016, Malawi has approximately 2 doctors for every 100,000 people and 25 nurses/midwives for every 100,000 people (World Bank https://data.worldbank.org/indicator/SH.MED.PHYS.ZS). Since 2004, the Government adopted an essential health package (EHP) which is comprised of 55 interventions (Bowie & Mwase, 2011, p. 1-10). Although the purpose of the EHP is to further health service coverage, Malawians living in poor and/or rural areas, experience uneven distribution/access of health services (Abiiro et al., 2014, p. 6 & 9).

Management

Malawi embarked on the process of decentralizing health service delivery in 2004. At the central level, the Ministry of Health is responsible for policy making, strategic planning, setting standards, quality assurance, resource mobilization, technical support, monitoring and evaluation and international representation. Five zonal Quality Management Offices are an extension of the central level and provide technical support to districts. The District Health Offices (DHOs) are responsible for managing all public health facilities at district level and directing provision of both primary and secondary level health services at district level. DHOs report to District Commissioners who are under Ministry of Local Government.

Mozambique

Mozambique uses four types of service provider: public, private (not for profit and for profit), community level, and traditional medicine practitioners (Republic of Mozambique, 2014, p. 30).

Public health service is delivered through the National Health Service (NHS). Although coverage is limited, the NHS continues to be the largest provider of health services in Mozambique (Ministry of Health Directorate of Planning and Cooperation, 2015, p. 37-8; and Visser-Valfrey & Umarji, 2010, p. 21). There is no data on the use of services in the private sector (Republic of Mozambique, 2014, p. 30). Private for-profit service providers are mostly limited to urban areas whereas non-profit private sector service providers tend to be at the community level and run by NGOs and faith-based organizations (Republic of Mozambique, 2014, p. 30 & 34). Community level service providers are supported by the Government or NGOs and tend to focus on outreach services, health campaigns and basic services provided by Community Health Agents (Agentes Comunitários de Saúde) and Community Health Workers, Traditional Birth Attendants (TBAs) and other Community Health Agents (Republic of Mozambique 2014, p. 34-5). However, most Mozambicans first turn to traditional medicine when seeking healthcare. The coverage of traditional medicine practitioners in Mozambique offering primary health care services at community level is approximately 70%, with a ratio of one traditional medicine practitioner per 200 community members (Republic of Mozambique, 2014, p. 35) and noting that 41% of household health expenditure is directed towards traditional medicine practitioners (Ministry of Health Directorate of Planning and Cooperation, 2015, p. 19). Traditional medicine practitioners form an important part of health service delivery with practitioners constituting a separate, parallel, and self-regulating health service that collaborates with the Mozambique Government in the provision of health services. Comparatively, the MoH in Malawi has had a weak relationship with traditional healers and little is mentioned in the National Health Strategic Plan on traditional medicine (Government of the Republic of Malawi Ministry of Health, 2011).

Mozambique has a four-tier public health care delivery system:

- Primary health care consists of health centres and health posts and provide primary health services;
- Secondary care is provided at district hospitals, general hospitals and rural hospitals and provide primary health services;
- Tertiary health care is provided at provincial hospitals; and

- Quaternary care is provided at specialized hospitals that provide differentiated care by specialists (Republic of Mozambique, 2014, p. 30).

Mozambique has approximately 34,500 health workers (Republic of Mozambique, 2014, p. 31). In 2011, Mozambique has 5 doctors for every 100,000 people and 40 nurses/midwives for every 100,000 people ((Republic of Mozambique, 2014, p. 86), almost double that of Malawi for both cadres of health staff. Refer to Table 8.2. However, this calculation fails to show that more than half of the country's doctors work in the capital city where the inhabitants to doctor ratio is 5,092:1 whereas in the province of Zambezia the ratio is 168,637:1 (Visser-Valfrey & Umarji, 2010, p. 21).

Table 8.2

Comparative Human Resources for Health Data

	Doctor's/100,000 Population	Nurses and Midwives/100,000 Population
Malawi (2016)	2	25
Mozambique (2013)	5	40

The Government of Mozambique has not yet adopted an integrated essential package of health services. Instead, the health system is structured around health programmes which tend to be vertical, financed through donors, and characterized geographic inequity.

Management

At the central level, the Ministry of Health is responsible for policy making, strategic planning, coordination, resource mobilization and allocation of funds, monitoring implementation plans and the health status of the population. The Provincial Health Directorate (Direcção Provincial de Saúde, DPS), reporting to the Provincial Governor, is responsible for coordinating the development and implementation of provincial sector plans, monitoring progress, distributing resources and providing logistical and technical support to districts (Republic of Mozambique, 2014, p. 39).

At the district level, the District Services for Health, Women and Social Action (Serviços Distritais de Saúde, Mulher e Acção Social, SDSMAS), reporting to the District Administrator, manage health sector resources and health services. Town council manage health facility operations at a primary level. Although MoH and NHS functions are separate, in practice the MoH, DPSs and SDSMASs share financing, supervisory and service provider functions.

8.4 Health financing system

Both Malawi and Mozambique share a similar financing system whereby they have moved away from project-based approaches to health development to a Sector-Wide Approach (SWAp) (African Development Bank, 2005, p. 13). Both countries adopted a SWAp to improve the overall management of the health sector by providing a common framework for planning, budgeting and performance monitoring (Pearson, 2010, p. 13; Visser-Valfrey & Umarji, 2010, p. 29 - 32). Both countries initiated their health SWAps at roughly the same times, 1999 for Malawi and 2000 for Mozambique, noting that Malawi took several years to operationalize the SWAp (WHO, 2019; and African Development Bank, 2005, p. 13).

In the Malawian health SWAp, funding from the government and donors were pooled together to finance a programme of work, a multi-year joint plan for the health sector that covered seven components: human resources, pharmaceutical and medical supplies, essential basic equipment, infrastructure/facility development, routine operations at service delivery level, systems support and development – non-district level operations (Chansa & Pattnaik, 2018, p. 18; and African Development Bank, 2005, p. 22). The programme of work focuses on the delivery of an essential package of health services (UNICEF, 2017, p. 1-2 & 7; and Ergo et al., 2010, p. 1, 16-17). The package of essential health services consists of several cost-effective interventions delivered together to reduce the total cost of the interventions.

The programme of work for the SWAp adopted various funding modalities (modes) to capture as many funding sources as possible despite different funding mechanisms from donors:

- Mode I (Pool/Basket Funding) - Under Mode I, contributions from collaborating donors are channeled directly to the MOH and deposited in a common bank account. These funds are controlled by the MOH and are available for the entire sector. (This is the preferred mode by the MOH).
- Mode II - Under Mode II, contributions are channeled directly to the MOH. These funds are be controlled by the MOH and they will be available for the entire sector. However, unlike Mode I, funds are deposited in separate accounts, not in a common account.
- Mode III - Under Mode III, contributions from collaborating donors are channeled directly to the MOH. These funds are controlled by the MOH. As in Mode II, these funds are deposited in separate bank accounts however these funds are only for specific activities.
- Mode IV - Under Mode IV, these funds are channeled directly to either an activity implementation team or a relevant entity and are not controlled by the MOH. They are available for a specific activity under a sub-programme of programme of work. They are deposited in separate individual accounts as appropriate (African Development Bank, 2005, p. 18).

A Memorandum of Understanding (MOU) was signed between the Government of Malawi and its development partners to finance and support the programme of work. The MOU provides for a common framework for health sector planning, budgeting, financing, financial management, and reporting and monitoring and evaluation, as well as agreement on both yearly and mid-term reviews (African Development Bank, 2005, p. 15).

Mozambican health SWAp was used as a forum for policy dialogue based on the Sector Wide Health Strategic Plan. The Government of Mozambique has not yet adopted an integrated essential package of health services. Instead, the health system was structured around vertical health programmes and financed through donors (Government of the Republic of Mozambique, 2014, p. 85).

Financial support for the Sector Wide Health Strategic Plan was provided through several common funds. Until 2008, three common funds were used in Mozambique: the Provincial Common Fund, the Common Fund for Drugs, and ProSaúde I. In 2008,

the first two were merged into ProSaúde II, which became the only joint funding mechanism to the sector (Swiss Cooperation Mozambique, 2013, p. 1). With ProSaúde II, resources were managed by MOH using national procedures; were reflected on budget; channeled through a single treasury account; follow government procurement policy; and required an external audit (UNICEF, 2017b, p. 7). Approximately 30% of external funding was channeled through the ProSaúde (WHO, 2019) however donors could still contribute through bilateral projects and in-kind donations of medicines and medical equipment (UNICEF, 2017b, p. 7). These contributions may be on budget and channeled through the single treasury account or they may not (UNICEF, 2017b, p. 4).

The Provincial Directorate for Planning and Finance determines allocation and distributes state budget to the Provincial Health Directorate. The Ministry of Health defines and earmarks ProSaúde funds across the health system and to Provincial Health Directorate. The Provincial Health Directorate allocates and distributes ProSaúde and the state budget to the districts (Ministry of Health Directorate of Planning and Cooperation, 2015, p. 111). Both ProSaúde and the Malawian SWAp experienced slowdowns with donors utilizing the SWAps. It is noted that the health SWAp has been abandoned in Malawi. Instead, other pooled funding mechanisms have emerged including the Health Sector Joint Fund (UNICEF, 2017, p. 7).

Both countries use a majority of health funding at the central level with approximately 61% and 59% held centrally in Malawi and Mozambique (UNICEF, 2017, p. 8; and UNICEF, 2017b, p. 16). The majority of funds were used for the purchasing of medicines and health supplies. Since 2012, 71 per cent of the donor funding channeled through the ProSaúde was expensed at the central level; 29 per cent at the provincial level, and 0 per cent at the district level. In comparison, the Malawian Government expensed 49 per cent at the central level, 28 per cent at the provincial level, and 23 per cent at the district level (UNICEF, 2017b, p. 6-9).

In Malawi, the government is set up by regions/zones and then districts. The district health budgets are financed through (1) the Ministry of Finance (MoF) with funding sourced from domestic sources (tax revenue) or through general budget support from donors; (2) donor funding from the SWAp which is channeled through the MOH; or (3) donor funding that is channeled straight to Local Councils through the Local

Government Financing Committee or through non-government channels as vertical (discrete) programmes (Borghi et al., 2018, p. 61; and UNICEF, 2017, p. 4). The financing is based on health budgets developed by District Health Management Team (DHMT), in consultation with service providers and communities, and based on their implementation plans for service delivery (Borghi et al., 2018, p. 60).

Similarly, in Mozambique, the government is set up by provinces and then districts. Provinces are responsible for the overall health administration and districts manage health resources for primary and secondary care (Ministry of Health Directorate of Planning and Cooperation, 2015, p. 24 & 39). Interestingly, there are no financial transfers to health facilities aside from salaries and provision of in-kind resources that have been procured centrally, provincially or at district level depending on the input (Ministry of Health Directorate of Planning and Cooperation, 2015, p. 95).

8.5 Health Financing

Malawi

Across the years included in this work, the mean GDP per capita for Malawi was US$323.34. GDP per capita rose from US$153.26 in 2000 to US$354.32 in 2014, noting however that from 2008 to 2012, GDP per capita was higher than that recorded in 2014. It was noted that there were year after year increases in GDP per capita between 2004 and 2011 after which there was a significant drop. Refer to Table 8.3.

Table 8.3

Malawian statistical information: GDP per capita, total health expenditure as a per cent of GDP, annual health expenditure and total health expenditure per capita (2000-2014)

Year	GDP per Capita (US$)	Total Health Expenditure as a % of GDP	Annual Health Expenditure (US$ millions)	Total Health Expenditure per Capita
2000	153.26	6.44	677	60.31
2001	146.76	5.51	547	47.52
2002	290.98	5.23	556	47.09
2003	260.11	7.11	791	65.33
2004	274.23	8.80	1,062	85.38
2005	280.37	9.63	1,206	94.31
2006	297.71	10.21	1,339	101.75
2007	320.28	10.97	1,630	120.43
2008	372.85	12.07	1,910	137.17
2009	420.75	11.18	1,785	124.50
2010	458.87	10.87	1,818	123.15
2011	512.17	13.63	2,420	159.16
2012	374.50	13.37	2,376	151.56
2013	332.92	12.24	2,196	135.72
2014	354.32	12.94	2,473	148.16
Mean	323.34	10.01	1,520	106.77

The mean total health expenditure as a per cent of GDP was 10.01%. Total health expenditure increased from 6.44% in 2000 to 12.94% in 2014, noting that in 2011 and 2012, total health expenditure was higher than that reported in 2014. Year after year increases were seen from 2002 to 2008; and from 2010 to 2012. Refer to Table 8.3.

The mean annual health expenditure across all years (rounded to the nearest million) was US$1,520 million. Annual health expenditure increased from US$677 million in

2000 to US$2,473 million in 2014. Year after year increases were seen from 2002 to 2008; and 2009 to 2011. Refer to Table 8.3.

The mean total health expenditure per capita across all years was US$106.77. total health expenditure per capita increased from US$60.31 in 2000 to US$148.16 in 2014, noting that in 2011 and 2012, the total health expenditure per capita was higher than that in 2014. Year after year increases were seen from 2002 to 2008; and 2010 to 2011. Refer to Table 8.3.

Mozambique

Across the years included in this work, the mean GDP per capita for Mozambique was US$420.15. GDP per capita rose from US$277.65 in 2000 to US$623.29 in 2014. It was noted that there were year after year increases in GDP per capita between 2001 and 2008; and 2010 to 2014. Refer to Table 8.4.

Table 8.4

Mozambican statistical information: GDP per capita, total health expenditure as a per cent of GDP, annual health expenditure and total health expenditure per capita (2000-2014)

Year	GDP per Capita (US$)	Total Health Expenditure as a % of GDP	Annual Health Expenditure (US$ millions)	Total Health Expenditure per Capita
2000	277.65	6.96	797	43.65
2001	256.44	6.34	809	43.08
2002	262.88	6.89	979	50.61
2003	283.89	7.00	1,066	53.50
2004	336.33	6.66	1,103	53.75
2005	369.15	7.76	1,397	66.14
2006	385.76	6.67	1,304	60.05
2007	422.15	6.06	1,263	56.55
2008	503.13	6.20	1,375	59.82

2009	463.85	6.03	1,397	59.08
2010	419.23	5.73	1,380	56.72
2011	526.53	5.93	1,502	60.05
2012	566.05	5.64	1,532	59.53
2013	605.99	5.78	1,720	65.00
2014	623.29	7.76	2,493	91.58
Mean	420.15	6.49	1,340	58.61

The mean total health expenditure as a per cent of GDP was 6.49%. Total health expenditure ranged from 5.64% in 2012 to 7.76% in 2005 and 2014. Refer to Table 8.4.

The mean annual health expenditure across all years (rounded to the nearest million) was US$1,340 million, lower than that seen for Malawi. Annual health expenditure had a steady increase from US$791 million in 2000 to US$2,493 million in 2014. Refer to Table 8.4.

The mean total health expenditure per capita across all years was US$58.61, almost half of that seen for Malawi. Total health expenditure per capita increased from US$43.65 in 2000 to US$91.58 in 2014. Year after year increases were seen from 2001 to 2005; 2006 to 2008; and 2012 to 2014. Refer to Table 8.4.

Comparisons

GDP per capita is more than US$100 higher per person in Mozambique than in Malawi. Malawi, however, spends more on health with US$200 million more spent annually on health than Mozambique; total health expenditure as a per cent of GDP higher by 3.5% per cent; and total health expenditure per capita almost double of that in Mozambique. Refer to Table 8.5.

Table 8.5
Comparison of key health financing indicators for Malawi and Mozambique (2000 – 2014)

Country	GDP per Capita (US$)	THE as per cent of GDP (%)	Mean THE (US$ millions)	Total Health Expenditure per Capita (US$)
Malawi	323.34	10.01	1,520	106.77
Mozambique	420.15	6.49	1,340	58.61

8.6 Sources of Health Financing

Malawi

Of the countries included in this work, Malawi has one of the highest mean government expenditures on health as a per cent of total health expenditure (39.84%) for a low-income country, noting that Ghana and Mauritania had more government expenditure on health as a per cent of total health expenditure in this work. Government expenditure on health as a per cent of total health expenditure ranged from 23.00% in 2007 to 58.55% in 2005, noting that the annual health expenditure increased to US$1,630 million in 2007 from US$1,206 million in 2005. Refer to Table 8.12.

Of the countries included in this research, Malawi had the second lowest combined amounts of private and out of pocket expenditure on health as percentages of THE, after Mozambique, at 21.65%. Across the years in this work, the mean private expenditure on health as a per cent of total health expenditure was 10.57%. Private expenditure on health as a per cent of total health expenditure ranged from 1.42% in 2003 to 26.13% in 2007, the year in which Government expenditure on health as a per cent of total health expenditure was at its lowest. Refer to Table 8.12.

The mean out of pocket expenditure on health as a per cent of total health expenditure was 11.08%. A decreasing trend could be seen across the years from 20.68% in 2000 to 9.35% in 2014, noting however that the highest value was 22.00% in 2001 and the lowest 7.01% in 2011. Refer to Table 8.12. From 2000 to 2014, the mean development

assistance for health expenditure as a per cent of total health expenditure was 38.50%. Development assistance for health expenditure as a per cent of total health expenditure ranged from 29.57% in 2005 to 53.15% in 2013. Refer to Table 8.12.

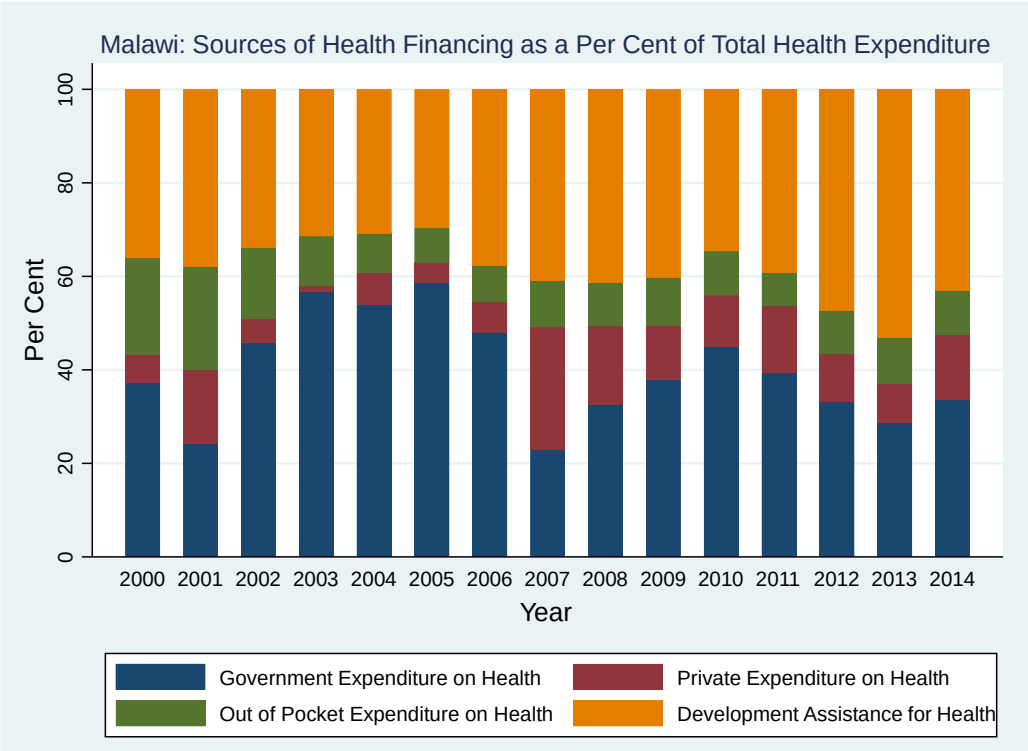
Table 8.12

Malawi Sources of Health Expenditure as a Per Cent of Total Health Expenditure between 2000-2014

Year	Government Expenditure on Health as a % of THE	Private Expenditure on Health as a % of THE	Out of Pocket Expenditure on Health as a % of THE	Development Assistance for Health as a % of THE
2000	37.25	5.98	20.68	36.09
2001	24.18	15.84	22.00	37.98
2002	45.88	4.99	15.24	33.88
2003	56.62	1.42	10.53	31.43
2004	53.93	6.81	8.37	30.90
2005	58.55	4.38	7.51	29.57
2006	48.05	6.47	7.76	37.71
2007	23.00	26.13	9.94	40.92
2008	32.47	16.98	9.19	41.35
2009	37.91	11.62	10.23	40.24
2010	45.03	10.94	9.39	34.64
2011	39.27	14.50	7.01	39.22
2012	33.09	10.39	9.23	47.29
2013	28.82	8.18	9.85	53.15
2014	33.54	13.98	9.35	43.13
Mean	39.84	10.57	11.08	38.50

Figure 8.1

Malawi Source of Health Expenditure by Year



Mozambique

Across the years in this work, the mean government expenditure on health as a per cent of total health expenditure was 24.07%. Surprisingly, government expenditure on health as a per cent of total health expenditure dramatically decreased from 49.52% in 2000 to 10.60% in 2014, with several years (2010 – 2013) having zero government expenditure on health as a per cent of total health expenditure. Refer to Table 8.13.

Mozambique had the lowest combined amounts of private and out of pocket expenditure on health as percentages of THE of the countries included in this research at 9.28%. Across the years in this work, the mean private expenditure on health as a per cent of total health expenditure was 0.74%. Private expenditure on health as a per cent of total health expenditure was relatively similar across the years ranging from 0.39% in 2004 to 1.41% in 2011. Refer to Table 8.13.

The mean out of pocket expenditure on health as a per cent of total health expenditure was 8.54%. Out of pocket expenditure on health as a per cent of total health expenditure ranged from 4.87% in 2008 to 11.52% in 2004. Refer to Table 8.13.

Of the countries included in this work, Mozambique has the second highest development assistance for health as a per cent of total health expenditure at 66.65%, after Liberia. Development assistance for health expenditure as a per cent of total health expenditure had an increasing trend from 38.92% in 2000 to 80.24% in 2014, noting that from 2008 to 2014, development assistance for health was over 80% and for four of those years, over 90% of total health expenditure. Refer to Table 8.13.

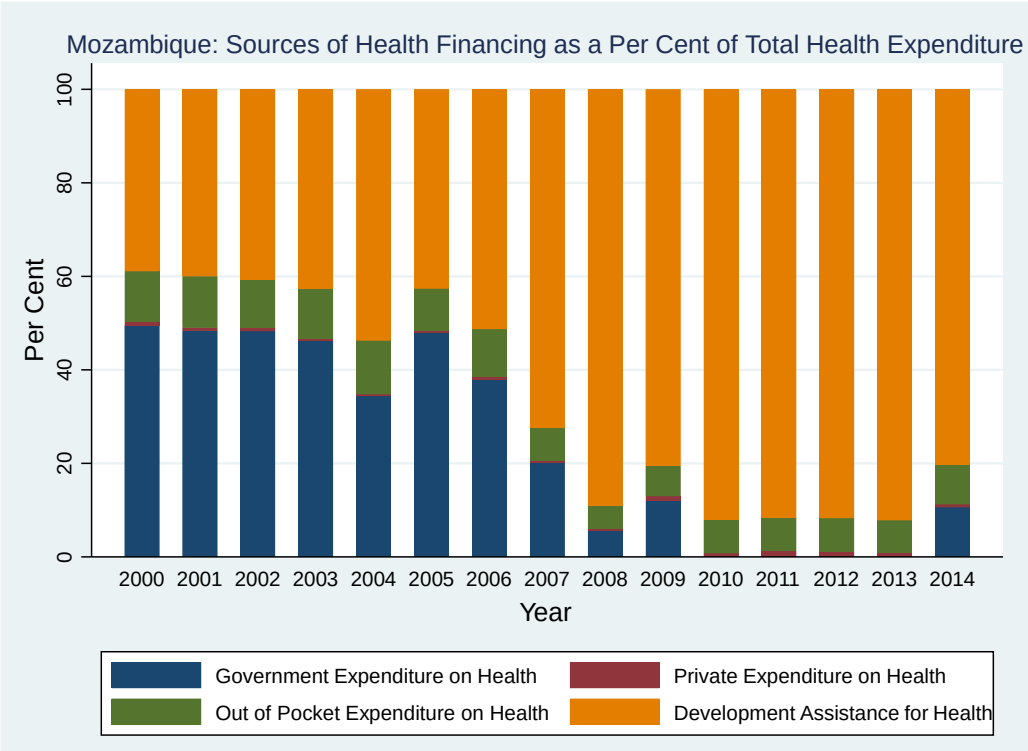
Table 8.13

Mozambique Sources of Health Expenditure (as a % of THE) between 2000-2014

Year	Government Expenditure on Health as a % of THE	Private Expenditure on Health as a % of THE	Out of Pocket Expenditure on Health as a % of THE	Development Assistance for Health as a % of THE
2000	49.52	0.76	10.79	38.92
2001	48.37	0.67	10.97	40.00
2002	48.26	0.82	10.18	40.74
2003	46.22	0.46	10.69	42.63
2004	34.38	0.39	11.52	53.71
2005	47.92	0.44	9.02	42.61
2006	37.94	0.67	10.10	51.29
2007	20.09	0.55	6.96	72.40
2008	5.58	0.48	4.87	89.07
2009	12.10	0.90	6.43	80.56
2010	0.00	0.76	7.24	92.00
2011	0.00	1.41	6.90	91.69
2012	0.00	1.16	7.10	91.74
2013	0.00	0.95	6.86	92.19
2014	10.60	0.64	8.52	80.24
Mean	24.07	0.74	8.54	66.65

Figure 8.2

Mozambique Sources of Health Expenditure by Year



Comparisons

Table 8.14 below shows a comparison of sources of health financing as percentages of total health expenditure by country.

Table 8.14

Sources of Health Expenditure as a Per Cent of Total Health Expenditure for Malawi and Mozambique (2000 – 2014)

	Country	
	Malawi	**Mozambique**
Government Health Expenditure per THE (%)	39.84	24.07
Private Health Expenditure per THE (%)	10.57	0.74
Out Of Pocket per THE (%)	11.08	8.54
Development Assistance for Health per THE (%)	38.50	66.65

8.6 Health Outcomes

Malawi

Life expectancy at birth increased from 45 to 61 years between 2000 and 2014 (World Bank), largely due to reductions in mortality from HIV/AIDS (UNAIDS, 2019). According to UNAIDS estimates, HIV/AIDS adult prevalence rate was 14.7% in 2000 and has reduced to 10.3% in 2014.

Under-five mortality per 1,000 live births improved from 171.90 in 2000 to 65.70 in 2014. The infant mortality rate declined from 101.10 per 1,000 live births in 2000 to 44.10 in 2014 and the neonatal mortality rate declined from 39.40 per 1,000 live births in 2000 to 25.00 in 2014 (World Bank). This could be partially attributable to declines in HIV prevalence and access to treatment as well as reductions in malaria incidence from 499 cases per 1,000 in 2000 to 244 per 1,000 in 2014 (World Bank) and reductions in malnutrition as shown in the decreased prevalence of stunting for children under-five from 54.6% in 2000 to 42.4% in 2014 (World Bank). The maternal mortality ratio dropped from 890 per 100,000 live births in 2000 to 638 in 2014 (World Bank). This could be partially attributable to improvements in the proportion of births with medical assistance from 56% in 2000 to 87% in 2014 (World Bank).

Table 8.15

Malawi under-five, infant, neonatal and maternal mortality data for 2000 - 2014

Year	Under-Five Mortality	Infant Mortality	Neonatal Mortality	Maternal Mortality
2000	171.90	101.10	39.40	890.00
2001	159.60	94.40	37.30	868.00
2002	146.40	87.10	35.30	839.00
2003	133.70	80.20	33.60	783.00
2004	122.60	74.00	32.10	699.00
2005	113.90	69.20	31.00	648.00
2006	107.70	65.80	30.20	614.00
2007	103.10	63.40	29.80	613.00
2008	97.70	60.50	29.50	629.00

2009	93.20	58.40	29.10	633.00
2010	88.60	56.20	28.50	629.00
2011	83.10	52.90	27.70	618.00
2012	75.90	49.20	26.90	624.00
2013	70.40	46.40	25.90	636.00
2014	65.70	44.10	25.00	638.00
Mean	108.90	66.86	30.75	690.73

Figure 8.3

Malawi Child Mortality by Year

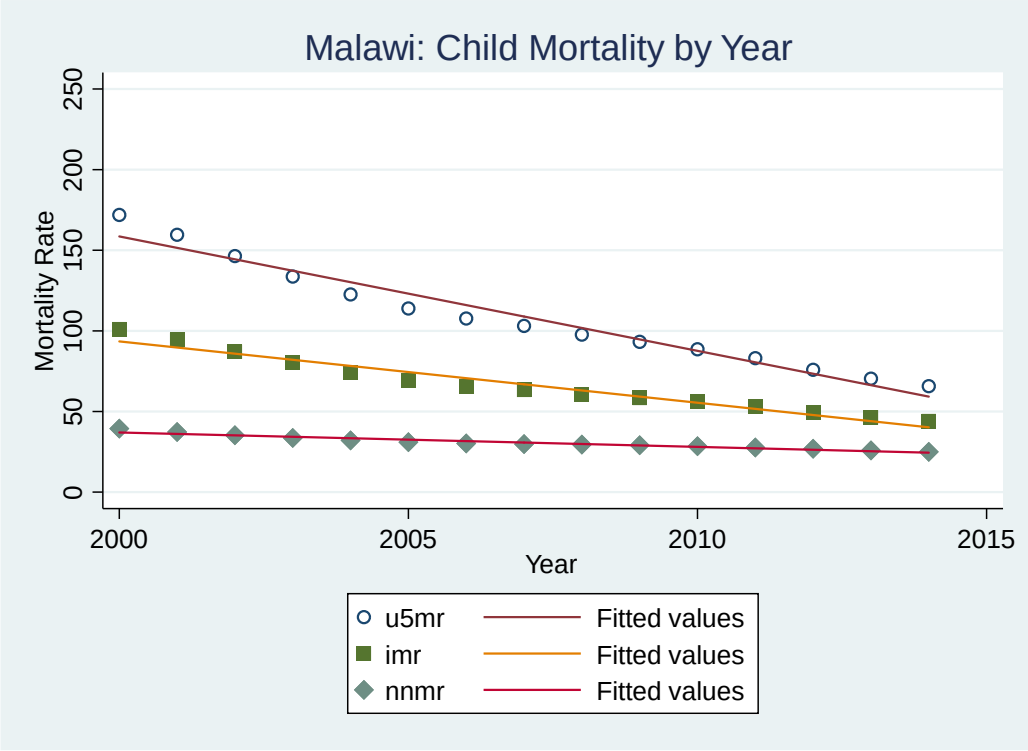
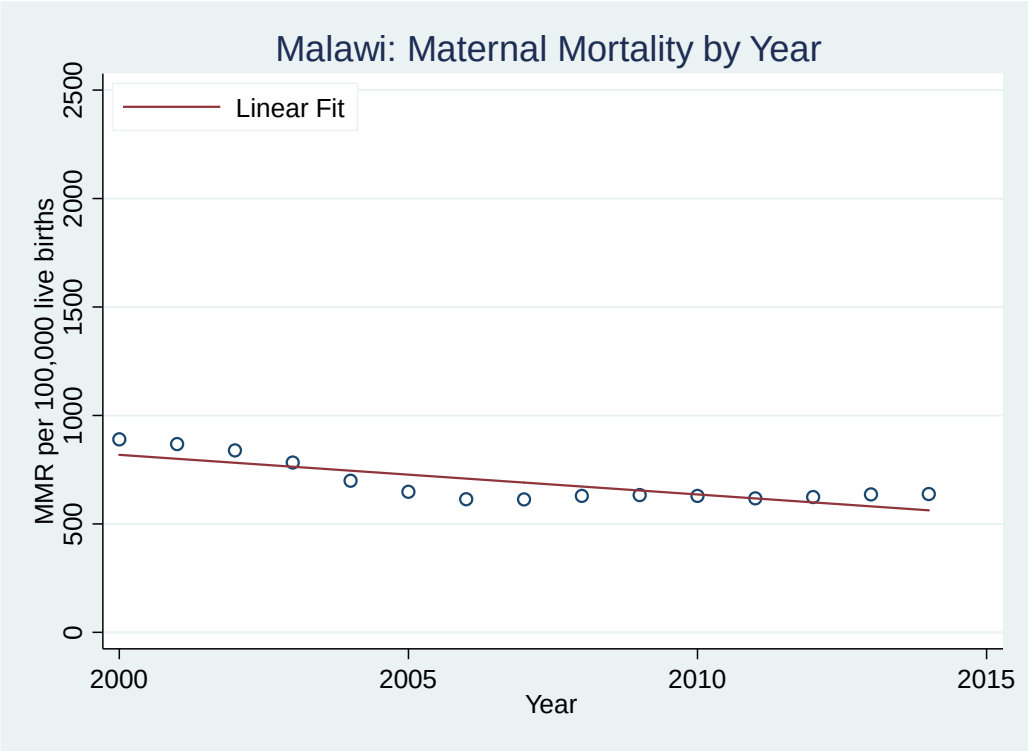


Figure 8.4
Malawi Maternal Mortality by Year



Mozambique

Life expectancy at birth increased from 49 to 56 years between 2000 and 2014 (World Bank) but did not improve as much as in Malawi. It was noted that HIV/AIDS adult prevalence rate increased from 8.8% in 2000 to 12.4% in 2014 (UNAIDS estimates), whereas the HIV/AIDS prevalence rate was decreasing in Malawi during the same period. This may have contributed to lower improvements in life expectancy in Mozambique.

Under-five mortality per 1,000 live births improved from 170.40 in 2000 to 83.20 in 2014, which was a smaller improvement than that seen in Malawi. The infant mortality rate declined from 113.30 per 1,000 live births in 2000 to 58.90 in 2014 and the neonatal mortality rate declined from 44.00 per 1,000 live births in 2000 to 28.70 in 2014 (World Bank). Improvements in infant and neonatal mortality were relatively similar between both countries. However, for malaria, a major contributor to child mortality, the decline in incidence was much lower than that of Malawi from 457 cases per 1000 in 2000 to 346 per 1,000 in 2014 (World Bank). Moreover, there was little

improvement in the prevalence of stunting for children under-five was 49.6% in 2000 reducing to 43.1% in 2011 (latest available data) (World Bank).

The maternal mortality ratio dropped from 915 per 100,000 live births in 2000 to 506 in 2014 (World Bank), a much higher drop than that seen in Malawi over the same period. This is surprising since there was only a marginal improvement in the proportion of births with medical assistance compared that that seen in Malawi from 47.7% in 2003 to 54.3% in 2011 (latest available data) (World Bank). Details of these health outcomes by year can be found in Table 8.16.

Table 8.16

Mozambique under-five, infant, neonatal and maternal mortality data for 2000 - 2014

Year	Under-Five Mortality	Infant Mortality	Neonatal Mortality	Maternal Mortality
2000	170.40	113.30	44.00	915.00
2001	161.80	107.60	42.10	875.00
2002	154.00	102.30	40.50	840.00
2003	146.70	97.40	39.00	804.00
2004	140.00	92.90	37.60	783.00
2005	133.60	88.70	36.40	762.00
2006	127.30	84.60	35.30	741.00
2007	120.50	79.90	34.40	716.00
2008	113.90	76.50	33.40	682.00
2009	107.60	72.80	32.60	646.00
2010	103.10	70.70	31.70	619.00
2011	97.60	66.90	30.90	596.00
2012	92.20	63.50	30.10	563.00
2013	87.20	60.90	29.40	528.00
2014	83.20	58.90	28.70	506.00
Mean	122.61	82.46	35.07	705.07

Figure 8.5

Mozambique Child Mortality by Year

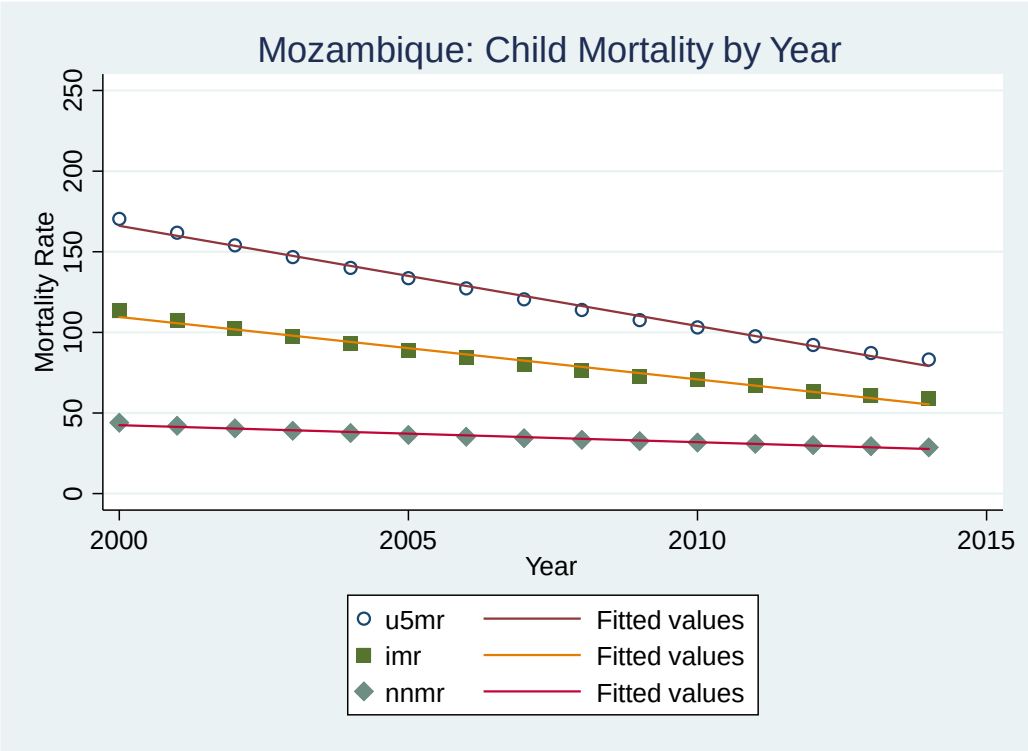
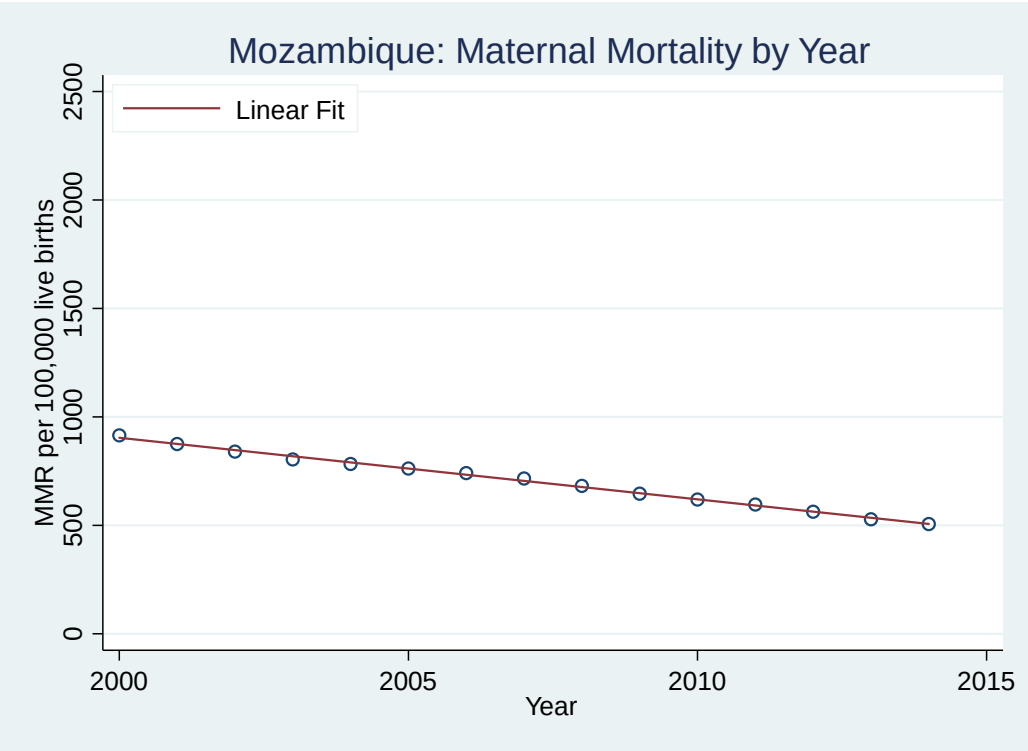


Figure 8.6

Mozambique Maternal Mortality by Year



8.7 Summary

Although Mozambique has a stronger economy, it invests far less in its health sector. Despite relatively close starting points in terms of maternal and under-five, infant and neonatal mortality, these countries showed different rates of improvement with Malawi achieving the biggest improvement in under-five mortality with a reduction of 62% compared to Mozambique that saw a 51% reduction. In contrast, Mozambique showed its biggest improvement in maternal mortality with a 46% reduction whereas Malawi showed a 28%. These differences in achievement may have been affected by the differences in health financing governance, the amount of resources controlled and managed nationally, pooling of government and donor resources and efficiency in the use of funds, all of which will be explored further in the next chapter.

Chapter 9: Discussion

9.1 Introduction

For the last 40 years, the focus for health financing in low- and middle-income countries was centred on increasing external resources for health (OECD, 2003; OECD, 2008; OECD, 2011; and MDG Report, 2015, p.68). However, this focus fails to account for other sources of health financing that countries use to cover the health care needs of their population such as government funding, private financing and out of pocket expenditures (MDG Report, 2015, p. 68 and UN, 2015c). The aim of the first part of this research was to fill the gap in knowledge regarding the impact that the source of health expenditure had on health outcomes (maternal, neonatal, infant and under-five mortality) in sub-Saharan African countries by analyzing existing data from 2000-2014. The first part of this discussion looks at the findings for this objective including the directional relationships between the source of health financing and health outcomes; as well as the scale of impact of the various sources of health expenditure on health outcomes.

The secondary aim of this research was to examine the impact that the source of child health expenditure had on child health outcomes (neonatal, infant and under-five mortality) in sub-Saharan African countries by analyzing existing data from 2000-2014. The second part of this discussion looks at the findings for this objective including the directional relationships between the source of child health financing and health outcomes; as well as the scale of impact of the various sources of child health expenditure on health outcomes.

The third section of this discussion examines the case studies for relationships between health financing sources and health outcomes. The final part of this chapter looks at the policy implications of the findings of this research and potential areas for future work.

9.2 Objective 1: Comparison of sources of health expenditure and their effect on health outcomes (maternal, neonatal, infant and under-five mortality) in sub-Saharan African countries between 2000 and 2014.

The sub-Saharan African countries in this work had a mean per capita health expenditure of US$213.01. Once split by income classification, the mean per capita health expenditure for low-income countries was US$98.69, increasing by almost 2.5 times for lower middle-income countries to US$248.67 and by almost 8 times for upper middle-income countries to US$781.88.

The countries in this work use a mix of resources to finance the health care needs of their population: on average, these countries had 35.2% government expenditure on health as a percent of THE; 7.2% private expenditure on health (refers to private insurance, charitable donations, and direct service payments by private corporations); 36.1% out of pocket expenditure on health (refers direct expenditure by households to health practitioners or for other goods and services for health care needs) and 21.6% development assistance for health as percentages of THE; results that are in line with previous analyses done by WHO (2017 p. 11 -13; and 2016, p. 88 – 89). In dollar value, the mean per capita government health expenditure was US$99.40, private expenditure on health US$27.11, out of pocket expenditure on health US$57.78 and development assistance for health US$28.71. The largest source of health expenditure was government followed by out of pocket expenditure. Per capita development assistance for health was about one-quarter of that spent by government per capita.

Once countries were categorized by income level, the mix of resources used to finance health dramatically different. Government health expenditure as a percent of THE for low-income countries was approximately half (27.7%) of what it was for lower middle- and upper middle-income countries (45.7% and 55.8% respectively). This indicates that low-income countries are relying more heavily on other sources of funding to cover the health care needs of their population. This corresponds to US$466.18 for upper middle-income countries, followed by lower middle-income countries at US$127.10 and low-income countries at US$27.59, the latter representing 6% of what governments in upper middle-income countries are spending on health. In low-income countries, options for mobilizing domestic resources are limited due to a

large informal sector and poorly developed administrative structures which make it difficult to generate revenue through taxation (Gottret and Schieber 2006, p. 48-51 and 213) so the results were in line with available knowledge that the low-income country grouping would have a lower government expenditure on health.

It appears that low-income countries are covering their health financing needs from out of pocket expenditure (38.7%) and development assistance for health (28.40%); which were significantly higher than the proportions used by lower middle- (34.3% and 11.62% respectively) and upper middle-income countries (25.0% and 3.5% respectively). Donors tend to use country income level as one of the main criteria for allocation of funding (Grepin et al., 2018, p. i24; and Ottersen et al., 2017, p. 223) so the result of low-income countries having a larger percentage of development assistance for health was in line with available knowledge. Interestingly, when looking at real values, per capita development assistance for health is relatively similar across the income categories with the higher per capita amount spent in lower middle-income countries at US$30.65, US$28.98 in upper middle-income countries and the lowest for low-income countries US$27.98. This suggests that low-income countries are not getting more assistance from donors. This may be due to diseases like HIV, tuberculosis and malaria that required large investments in upper middle-income countries like South Africa and Botswana and lower middle-income countries like Namibia, Lesotho and Swaziland where the disease burdens are very high.

While the proportion of health expenditure sourced from out of pocket decreased from low-income to upper middle-income countries (38.7%, 34.3% and 25.0% respectively), in real terms per capita out of pocket expenditure on health was highest for upper middle-income countries at US$170.42, followed by lower middle-income countries at US$59.64 and low-income countries at US$37.01. The proportion of health expenditure from private sources was lowest for low-income and highest for upper middle-income countries (5.6%, 8.4% and 15.7% respectively). As low and middle-income countries are characterized by a larger informal work force, the contribution base for private insurance is small (Savedoff, 2004, p. 184; and Kutzin, 1997, p. 5) so the result of upper middle-income countries having the highest percentage of private health expenditure as a per cent of THE was in line with available knowledge. In real terms, private expenditure on health also increased from low-

income to upper middle-income countries (US$6.12, US$31.29 and US$136.30 respectively). This aligns with existing literature that indicates that access to private health insurance schemes is more likely in lower middle- and upper middle-income countries given the greater attention to financial protection from catastrophic health expenditures (Gottret and Schreiber, 2006, p. 244-277).

This research was particularly interested in the effectiveness of different sources of financing to produce health outcomes. It was noted that low-income countries had the lowest combined total of government and donor expenditure as a per cent of THE at 56.1%; lower middle-income countries had 57.4% and upper middle-income countries had 59.4%. This indicates that low-income countries rely more on private and out of pocket expenditures on health than lower middle- and upper middle-income countries. Out of pocket expenditures on health often present a major barrier to accessing health care (WHO https://www.who.int/health_financing/topics/financial-protection/out-of-pocket-payments/en/).

9.2.1 Directional relationships between source of health financing and health outcomes

9.2.1.1 Government health expenditure

Under-five, infant and neonatal mortality

In the model which includes all eligible sub-Saharan countries for this work, per capita government expenditure on health was shown to decrease under-five and infant mortality. When the regressions results were examined by country income level, there were differences in the effect caused by government expenditure on health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

After separating the countries by income level, per capita government expenditure on health did not have any statistically significant results for under-five, infant and neonatal mortality in the low-income countries model. In the lower middle-income countries model, per capita government expenditure on health was associated with decreases in under-five, infant, neonatal mortality. In the upper middle-income countries model, per capita government expenditure on health was associated with decreases in neonatal mortality.

These results suggest that increases in per capita government expenditure on health may decrease under-five, infant and neonatal mortality when all countries are combined and in lower middle-income countries. This is somewhat consistent with existing literature (Dieleman, 2013; Farag et al., 2013; Bokhari et al., 2007; Gottret and Schreiber, 2006; and Issa and Ouattara, 2005) support th. Dieleman (2013) showed that increases in government health expenditure were associated with decreases in under-five mortality for low-income countries. Farag et al. (2013) showed that increases in government health expenditure are associated with decreases in infant and under-five mortality for 133 low- and middle-income countries. Bokhari et al. (2007) showed that increased government health expenditure reduces under-five mortality. Gottret and Schreiber (2006) showed that government health expenditures reduces under-five mortality across 113 countries.

These results seem reasonable considering the types of investments made by governments in sub-Saharan Africa. Primary health care has been shown to improve under-five, infant and neonatal mortality (Black et al., 2017, Perry et al., 2017, Macinko et al., 2009, Bhutta et al., 2008, Starfield et al., 2005, and Macinko et al., 1998). Recent analysis by Vande Maele et al. (2019, p. 5), found that an average of 38.0% of government expenditure on health was spent on primary health care in the 18 sub-Saharan African countries (Benin, Burkina Faso, Burundi, Cameroon, Congo, Cote d'Ivoire, DRC, Gambia, Ghana, Guinea, Malawi, Mali, Mauritania, Nigeria, Senegal, Sierra Leone, Uganda and Tanzania) ranging from 19.3% in Cote d'Ivoire to 71.8% in Ghana (Vande Maele et al., 2019, p. 5). In addition, 29.5% of government expenditure on health was used to finance human resources for health in 14 African countries (Hernandez et al., 2006, p. 3). The health workforce is critical for the effective delivery of health services and there is evidence that investments in this area

are correlated with improved under-five, infant and maternal survival (Anyangwe & Mtonga, 2007, p. 97; WHO, 2006, p. xv & 68; and Hernandez et al., 2006, p. 3).

The effect of per capita government expenditure on health on reducing infant mortality increased in scale from the all countries model to the lower middle-income countries model. The scale of the effect of per capita government expenditure on health on neonatal mortality appeared to reduce from lower middle-income countries compared with upper middle-income countries. This may reflect the different types of investments required in upper-middle income countries to address neonatal mortality. Neonates are much more likely to die in a lower-income country than in higher-income countries (WHO, 2020). In higher-income countries, most neonatal deaths occur in neonates born weighing less than 1500 grams, and thus they require highly technical and expensive newborn intensive care (Belizan et al, 2015, p. 2).

Maternal mortality

In the model which includes all eligible sub-Saharan countries for this research, per capita government expenditure on health was associated with increases in maternal mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita government expenditure on health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

Per capita government expenditure on health was associated with increases in maternal mortality in low-income countries but decreases in maternal mortality in lower middle-income countries. This may indicate that low-income countries are not investing sufficiently or perhaps efficiently in addressing causes of maternal mortality.

While there were mixed results, existing literature (Ogu and Ephraim-Emmanuel, 2018; Maruthappu et al., 2014; Bokhari et al., 2007; Kruk et al., 2007; and Gottret and Schreiber, 2006). Ogu and Ephraim-Emmanuel (2018) found that government expenditure on health was important for reducing maternal mortality. Maruthappu et al. (2014) showed that a 1% decrease in government health spending was associated

with significant rises in maternal mortality rates in 24 European Union countries from 1981 to 2010. Bokhari et al. (2007) and Gottret and Schreiber (2006), showed that increased government health expenditure reduces maternal mortality. These two studies used cross-sectional methods rather than a panel method as in this research and they covered 127 and 113 countries, respectively, across the world regardless of country income level. Kruk et al. (2007) showed that the government share of health care spending is associated with the presence of a skilled birth attendant and increases in Caesarean sections, essential interventions to reduce maternal mortality, which suggest that higher shares of government health expenditure in relation to the total health expenditure result in reduced maternal mortality. The work of Kruk et al. (2007) is also cross-sectional and covered 42 low and lower middle-income countries across the world. It was noted that work by Pérez-Pérez et al. (2019) found that the incidence of maternal mortality was independent of government expenditure on health.

It was surprising that the results were less conclusive given other evidence available. Primary health care, which includes antenatal care, has been shown to improve maternal mortality (Black et al., 2017, Perry et al., 2017, Macinko et al., 2009, Bhutta et al., 2008, Starfield et al., 2005, and Macinko et al., 1998). Work by Vande Maele et al. (2019, p. 5), found that an average of 38.0% of government expenditure on health was spent on primary health care in the 18 sub-Saharan African countries (Benin, Burkina Faso, Burundi, Cameroon, Congo, Cote d'Ivoire, DRC, Gambia, Ghana, Guinea, Malawi, Mali, Mauritania, Nigeria, Senegal, Sierra Leone, Uganda and Tanzania) ranging from 19.3% in Cote d'Ivoire to 71.8% in Ghana (Vande Maele et al., 2019). However, Bokhari et al. (2007) indicates that antenatal care, a component of primary health care, is not sufficient to reduce maternal mortality and that investments in hospitals and referral systems, protocols to assist in determining at which point a woman requires referral to a higher level of care, are important for mothers experiencing complications. Hernandez et al. (2006, p. 3) showed that 29.5% of government expenditure on health was used to finance human resources for health in 14 African countries. The health workforce is critical for the delivery of health services and there is evidence that investments in this area are correlated with improved maternal survival (Anyangwe & Mtonga, 2007, p. 97; WHO, 2006, p. xv & 68; and Hernandez et al., 2006, p. 3). Perhaps the human resources are not sufficiently allocated for maternal health interventions and/or there are issues in the quality of care

which may be why government expenditure on health was not shown to reduce maternal mortality.

9.2.1.2 Development assistance for health expenditure

Under-five, infant and neonatal mortality

In the model which includes all eligible sub-Saharan countries for this research, per capita development assistance for health did not have any statistically significant effects on under-five, infant and neonatal mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita development assistance for health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

After separating the countries by income level, per capita development assistance for health was associated with decreases in under-five, infant and neonatal mortality for low-income countries. In the lower middle- and upper middle-income countries models, per capita development assistance for health did not have any statistically significant effects on under-five, infant and neonatal mortality. It was noted that low-income countries had 28.4% of total health expenditure coming from development assistance whereas lower middle-income countries had 11.6% and upper middle-income countries had 3.5%. In real values, per capita development assistance for health is relatively similar across the income categories with the higher per capita amount spent in lower middle-income countries at US$30.65, US$28.98 in upper middle-income countries and the lowest for low-income countries US$27.98. The difference in effect on under-five, infant and neonatal mortality may reflect the inherently different types of investments made by donors. Donors tend to be earmarked for malaria, vaccinations, HIV treatment etc. which significantly contribute to addressing the biggest causes of under-five deaths in sub-Saharan Africa. While a considerable amount of infant and neonatal mortality is also preventable, the causes of mortality are more likely to need specialized interventions, often which are not funded by donors. Hence, the larger scale of effect on under-five mortality is aligned with what is known about donor investments.

These results suggest that increases in per capita development assistance for health may decrease under-five, infant and neonatal mortality in low-income countries. These results are consistent with existing literature (Akachi and Atun, 2011; Bendavid & Bhattacharya, 2009; and Mishra and Newhouse, 2009). Akachi and Atun (2011) showed that ODA for malaria prevented deaths in sub-Saharan African countries. Bendavid & Bhattacharya (2009) found PEPFAR funded countries showed a 10.5% reduction annually in the number of HIV-related deaths which equated to a reduction of roughly 0.5 HIV-related death per 1,000 population compared with non-PEPFAR funded countries. Mishra and Newhouse (2009) found that doubling per capita health aid is associated with a 2 per cent reduction in the infant mortality rate, with statistical significance at 10%.

Given the relatively small percentage of health expenditure which is attributable to donors in the lower middle- and upper middle-income countries models, it seems reasonable that this source of health expenditure did not have a statistically significant effect on under-five, infant and neonatal mortality.

Maternal Mortality

In the model which includes all eligible sub-Saharan countries for this work, per capita development assistance for health was associated with decreases in maternal mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita development assistance for health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

Per capita development assistance for health was associated with decreases in maternal mortality in low-income countries. In the lower middle- and upper middle-income countries models, per capita development assistance for health did not have any statistically significant effects on maternal mortality. It is noted that upper middle-income countries have the least development assistance for health as a per cent of total health expenditure compared with low- and lower middle-income countries. This may

have limited the effects of such investments and/or limited the ability to see the effects in the model used for this work.

Looking at the existing literature, Banchani and Swiss (2019) indicate that the effects of development assistance for health on maternal mortality in a sample of 130 low- and middle-income countries from 1996 to 2015 are limited. However, while general donor investment in health has limited effect on maternal mortality, Banchani and Swiss (2019) showed that development assistance for health that is allocated to the reproductive health sector and directly at maternal health was associated with reductions in maternal mortality. This may suggest that a model that focused on reproductive and maternal health allocations from development assistance for health may be more sensitive to pick up the effects that development assistance may have on maternal mortality. It is noted that very few countries detail government and donor investments in reproductive and maternal health. This should be encouraged so there can be greater insight into the respective effects on maternal health outcomes.

Gottret and Schreiber (2006) showed that donor funding does not directly impact maternal mortality; maternal mortality is affected indirectly by increasing the impact of government health expenditures. Bokhari et al. (2007) showed donor funding commitments were related to decreases in maternal mortality but the authors suggest that donor funding may not in fact effect maternal mortality due to attenuation bias since commitment data was used. Bokhari et al. (2007) indicate that donor funds may be used for antenatal care but are typically not used for investments in hospitals or referral systems which are important for mothers experiencing complications which result in death. Hence, both Bokhari et al. (2007) and Gottret & Schreiber (2006) indicate that donor funding may not affect maternal mortality.

Only Banchani and Swiss (2019) used panel research methods whereas Bokhari et al. (2007) and Gottret & Schreiber (2006) used cross-sectional methods. These studies covered countries across the world with different income levels which may have masked some of the effects of development assistance for health. Bokhari et al. (2007) and Gottret & Schreiber (2006) used donor commitment data whereas this work used donor expenditure data. This may have affected the results significantly as according to the work of Vande Maele et al. (2013), development assistance for health

expenditure is approximately 15% lower than development assistance for health disbursements and 25% lower than development assistance for health commitments. Hence the methodologies across this research and that of Bokhari et al. (2007) and Gottret & Schreiber (2006) differ significantly which could account for the differences in results.

Interestingly work by Pitt et al. (2017, p. 10), Bhawalkar (2014, p. 3) and Lincetto et al. (2006, p.2) indicates that maternal health interventions, such as antenatal care, received minimal attention in donor funding decisions between 2003 and 2013. As donors tend not to invest in infrastructure and human resources yet investments in hospitals and referral systems are important for mothers experiencing complications (Bokhari et al., 2007), and this research does not disaggregate funding specifically for maternal health, it may be that the effects seen for development assistance for health as a per cent of total health expenditure are amplified by other investments, specifically those from government. Further work needs to be done in this area to investigate the investments made by donors in maternal mortality and then to see how those investments are related to maternal mortality.

9.2.1.3 Out of pocket expenditure on health

<u>Under-five, infant and neonatal mortality</u>

In the model which includes all eligible sub-Saharan countries for this research, per capita out of pocket expenditure on health did not have any statistically significant effects on under-five, infant and neonatal mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita out of pocket expenditure on health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

Per capita out of pocket expenditure on health did not have any statistically significant effects on under-five, infant and neonatal mortality in low-income countries. In lower middle-income countries, per capita out of pocket expenditure on health was

associated with increases in under-five and infant mortality. In the upper middle-income models, per capita out of pocket expenditure on health was associated with a decrease in neonatal mortality.

While the proportion of health expenditure sourced from out of pocket steadily decreased from low-income to upper middle-income countries (38.7%, 34.3% and 25.0% respectively), in real terms per capita out of pocket expenditure on health was highest for upper middle-income countries at US$170.42, followed by lower middle-income countries at US$59.64 and low-income countries at US$37.01.

Upper middle-income countries may have shown reductions in neonatal mortality as the out of pocket expenditure on health may be able to purchase more effective and efficient specialized health services and, in general, people in upper middle-income countries have greater access to finances to spend on health services.

It was expected that any expenditure on health, regardless of source, would improve health outcomes. This work demonstrates that out of pocket expenditure on health is associated with increases in under-five and infant mortality in lower middle-income countries. Existing literature (Rahman et al., 2018; Novignon et al., 2012; Issa & Ouattara, 2005) has not fully examined out of pocket expenditure and its association with under-five, infant and neonatal mortality. Rahman et al. (2018) found that private health expenditure, of which out of pocket expenditure accounted for more than 80.07% of private health expenditure, significantly reduced infant mortality rates. Novignon et al. (2012), also found that private health expenditure of which out of pocket expenditure accounted for approximately 67%, reduced infant mortality. Issa & Ouattara (2005) showed that private health expenditure decreased infant mortality in both low- and high-income countries. However, coupling private health expenditure and out of pocket health expenditure may mask their individual effects on health outcomes. Private health expenditure is typically insurance that is bought in advance of illness whereas out of pocket expenditure is purchased at the time of illness. People with private health expenditure may take more preventative measures to ensure their health whereas out of pocket expenditure has been shown to deter health seeking behaviours. Families having to use out of pocket payments for health care often delay seeking health care due to the catastrophic nature that health and/or transportation

expenses can be for the household (Lassi et al., 2019, p. 1-14; Hunt & Bueno de Mesquita, 2010, p. 6 & 8; Thaddeus & Maine, 1994, p. 1091-1110). Delayed health seeking behaviours are associated with higher child mortality rates (Weldesamuel et al., 2019, p. 1-2; Kassile et al., 2014, p. 2; and WHO, 2011 p. 1–42). This could explain why an increase in out of pocket expenditure would be associated with increases in under-five and infant mortality.

Maternal mortality

In the model which includes all eligible sub-Saharan countries for this research, per capita out of pocket expenditure on health was associated with increases in maternal mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita out of pocket expenditure on health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

Per capita out of pocket expenditure on health was associated with decreases in maternal mortality in low-income countries. In the lower middle- and upper middle-income countries models, per capita out of pocket expenditure on health did not have any statistically significant effects on maternal mortality.

The results for the all countries model was consistent with the results found by Maruthappu et al. (2014). Maruthappu et al. (2014) showed that out of pocket health expenditure was associated with increased maternal mortality in the European Union. Both direct and indirect costs of health services have been shown to be a barrier to maternal health services (Koenig et al., 2007, p. 80; McIntyre et al., 2005, p. 858; Nahar & Costello, 1998, p. 417-422; and Stanton & Clemens, 1989, p. 1199). Families having to use out of pocket payments for health care often delay seeking health care due to the catastrophic nature that health and/or transportation expenses can be for the household (Lassi et al., 2019, p. 1 - 14; Hunt & Bueno de Mesquita, 2010, p. 6 & 8; and Thaddeus & Maine, 1994, p. 1091-1110). Thaddeus & Maine's (1994) indicate that these delays drive maternal mortality.

Low-income countries had the largest per cent of health expenditure sourced from out of pocket at 38.69%, followed by lower middle-income countries at 34.26% and upper middle-income countries at 24.96%. With such a low mean per capita health expenditure for low-income countries (US$98.69) compared to lower middle-income countries (US$248.67) and upper middle-income countries (US$781.88), perhaps the effects of out of pocket expenditure were much more important in low-income countries for accessing health services that contribute to reducing maternal mortality.

9.2.1.4 Private expenditure on health

Under-five, infant and neonatal mortality

In the model which includes all eligible sub-Saharan countries for this research, per capita private was associated with decreases in under-five and infant mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita private expenditure on health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

Per capita private expenditure on health was associated with reducing under-five and infant mortality in low-income countries. Conversely, per capita private expenditure on health was associated with increasing under-five and infant mortality in lower middle-income countries. Per capita private expenditure on health did not have any statistically significant effects on under-five, infant and neonatal mortality in upper middle-income countries.

The proportion of health expenditure sourced privately steadily increased from low-income to upper middle-income countries (5.3%, 8.4% and 15.7% respectively), in real terms per capita private expenditure on health was highest for upper middle-income countries at US$136.30, followed by lower middle-income countries at US$31.29 and low-income countries at US$6.12. With such a low mean per capita health expenditure for low-income countries (US$98.69) compared to lower middle-

income countries (US$248.67) and upper middle-income countries (US$781.88), perhaps the effects of private expenditure were much more important in low-income countries for accessing health services that contribute to reducing under-five and infant mortality.

The results for all countries and low-income countries aligns with the existing literature (Rahman et al., 2018; Novignon et al., 2012; Issa & Ouattara, 2005) has not fully examined out of pocket expenditure and its association with under-five, infant and neonatal mortality. Rahman et al. (2018) found that private health expenditure significantly reduced infant mortality rates. Novignon et al. (2012), also found that private health expenditure reduced infant mortality. Issa & Ouattara (2005) showed that private health expenditure decreased infant mortality in both low- and high-income countries. However, it is noted that Rahman et al (2018) and Novignon et al. (2012) coupled private health expenditure and out of pocket health expenditure which may mask their individual effects on health outcomes.

Private health expenditure is typically insurance that is bought in advance of illness and people with health insurance may take more preventative measures to ensure their health. Escobar et al (2010) reviewed evidence and showed that health insurance improves access and use of health services. Thus, it is surprising that lower middle-income countries showed that private expenditure was associated with increases in under-five and infant mortality. Perhaps there may be inefficiencies in the purchase of health services with private expenditure that limit its effectiveness in reducing mortality in lower middle-income countries.

Maternal mortality

In the model which includes all eligible sub-Saharan countries for this research, per capita private expenditure on health did not have any statistically significant effects on maternal mortality. When the regressions results were examined by country income level, there were differences in the effect caused by per capita private expenditure on health, in line with the work by Celik (2013); Schell et al. (2007); and Issa and Ouattara (2005) that suggests that the association of expenditure and health outcomes vary according to the income level of the countries or are masked by other factors (including aggregation of data).

Per capita private expenditure on health did not have any statistically significant effects on maternal mortality in low-income countries. In the lower middle-income countries, per capita private expenditure on health was associated with increases in maternal mortality. Per capita private expenditure on health did not have any statistically significant effects on maternal mortality in upper middle-income countries.

The proportion of health expenditure sourced privately steadily increased from low-income to upper middle-income countries (5.3%, 8.4% and 15.7% respectively), in real terms per capita private expenditure on health was highest for upper middle-income countries at US$136.30, followed by lower middle-income countries at US$31.29 and low-income countries at US$6.12.

Private health expenditure is typically insurance that is bought in advance of illness and people with health insurance may take more preventative measures to ensure their health. Escobar et al (2010) reviewed evidence and showed that health insurance improves access and use of health services. Thus, it is surprising that lower middle-income countries showed that private expenditure was associated with increases in maternal mortality. Perhaps there may be inefficiencies in the purchase of health services with private expenditure that limit its effectiveness in reducing mortality.

9.2.2 Scale of impact of source of health financing and health outcomes

9.2.2.1 Under-five, infant and neonatal mortality

It was expected that government resources have a greater impact in reducing under-five, infant and neonatal mortality than other sources of health expenditure. For the all countries model, per capita private expenditure on health had a larger effect on reducing under-five mortality than per capita government expenditure on health however the effects were equal for infant mortality.

The results were not in accordance with the original expectation nor existing literature (Gottret & Schieber, 2006; Bokhari et al., 2007; and Achoki & Chansa, 2013). Government resources were expected to show a higher impact on health outcomes than donor funding as governments can better plan for long term health investments for the population; direct funding to areas of greatest need; and ensure sustainability of financing for priority health programmes. Conversely, donor funding tends to be project-based, focused on donor priorities, and are subject to the political influences from the donor country. Moreover, donor commitments are short term, tend to be conditional and difficult to manage, and may not be fulfilled in its entirety which effects the country's ability to effectively plan and manage the resources for health services (Gottret & Schieber, 2006, p. 138 - 150; Bokhari et al., 2007, p. 271-2; and Achoki & Chansa, 2013, p. 166-7).

As private expenditure is primarily made up of insurance and direct service payments by private corporations, and given the large informal workforce in many sub-Saharan African countries who would likely not be able to access insurance, it was expected that government expenditure on health would have a larger effect on reducing under-five, infant and neonatal mortality, similar to the findings of Novignon et al (2012). However, the findings of this work are aligned with those of Issa and Ouattara (2005) who, when examining 160 countries, found that private health expenditure seemed to produce a larger effect on reducing infant mortality than public health expenditure. It may also be an indication that people with insurance may be more willing to seek health services, perhaps based on a better perception of quality of health services or with the knowledge that the health services, specifically preventative health services, are covered by the insurance scheme. Escobar et al (2010) suggest that insurance is associated with better health-seeking behavior and better management of a family's health. Escobar et al (2010) also suggest that insurance may increase the use of appropriate services, improves access to services, creates incentives for providers to deliver the right services, and equalizes use of health services among the rich and the poor.

Low-income countries

For the low-income countries model, per capita development assistance for health showed almost double the effect on reducing under-five and infant mortality than private expenditure on health.

The results were not in accordance with the expectations or existing literature whereby government resources were expected to show a higher impact on health outcomes than donor funding (Gottret & Schieber, 2006, p. 138 - 150; Bokhari et al., 2007, p. 271-2; and Achoki & Chansa, 2013, p. 166-7).

In low-income countries, the per capita health expenditure source from government and from donors is almost equal (US$27.59 versus US$27.98 respectively). This raises questions of why development assistance would have almost double the effect on reducing under-five and infant mortality. If the types of investments typically made by each source of health financing are examined, dramatic differences can be seen. Government funding tends to finance capital expenditure, operational costs, human resources for health, medical supplies/equipment etc... Hernandez et al. (2006, p. 3) showed 29.50% of government expenditure on health was used to finance human resources for health in 14 African countries. The health work force is critical for the delivery of health services and there is evidence that investments in this area are correlated with improved under-five, infant and maternal survival (Anyangwe & Mtonga, 2007, p. 97; WHO, 2006, p. xv & 86; Hernandez et al., 2006, p. 3). Conversely, donors tend to finance specific projects and/or health interventions (vaccinations, HIV treatment etc.…) however those interventions would be administered in health facilities by health workers both of which tend to be financed by government. Thus, it seems reasonable that the effects of development assistance for health may be dependent on government investments in health.

As private expenditure is primarily made up of insurance and direct service payments by private corporations, and given the large informal workforce in many sub-Saharan African countries, most of whom would likely not be able to access insurance, it was expected that government expenditure on health would have a larger effect on reducing under-five, infant and neonatal mortality, followed by development

assistance for health. The findings of this work suggest the importance of private expenditure in reducing under-five and infant mortality albeit not at the same level as development assistance for health. Escobar et al (2010) suggest that insurance is associated with better health-seeking behavior and better management of a family's health. Escobar et al (2010) also suggest that insurance may increase the use of appropriate services, improves access to services, creates incentives for providers to deliver the right services, and equalizes use of health services among the rich and the poor.

Lower middle-income countries

For the lower middle-income countries model, per capita government expenditure on health was the only source of health expenditure that was associated with reductions in under-five, infant and neonatal mortality.

Lower middle-income countries generate more resources for health from government and donors at 57.3%, compared to low-income countries that have 56.1%. Interestingly, lower middle-income countries spend 2.5 times more on health (all sources) per capita (US$248.67) than low-income countries (US$98.69) and almost 5 times as much is sourced from government expenditure (US$127.10 versus US$27.59). Moreover, government expenditure on health is more than the other sources of health expenditure combined at (US$121.58).

The results suggest that government resources have a higher impact on under-five, infant and neonatal mortality. This may be due to governments being better able to plan for long term health investments for the population; direct funding to areas of greatest need; and ensuring sustainability of financing for priority health programmes (Gottret & Schieber, 2006, p. 138 - 150; Bokhari et al., 2007, p. 271-2; and Achoki & Chansa, 2013, p. 166-7).

Contrary to expectations that any source of health expenditure would be associated with reductions in mortality, both out of pocket and private expenditure on health were associated with increases in under-five and infant mortality. Private expenditure on health was associated with larger increases in under-five and infant mortality than

out of pocket expenditure. This is surprising given that private expenditure is primarily made up of insurance and direct service payments by private corporations, which are largely paid in advance of health services rather than at the time health services are need, as in the case of out of pocket expenditures on health. Escobar et al (2010) suggest that insurance is associated with better health-seeking behavior and better management of a family's health. Escobar et al (2010) also suggest that insurance may increase the use of appropriate services, improves access to services, creates incentives for providers to deliver the right services, and equalizes use of health services among the rich and the poor. This work suggests that private expenditure is less efficient in lower middle-income countries.

There were only 10 lower middle-income sub-Saharan African countries included in this research, so these results have to be interpreted very cautiously.

Upper middle-income countries

For the upper middle-income countries model, out of pocket expenditure on health seemed to have a larger impact on reducing neonatal mortality than government expenditure on health.

Upper middle-income countries spent the most on health (US$781.88) of which almost 60% is made up of government expenditure on health (US$446.18) and a fifth from out of pocket expenditure on health.

The scale of the effect of out of pocket expenditure on health is surprisingly given the existing evidence. Out of pocket expenditures on health are associated with delays seeking or continuing health care because of inability to pay (Gotsadze et al., 2005, p. 232; Russell & Gilson, 1997, p. 360-1; Hussein & Mujinja, 1997, p. 751-7; and Mbugua et al., 1995, p. 829-835). In addition, there is evidence that removing out of pocket expenditures are related to decreases in under five and infant mortality. For instance, infant and child mortality fell by 43% in Burundi between 2006-2011, coinciding with a decision in 2006 by the government to eliminate user fees for services provided to pregnant women and children under-five (Burundi Standard DHS,

2010). Perhaps in upper middle-income countries, there is more efficient spending on health care and with the higher income levels in the country, paying out of pocket would not necessarily delay health seeking behaviours. It could even be argued that in upper middle-income countries, individuals are paying for better quality of health services than those in low- and lower middle-income countries.

There were only 5 upper middle-income sub-Saharan African countries included in this research, so these results have to be interpreted very cautiously.

9.2.2.2 Maternal mortality

It was expected that government resources have a greater impact in reducing maternal mortality than development assistance for health, followed by private and out of pocket expenditure on health respectively. While per capita government expenditure on health showed the largest impact in reducing maternal mortality in lower middle-income countries, per capita development assistance for health was the only source of health financing to reduce maternal mortality in the all countries model and per capita development assistance for health had a greater impact in reducing maternal mortality than out of pocket expenditure on health in low-income countries.

Lower middle-income countries generate more resources for health from government and donors at 57.3%, compared to low-income countries that have 56.1%. Interestingly, lower middle-income countries spend 2.5 times more on health (all sources) per capita (US$248.67) than low-income countries (US$98.69) and almost 5 times as much is sourced from government expenditure (US$127.10 versus US$27.59). Moreover, government expenditure on health is more than the other sources of health expenditure combined at (US$121.58).

The results suggest that government resources have a higher impact on reducing maternal mortality in lower middle-income countries. This may be due to governments being better able to plan for long term health investments for the population; direct funding to areas of greatest need; and ensuring sustainability of financing for priority health programmes (Gottret & Schieber, 2006, p. 138 - 150; Bokhari et al., 2007, p.

271-2; and Achoki & Chansa, 2013, p. 166-7). However, there were only 10 lower middle-income sub-Saharan African countries included in this research, so these results have to be interpreted very cautiously.

Surprisingly, government expenditure on health as associated with increases in maternal mortality in the all countries model and in low-income countries, given that governments tend invest in primary health care, including antenatal care, which has been shown to improve maternal mortality (Vande Maele, 2019; Black et al., 2017; Perry et al., 2017; Macinko et al., 2009; Bhutta et al., 2008; Starfield et al., 2005; and Macinko et al., 1998); and make investments in hospitals and referral systems (Bokhari et al., 2007). Perhaps the investments made by governments are not sufficiently covering the needs for the provision of maternal health and/or there are issues in the quality of care. In addition, government expenditure on health cover many health interventions and is not specific to reproductive and maternal health. It is plausible that examining reproductive and maternal health expenditures may produce drastically different results.

9.3 Objective 2: This research compares sources of child health expenditure on under-five, infant and neonatal mortality in selected sub-Saharan African countries between 2000 and 2014.

The secondary aim of this research was to examine the impact that the source of child health expenditure had on child health outcomes (neonatal, infant and under-five mortality) in sub-Saharan African countries by analyzing existing data from 2000-2014. This section looks at the findings for this objective including the directional relationships between the source of child health financing and health outcomes; as well as the scale of impact of domestic resources for child health versus donor resources for child health on health outcomes.

Child health expenditure data is not routinely collected. During the 15-year period covered by in this research, most countries did not complete child health subaccounts as part of the national health accounts exercises; and for the countries that did, they did not do so every year. The average number of observations per country was 3.9,

ranging from 2 observations to 9 observations per country. For this research, only countries with at least two years of data were included, noting that the low number of observations made it very difficult to analyze the data and any possible relationships.

It is also noted that there are serious questions whether child health expenditure data captures all the inputs required for the provision of child health. For instance, health facility infrastructure, health care workers and other support staff (cleaners, technicians, administration, etc.), may be counted under other national health account categories. Bhawalkar (2015, p. 8) noted that such health system costs were ad hoc and not consistent between countries and even within a country from year to year. Bhawalkar (2015, p. 8) also noted that health interventions could also be allocated differently. For instance, HIV treatment for a child could be allocated as a disease expenditure or child health expenditure. It is likely that significant inputs for child health were not captured in the child health expenditure data. This research points towards the need to harmonize what data are collected for child health expenditure and encourage countries to report on this so that there can be a better understanding of the interactions of sources of child health expenditure on health outcomes.

The countries with child health expenditure data had, on average, 22.95% government health expenditure as a per cent of as a per cent of total child health expenditure; 45.86% private health expenditure (which includes out of pocket expenditure) as a per cent of total child health expenditure; and 32.91% development assistance for health as percentages of as a per cent of total child health expenditure. It is noted that there was one country, Nigeria, which was a lower middle-income country. Once Nigeria was removed, government expenditure on health as a per cent of THE slightly increased to 23.38%; private expenditure decreased to 42.07% and development assistance increased to 37.06% for the low-income country cohort. In real terms, per capita government expenditure on child health was US$1.02, per capita private expenditure on child health was US$2.67 and per capita development assistance for child health was US$1.25.

9.3.1 Government expenditure on child health and its relationship with under-five, infant and neonatal mortality

Government expenditure on child health as a per cent of as a per cent of total child health expenditure was associated with decreases in under-five, infant and neonatal mortality however none of these results had statistical significance.

The results in this research are likely related to inconsistencies in what is counted as child health expenditure; and poor tracking of child health expenditure which limited not only the sample size but also the number of observations. Bhawalkar (2015, p. 8) noted the same issues of incompleteness and inconsistencies in the reporting of child health expenditure data. Bhawalkar (2015, p. vi) found that child health expenditures were skewed towards curative health services rather than preventive. Several researchers have shown that the provision of preventive health care is as important as curative health care for reducing causes of death, disease and disability (Newhouse 1977; and Wang 2018). Given the relatively limited investment in child health, it may be challenging for governments to balance preventive child health as well as curative child health to achieve maximum health benefits. Even governments that are spending primarily on curative services will likely not be able to cover all the financial needs. Governments may focus on secondary and tertiary care; or focus on the provision of services in commercial centres where it is easier and cheaper to deliver services. This may mean that some of the most vulnerable populations may not have equitable access which may contribute to higher mortality.

Interestingly, the scale of the coefficients increased substantially when examining child health expenditure versus health expenditure. This may suggest a more direct relationship with under-five, infant and neonatal mortality, noting however that none of the relationships showed statistical significance. Further work is needed to examine the relationship between government expenditure on child health and under-five, infant and neonatal mortality given the extremely small sample size and low number of observations in this research. To ensure that the analysis is meaningful, there needs to be more countries collecting data on child health expenditure; and the data needs to be consistently reported so that there can be a better understanding of the interactions of government expenditure on child health and health outcomes.

9.3.2 Development assistance for child health expenditure and its relationship with under-five, infant and neonatal mortality

Development assistance for child health was associated with decreases in under-five and infant mortality and increases in neonatal mortality however none of the results were statistically significant.

Although no research was found on development assistance for child health and health outcomes, likely due to the limited data for child health accounts, existing literature on development assistance for health was shown to reduce under-five and infant mortality (Akachi and Atun 2011; Bendavid & Bhattacharya 2009; and Mishra and Newhouse 2009). Given this literature, coupled with the knowledge that donors tend to investment in child health services such as vaccinations, malaria prevention and treatment, HIV etc., which address some of the biggest killers of children (measles, malaria and HIV) in sub-Saharan Africa, a similar relationship of development assistance for child health reducing under-five, infant and neonatal mortality was expected.

The insignificant results in this research may be due to several factors including inconsistencies in what is counted as child health expenditure; and poor tracking of child health expenditure which limited not only the sample size but also the number of observations. Moreover, it seems reasonable to expect that donor funding on child health would probably have a larger impact on under-five and infant mortality given the types of investments donors tend to make in vaccinations, malaria prevention and treatment, HIV etc., and probably less of an effect on neonatal mortality which tends to require specialized services in specialized health facilities which are typically funded from government sources.

Interestingly, the scale of the coefficients increased substantially when examining child health expenditure versus health expenditure. This may suggest a more direct relationship with under-five, infant and neonatal mortality, noting however that none of the relationships showed statistical significance.

Further work is needed to examine the relationship between development assistance for child health and under-five, infant and neonatal mortality given the extremely small sample size and low number of observations in this research. To ensure that the analysis is meaningful, there needs to be more countries collecting data on child health expenditure; and the data needs to be consistently reported so that there can be a better understanding of the interactions of development assistance for child health and health outcomes.

9.3.3 Private expenditure on child health and its relationship with under-five, infant and neonatal mortality

Per capita private expenditure on child health was associated with increases in under-five, infant and neonatal mortality however none of these results were statistically significant.

Although there was no research on child health expenditure, existing research by Rahman et al. (2018), Novignon et al. (2012) and Issa and Ouattara (2005) showed that private health expenditure reduced infant mortality rates, suggesting that private child health expenditure would have reduced under-five, infant and neonatal mortality.

The insignificant results in this research may be due to several factors including inconsistencies in what is counted as child health expenditure; and poor tracking of child health expenditure which limited not only the sample size but also the number of observations.

Further work is needed to examine the relationship between private expenditure on child health and under-five, infant and neonatal mortality given the extremely small sample size and low number of observations in this research. To ensure that the analysis is meaningful, there needs to be more countries collecting data on child health expenditure; and the data needs to be consistently reported so that there can be a better understanding of the interactions of private expenditure on child health and health outcomes.

9.4 Objective 3: This research will provide a detailed analysis of health financing sources and health outcomes (maternal, neonatal, infant and under-five mortality) in two sub-Saharan African countries.

Despite relatively close starting points in terms of under-five, infant, neonatal and maternal mortality, there were large variances in the improvements made to these indicators over the period included in this research. One of the most significant variances was that for under-five mortality. Malawi saw a 62% reduction in under-five deaths per 1,000 live births whereas Mozambique saw a 51% reduction. The other significant variance was that for maternal mortality where Mozambique saw a 46% reduction compared to Malawi which had a 28% reduction in maternal deaths for every 100,000 live births.

The first impression from the data collected in this case study was the difference in health financing governance. The governance for the Malawi SWAp was centered around the implementation of a costed common multi-year strategy with Government and partners all contributing, through four funding modalities. While the Mozambique SWAp also supported a sector wide strategy, it was argued there was an "insufficient level of detail and analysis to guide priority setting and accountability" (Visser-Valfrey & Umarji, 2010, p. 19). Moreover, Mozambique did not have a multi-year budget that identified how the strategy can be funded (Walford, 2007, p. 3).

There was also a noted difference in adoption of an essential package of health services. The Malawian health sector strategic plan focused on the implementation of an essential package of health services, a package that concentrated on a select group of interventions including reproductive, maternal, neonatal and child health; integrated management of childhood illnesses; vaccine preventable diseases; malaria and HIV interventions (UNICEF, 2017, p. 1-2 & 7; and Ergo et al., 2010, p. 1, 16-17). Conversely, Mozambique had not adopted an essential package of health services, rather relying on vertical programming. The benefit of adopting an essential or basic package of health services is that it clearly sets out the policy of the Ministry of Health, defines the services to be delivered which supports planning, and it supports resource allocation (Global Health Cluster and WHO, 2018). Interestingly, other countries using SWAp, adopted an essential package of health services or alternatively a basic

package of health services as a means to prioritize health activities to be funded (Walford, 2007).

In the literature review for this research, several authors described the importance of good governance as a determinant of health outcomes and efficiency in public spending on health (Makuta & O'Hare, 2015; Farag et al., 2013; and Rajkumar & Swaroop 2008). Generally, governance refers to the way public officials and institutions acquire and exercise authority to shape public policy and provide public goods and services (World Bank, 2006). The World Bank defines the dimensions of governance as government effectiveness and regulatory quality as well as voice and accountability, control of corruption, political stability and rule of law. The first two dimensions centre on the quality of policy formulation and implementation, the credibility of the government's commitment to such policies and perceptions on the ability of the government to formulate and implement these policies (Makuta & O'Hare, 2015).

In terms of the first two dimensions on good governance (government effectiveness and regulatory quality with the data collected by the World Bank, the percentile rank of Malawi and Mozambique on government effectiveness are similar at 33.11 and 34.76 (averaged for the years included in this research) and for regulatory environment Mozambique is slightly better at 35.47 and 32.69 (World Bank). Although these figures seem relatively close in range, and slightly favouring Mozambique, a national public expenditure and financial accountability assessment in Mozambique in 2007/8 suggested that public financial management in the health sector was significantly weaker than the national financial management system (Visser-Valfrey & Umarji 2010).

Examining the health sector, it appears Malawi may have better policy formulation and implementation, and the government's commitment to the policies are evidenced by their strong investment in the SWAp. This may have supported better planning, coordination, budgeting and resource allocation.

The second impression was that there was a difference in the control of funds. Although both countries maintained several funding modalities, Malawi aligned the

funding modalities under the SWAp whereas Mozambique maintained several options for the flow of health resources, including several common funds, many of which were not aligned under the SWAp. The SWAp, and its corresponding funding modalities, was the primary financing mechanism in Malawi with both Government and other partners contributing to financing the strategy. Of the four funding modalities used by Malawi, three were controlled by MOH and almost 90% of donor funding was channeled through the pooled funding modalities between 2005 and 2009, the remaining 10% were discrete funding (Pearson, 2010, p. 37). In comparison, only 30% of external funding was channeled through a common fund, ProSaúde, as donors could still contribute through bilateral projects and in-kind donations of medicines and medical equipment (WHO, 2019). With the lack of coordination for its funding modalities, much of the donor funding for Mozambique was channeled outside of national planning, budget and treasury systems (World Bank, 2017). The fragmentation of the health financing system likely added complexities, inefficiencies, and confusion, making it difficult for the government to effectively budget and coordinate resources (Ministry of Health Directorate of Planning and Cooperation, 2015, p. 15).

The third impression was that there was a difference in the management of funds. Government agencies (MoH, local government, NAC, other ministries) in Malawi managed an average of 57% of total health funds (government or donor resources) between 2009 and 2012 (Ministry of Health, 2014) whereas government agencies in Mozambique managed approximately 46% (Ministry of Health Directorate for Planning and Cooperation, 2015). Further information on how the funds were channeled were found in the reproductive and child health sub-accounts for the Government of the Republic of Malawi. Although both programmes were primarily financed by donors from 2009 – 2012 with reproductive health having 65.3% of financing from donors and child health having 62.8%, a greater portion of child health funds were managed by government agencies (Ministry of Health, 2014). Of the reproductive health funds, government managed 50% whereas government managed 62% of child health funds (Ministry of Health, 2014). Hence the Government of the Republic of Malawi managed more of the child health resources (62%) than all health resources coupled together (57%). Interestingly, under-five mortality was the indicator with the greatest reduction in mortality (reduced by 62%) and comparatively maternal

mortality, where the government controlled the least amount of funding (50%) had a much lower reduction in mortality. Presumably, as the main financing agent, the government would have been able to better plan, coordinate, budget and allocate the use of resources which may have contributed to better child health outcomes.

The fourth impression was that there were differences in the pooling of government and donor resources. The SWAp, and its corresponding funding modalities, was the primary financing mechanism in Malawi with both Government and other partners contributing to financing the strategy. Putting government resources into the SWAp showed the commitment that the Government of Malawi was making not only to the sector but also to making the SWAp work. In fact, government support was almost three times higher than expected (Pearson, 2010). In contrast, domestic funding in Mozambique government and donor resources, not used for central functions like procurement, only merged at the Provincial Health Directorate (Ministry of Health Directorate of Planning and Cooperation, 2015). This would make it more challenging to plan, coordinate, budget and allocate resources.

The fifth impression involves the efficiency in the use of funds. Mozambique spends more in administration and on the health workforce than Malawi. Almost a third of all the health resources in Mozambique are used for administration, management and coordination of general health services (for comparison, curative care uses 40% and preventive care uses 27% of resources) (Ministry of Health Directorate of Planning and Cooperation, 2015). It was also noted that the share of resources used for administration, management and coordination has doubled since 2006 (Ministry of Health Directorate of Planning and Cooperation 2015). Comparatively, Malawi uses approximately 18% for administration and governance (Ministry of Health, 2014) while OECD countries used 3% (Ministry of Health Directorate of Planning and Cooperation, 2015).

The Government of Mozambique spends 31% of its health resources on the compensation of employees, noting that the next largest input category is pharmaceuticals at 15% (Ministry of Health Directorate of Planning and Cooperation, 2015). Mozambique has almost twice the health workforce (doctors and nurses/midwives) than Malawi however there are large disparities between rural and

urban settings. In one province, Zambezia, the inhabitants to doctor ratio is 168,637:1 (Visser-Valfrey & Umarji, 2010), which is far worse than that of Malawi.

However, investments in the workforce may have supported specialized interventions specifically those related to maternal health. Mozambique showed improvements in institutional delivery rates, caesarean delivery rate, met need for emergency obstetric care (EmOC), and cause-specific case fatality rates (Ministry of Health Directorate of Planning and Cooperation, 2015). These improvements resulted in decreasing the direct causes of maternal deaths. Unfortunately, the proportion of indirect causes increased which indicates that there is likely a need for more attention in preventing and treating malaria, HIV and anemia during pregnancy (Ministry of Health Directorate of Planning and Cooperation, 2015).

In reviewing the most recent of the Malawi National Health Accounts (with sub-accounts), it was found that HIV/AIDS, malaria and reproductive health accounted for an average of 67 per cent of the total health expenditure budget between 2009 and 2012 (Ministry of Health, 2014). In comparison, Mozambique allocated approximately 36 per cent in 2012 (Ministry of Health Directorate for Planning and Cooperation, 2015). As Malawi was left with only 33 per cent of expenditures for all other diseases/conditions, it raises questions on how this funding can adequately cover preventative and curative child health.

According to the UN Interagency Group for Child Mortality, malaria and HIV programmes were two of the top five interventions that saved the most children (Countdown to 2015). With the reduction in under-five mortality, allocating a large proportion of funding to these programmes may have been an important choice in the context of Malawi.

It was noted that HIV/AIDS adult prevalence rate increased from 8.8% in 2000 to 12.4% in 2014 whereas the HIV/AIDS prevalence rate was decreasing in Malawi from 14.7% in 2000 to 10.3% in 2014 (UNAIDS estimates). There was significant volatility in donor funding for the ProSaúde and in 2011, the Global Fund, one of the two largest donors to the ProSaúde, withdrew from the ProSaúde (Global Fund, 2017). As the Global Fund financing covered HIV, TB and malaria interventions, and given the

volatility of the other donor funding, it would have been difficult to plan, implement and finance related activities and may have reduced the effectiveness of the investments in HIV and malaria.

As Malawi had sub-accounts for child health for several years as part of the National Health Accounts, more information could be discerned for child health. Interestingly, preventive care consumed the most child health resources (Ministry of Health, 2014). Recent literature suggests that health expenditure should be allocated optimally between preventive and curative health services as both are important for reducing mortality, disease and disability (Wang, 2018). Despite preventative and curative being complementary, preventive and curative health services compete for resources. Perhaps in low-income countries, where curative health services are more difficult to provide given the need for specialized health services, the investments for preventative health may have higher effects on reducing mortality, disease and disability. Investing in prevention, may have been a cost-effective way to reduce child mortality, specifically in relation to the biggest causes of death in Malawi (i.e. HIV and malaria) which signifies cost effectiveness and allocative efficiency in the use of child health resources (Ministry of Health, 2014).

While there were greater reductions in under-five mortality, the scale of the reductions in infant and neonatal mortality were far smaller. The investments made in infant and neonatal health seem to be much smaller, albeit for malaria interventions, with 33 per cent of the total health budget to be used to cover all the programming needs to address pneumonia, malnutrition, diarrhea, birth complications, sepsis, among others. While reducing mortality is not only dependent on financial inputs, could more have been achieved if there were greater investments in specialized equipment, medicines, health workers and improving quality of care?

9.5 Limitations of this research

The choice of indicators is a crucial and an important factor when interpreting empirical results. Investments in other sectors (i.e. water and sanitation, education, nutrition, infrastructure, humanitarian assistance etc) contribute to the overall health

of a population however this analysis could not control for all socio-economic determinants that interact with health outcomes.

Measurement errors are likely. Definitions, data collection methods, population coverage and estimation methods used can differ between countries hence the data may not always be counting the same things, may be double-counting or be missed completely. Health financing is complicated and can be hard to track since not all financing is channelled through the national treasury and funds can flow through various intermediaries and implementing agencies thereby increasing the risk of those funds being counted multiple times. In addition, mortality data may not be captured, specifically neonatal and maternal mortality and thus could be under-reported. Data sources are constantly being updated based on new information or new methodologies for data collection thus the figures in this research reflect only one point in time.

Many of the variables are likely endogenous as they may be influenced by other variables in the model. Several estimation methods were used, including GMM where instrumental variables were utilized.

This research did not consider governance and effectiveness of health management which likely play an important factor in health financing. Moreover, this research did not consider how health financing is used and effectiveness of investments in different areas of health programming.

Conclusions drawn in this research are only valid for the sub-Saharan countries included in this work and reflect a snapshot at a given period in time.

9.6 Policy Implications and Recommendations

In recent years, donor countries have put increasing emphasis on directing development assistance for health to low-income countries. In this analysis, the investments of per capita development assistance for health are relatively similar across the country income classifications: with the highest development assistance for health recorded in lower middle-income countries at US$30.65, followed by upper middle-income countries at US$28.98 and the lowest for low-income countries at US$27.98. According to this work, development assistance for health was an important contributing funding source for decreasing under-five, infant and neonatal mortality for low-income countries. Donor countries may want to further prioritize low-income countries which overall have less money spent per capita on health as such investments may have a larger impact in reducing under-five, infant and neonatal mortality. In addition, this research shows that development assistance for health contributes significantly to health outcomes in sub-Saharan African countries. Donor countries are encouraged to meet the ODA targets.

Government expenditure on health seems to play a much more important role as country income level increases. This may be related to a better investment in health for the population, noting that in low-income countries, government expenditure on health was a fifth of what it was in lower middle-income countries. Sub-Saharan African governments are encouraged to increase the share of annual budgets to health in an effort to meet the Abuja target, and the share must be consistently maintained.

Moreover, this research suggests that investments in increasing the proportion of the population with access to an improved water source and in mean years of schooling for females are significant contributing factors to under-five, infant, neonatal and maternal mortality. Investments in these areas should continue.

While not covered in this work, spending funds on health does not necessarily translate into effective and efficient service provision. Thus, policies that improve governance, coordination, the flow and management of health resources are critical for improving the impact of health financing on health outcomes. In addition, ensuring policies are in place that provide clarity on the flow of funds and resource tracking which would

make it easier for governments to budget and coordinate resources, perhaps enabling more effective and efficient use of funds.

Although WHO provides countries with a harmonized and integrated platform for annual reporting of health expenditure data, National Health Accounts differ widely. Countries should ensure the full completion of National Health Accounts, including sub-accounts, as a way to increase accountability and learn from past expenditure, while at the same time improve planning and allocation of resources going forward. African countries are encouraged to better track health resources. Improved data would make analyses more accurate and may allow new questions to be investigated.

9.7 Areas for Future Research

While this research was able to provide some insights into the relationships between source of health expenditure and health outcomes by country income classification, the number of lower middle- and upper middle-income countries in this work was small. It would be advantageous to look at larger samples to confirm the relationships that were identified in this research.

Further work is needed to examine the relationship between sources of child health expenditure and under-five, infant and neonatal mortality given the extremely small sample size and low number of observations in this research. To ensure that the analysis is meaningful, there needs to be more countries collecting data on child health expenditure; and the data needs to be consistently reported so that there can be a better understanding of the interactions of sources of child health expenditure and health outcomes. Countries should be encouraged to generate child health data as part of the National Health Accounts exercise as it will help in understanding of the interactions of sources of child health expenditure on health outcomes, which could better inform policy and decision-making.

This work did not analyze reproductive and maternal health expenditure data. Similar to child health expenditure data, it is often not reported by countries. If there are more countries reporting, and consistently, research on the relationship between the sources

of reproductive and maternal health expenditure and maternal mortality may provide significant insight and could better inform policy and decision-making.

While not covered in this work, it is likely that different sources of health expenditure allow access to different types of health services (public or private) and the quality of these services may vary widely, including across country income classifications. Moreover, there may be public perceptions of the services which impact health seeking behaviours. Adding such variants may give greater insight into the effectiveness of sources of health expenditure to improve health outcomes.

9.8 Conclusions

Previous literature on the relationship between source of health financing and health outcomes showed mixed results (Shaw et al., 2015; Achoki & Chansa, 2013; Bokhari et al., 2007; and Gottret & Schieber, 2006). The mixed results may have been due to the inherently different methods of examining the data. This research used methods that were common across several studies and used multi-year data (a panel dataset) to enable observation of changes in health outcomes.

To contribute to the body of knowledge in the health economics discipline, this researched examined the relationship between the source of health expenditure and health outcomes (under-five, infant, neonatal and maternal mortality) in sub-Saharan African countries by analyzing existing data from 2000-2014. This research also examined the relationship between the source of child health expenditure and child health outcomes (neonatal, infant and under-five mortality) in sub-Saharan African countries by analyzing existing data from 2000-2014.

Under objective 1, this research found that both government expenditure on health and development assistance for health appear to be associated with decreases in under-five, infant and neonatal mortality. For maternal mortality, government expenditure on health showed mixed results while development assistance for health appeared to be associated with decreases in maternal mortality.

The results for out of pocket expenditure on health and private expenditure on health were also mixed and dependent on the country income classification.

It appears that the most effective source of health expenditure for reducing under-five, infant, neonatal and maternal mortality changes with the various country income classifications.

Under objective 2, none of the sources of child health expenditure showed statistically significant relationships with under-five, infant or neonatal mortality.

Under objective 3, despite relatively close starting points in terms of maternal and under-five, infant and neonatal mortality, these countries showed different rates of improvement. There were noted differences in health governance, focus of expenditure, coordination and financial controls/expenditure efficiencies which likely contribute to the effectiveness of the source of health expenditure.

According to this work, additional investments from sub-Saharan African governments and from donor countries, especially in low-income countries could significantly improve health outcomes.

In line with Kutzin's conceptual framework (2008), the findings from this research could be useful for fostering dialogue on investments made to the health sector and the functioning of the health system, specifically equitable use and provision of services, as well as quality and efficiency in service delivery.

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Appendix 1: Table of variables

Variable Acronym	Variable Name	Definition
GDPPRCAP	Gross domestic product (GDP) per capita	A country's economic output by its total population (constant 2010 US$)
THETOTAL	Total health expenditure	The sum of public and private health expenditure covering the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation
THEPCGDP	Total health expenditure as a per cent of GDP	The sum of public and private health expenditure by the country's economic output
GHEPRTHE	Government health expenditure as a per cent of total health expenditure	Spending for health care that is derived from domestic sources; includes spending on public health system infrastructure and government-provided social health insurance by total health expenditure
PRVHETHE	Prepaid private health expenditure as a per cent of total health expenditure	Health spending sources from non-public programs that are funded prior to obtaining health care, such as private health insurance and services provided for free by non-governmental agencies by total health expenditure
OOPPRTHE	Out-of-pocket health expenditure as a per cent of total health expenditure	Payments made by individuals for health maintenance, restoration, or enhancement at or after the time of health care delivery, including health insurance copayments or payments devoted to deductibles by total health expenditure (health insurance

		premiums are not considered out-of-pocket)
DAHPRTHE	Development assistance for health as a per cent of total health expenditure	Financial and in-kind resources that are transferred through major health development agencies to low- and middle-income countries with the primary purpose of maintaining or improving health by total health expenditure
H2OSAFE	Per cent population with access to improved water source	The percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection
FOODSEC	Prevalence of undernourishment	An estimate of the proportion of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal active and healthy life
U5MR	Under-five mortality rate	Probability of a child dying before reaching five years of age, per 1,000 live births in a given year
IMR	Infant mortality rate	Probability of an infant dying before reaching one year of age, per 1,000 live births in a given year
NNMR	Neonatal mortality rate	Probability of an infant dying during the first 28 days of life, per 1,000 live births in a given year
MMR	Maternal mortality ratio	Number of maternal deaths (estimate) per 100,000 live births in a given year
PREVHIV	Prevalence of HIV	An estimation of the percentage of population between 15-49 years of age

		living with HIV/AIDS out of the total population between 15-49 years of age
GHETHECH	Government health expenditure on child health as a per cent of total health expenditure on child health	Spending for child health care that is derived from domestic sources
PRVTHECH	Private health expenditure on child health as a per cent of total health expenditure on child health	Payments made by individuals for child health maintenance, restoration, or enhancement at or after the time of health care delivery, including health insurance payments or payments devoted to deductibles
DAHTHECH	Development assistance for child health as a per cent of total health expenditure on child health	Financial and in-kind resources that are transferred through major health development agencies to low- and middle-income countries with the primary purpose of maintaining or improving child health.
THECHTHE	Total health expenditure on child health as a per cent of total health expenditure	Total spending on child health care by total health expenditure

Appendix 2: Keyword search for literature review

Examples of the combinations used for the literature review are listed below.

1. Health financing and domestic or foreign or donor and commitment or expenditure and health outcome
2. Health financing, panel and mortality
3. Health financing, government health expenditure and health outcomes
4. Government health expenditure and maternal health and child health
5. Health financing and health outcomes
6. Health financing and child health
7. Health financing and maternal health
8. Health financing, panel and mortality
9. Health financing and government health expenditure and health outcome
10. Health financing and government and commitment or expenditure and health outcome
11. Health funding and government health expenditure and health outcome
12. Health funding and source of funding and domestic or foreign and health outcome
13. Health funding and source of funding and domestic or donor and health outcome
14. Health funding and source of funding and domestic or donor and child health
15. Health funding and source of funding and domestic or donor and maternal health
16. Health funding and source of funding and government or donor and child health
17. Health funding and health outcomes
18. Health funding and child health
19. Health funding and maternal health

Appendix 3: Literature review references identified

Author	Title	Reference	Database	Status
Achoki T and Chansa C	Impact of funding modalities on maternal and child health intervention coverage in Zambia.	Health Policy and Technology. 2003. 2: 162–167	Snowball	Included
Adebayo EF, Ataguba JE, Uthman OA, Okwundu CI, Lamont KT, Wiysonge CS.	Factors that affect the uptake of community-based health insurance in low-income and middle-income countries: a systematic protocol.	BMJ Open. 2014 Feb 14;4(2):e004167. doi: 10.1136/bmjopen-2013-004167.	PubMed	Excluded
Afridi MA and Ventelou B	Impact of health aid in developing countries: The public vs. the private channels	Economic Modelling, Volume 31, March 2013, Pages 759-765, ISSN 0264-9993	Science Direct	Excluded
Ahasan R, Partanen T and Keyoung L	Global corporate policy for financing health services in the third world: the structural adjustment crisis	International Quarterly of Community Health Education Volume: 20 issue: 1, page(s): 3-15	ProQuest	Excluded
Akachi Y and Atun R	Effect of investment in malaria control on child mortality in sub-Saharan Africa in 2002-2008.	PLoS One. 2011;6(6):e21309. doi: 10.1371/journal.pone.0021309. Epub 2011 Jun 30.	PubMed	Excluded with Reasons
Akashi H, Yamada T, Huot E, Kanal K, and Sugimoto T	User fees at a public hospital in Cambodia: effects on hospital performance and provider attitudes, Social Science & Medicine, Volume 58, Issue 3, February 2004, Pages 553-564, ISSN 0277-9536, http://dx.doi.org/10.1016/S0277-9536(03)00240-5.	(http://www.sciencedirect.com/science/article/pii/S0277953603002405)	Science Direct	Duplicate
Akashi H, Yamada T, Huot E, Kanal K, Sugimoto T.	User fees at a public hospital in Cambodia: effects on hospital performance and provider attitudes.	Soc Sci Med. 2004 Feb;58(3):553-64.	MEDLINE	Excluded

Akhmedjonov A, Güç Y, and Akinci F.	Healthcare financing: how does Turkey compare?	Hosp Top. 2011 Jul-Sep;89(3):59-68. doi: 10.1080/00185868.2011.596800.	MEDLINE	Duplicate
Akhmedjonov A, Güç Y, and Akinci F.	Healthcare financing: how does Turkey compare?	Hosp Top. 2011 Jul-Sep;89(3):59-68. doi: 10.1080/00185868.2011.596800.	PubMed	Excluded
Anderson I, Axelson H and Tan B-K	The Other Crisis: The Economics and Financing of Maternal, Newborn and Child Health in Asia	Health Policy and Planning, July 2011, v. 26, iss. 4, pp. 288-97	Econolit	Excluded
Anell A, Glenngård AH, and Merkur S.	Sweden health system review.	Health Syst Transit. 2012;14(5):1-159.	MEDLINE	Excluded
Arora GK and Gumber A	Globalisation and Healthcare Financing in India: Some Emerging Issues	Public Finance and Management, 2005, v. 5, iss. 4, pp. 567-96	Econolit	Excluded
Arsenault C, Fournier P, Philibert A, Sissoko K, Coulibaly A, Tourigny C, Traoré M, and Dumont A.	Emergency obstetric care in Mali: catastrophic spending and its impoverishing effects on households.	Bull World Health Organ. 2013 Mar 1;91(3):207-16. doi: 10.2471/BLT.12.108969. Epub 2013 Jan 17.	PubMed	Excluded
Asiskovitch S.	Gender and health outcomes: the impact of healthcare systems and their financing on life expectancies of women and men.	Soc Sci Med. 2010 Mar;70(6):886-95. doi: 10.1016/j.socscimed.2009.11.018. Epub 2010 Jan 21.	MEDLINE	Excluded
Atun R, Aydın S, Chakraborty S, Sümer S, Aran M, Gürol I, Nazlıoğlu S, Ozgülcü S, Aydoğan U, Ayar B, Dilmen U, and Akdağ R.	Universal health coverage in Turkey: enhancement of equity.	Lancet. 2013 Jul 6;382(9886):65-99. doi: 10.1016/S0140-6736(13)61051-X. Epub 2013 Jun 27.	MEDLINE	Duplicate

Atun R, Aydın S, Chakraborty S, Sümer S, Aran M, Gürol I, Nazlıoğlu S, Ozgülcü S, Aydoğan U, Ayar B, Dilmen U, and Akdağ R.	Universal health coverage in Turkey: enhancement of equity.	Lancet. 2013 Jul 6;382(9886):65-99. doi: 10.1016/S0140-6736(13)61051-X. Epub 2013 Jun 27.	MEDLINE	Excluded
Baker B	Effect of development assistance on domestic health expenditures	The Lancet, Volume 376, Issue 9741, 21–27 August 2010, Pages 589-590, ISSN 0140-6736	Science Direct	Excluded
Balabanova D and Martin McKee	Reforming health care financing in Bulgaria: the population perspective	Social Science & Medicine, Volume 58, Issue 4, February 2004, Pages 753-765, ISSN 0277-9536	Science Direct	Excluded
Balabanova D, Mills A, Conteh L, Akkazieva B, Banteyerga H, Dash U, Gilson L, Harmer A, Ibraimova A, Islam Z, Kidanu A, Koehlmoos TP, Limwattananon S, Muraleedharan VR, Murzalieva G, Palafox B, Panichkriangkrai W, Patcharanarumol W, Penn-Kekana L, Powell-Jackson T,	Good Health at Low Cost 25 years on: lessons for the future of health systems strengthening	The Lancet, Volume 381, Issue 9883, 15–21 June 2013, Pages 2118-2133, ISSN 0140-6736	Science Direct	Excluded

Tangcharoensathien V, and McKee M				
Baltagi BH and Francesco Moscone	Health care expenditure and income in the OECD reconsidered: Evidence from panel data	Economic Modelling, Volume 27, Issue 4, July 2010, Pages 804-811, ISSN 0264-9993	Science Direct	Excluded
Baltussen R	Priority setting of public spending in developing countries: Do not try to do everything for everybody	Health Policy, Volume 78, Issues 2–3, October 2006, Pages 149-156, ISSN 0168-8510	Science Direct	Excluded
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Beaulière A, Le Maux A, Trehin C, and Perez F	Access to antiretroviral treatment in developing countries: Which financing strategies are possible?	Revue d'Épidémiologie et de Santé Publique, Volume 58, Issue 3, June 2010, Pages 171-179, ISSN 0398-7620	Science Direct	Excluded

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deRiel E, Fort M, and Barry D	Effect of development assistance on domestic health expenditures	The Lancet, Volume 376, Issue 9741, 21–27 August 2010, Page 590, ISSN 0140-6736	Science Direct	Excluded
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Ebuehi OM and Omogbemi KB	Juvenile delinquency among students of an approved sheltered girls' school in Lagos, Nigeria.	Nig Q J Hosp Med. 2011 Jan-Mar;21(1):50-8.	MEDLINE	Excluded
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Fan VY and Savedoff WB	The health financing transition: A conceptual framework and empirical evidence	Social Science & Medicine, Volume 105, March 2014, Pages 112-121, ISSN 0277-9536	Science Direct	Excluded
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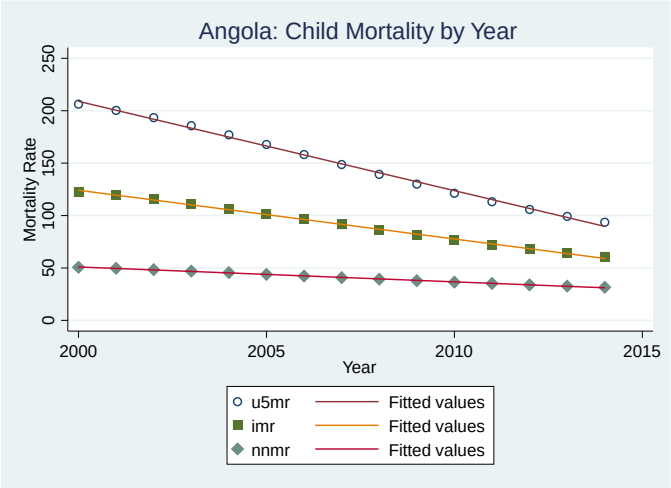
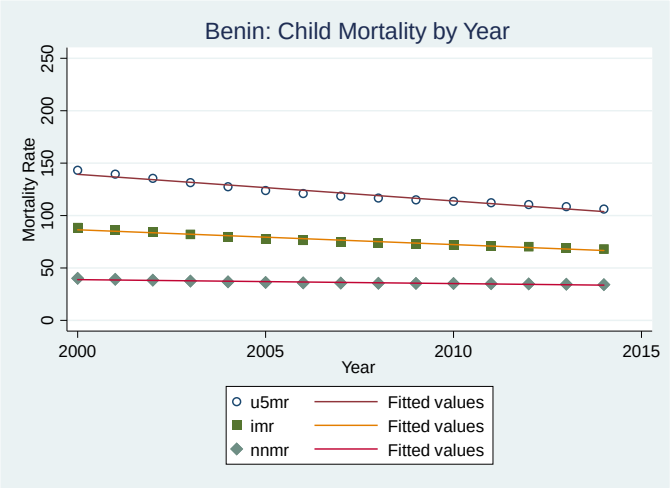
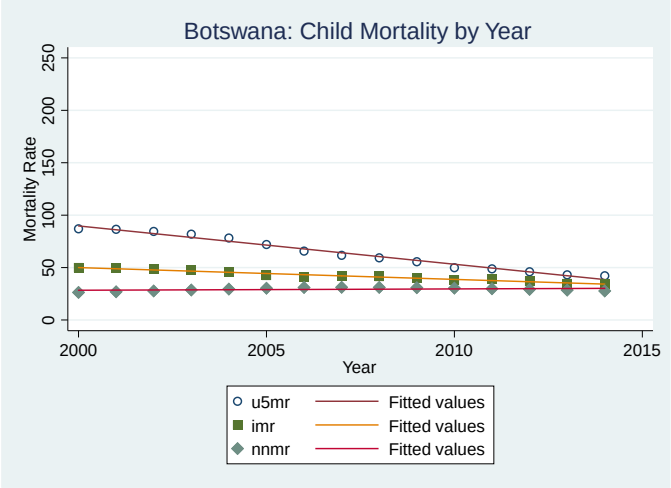
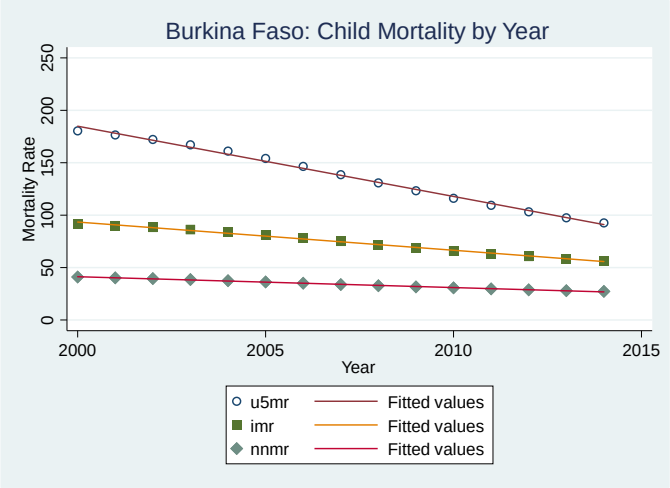
Wright S	Effect of development assistance on domestic health expenditures	The Lancet, Volume 376, Issue 9741, 21–27 August 2010, Pages 590-591, ISSN 0140-6736	Science Direct	Excluded
Younis MZ, Jaber S, Mawson AR, and Hartmann M	Estimating the unit costs of public hospitals and primary healthcare centers.	Int J Health Plann Manage. 2013 Oct;28(4):320-32. doi: 10.1002/hpm.2147. Epub 2012 Nov 5.	MEDLINE	Excluded
Zere E, Walker O, Kirigia J, Zawaira F, Magombo F and Kataika E	Health financing in Malawi: Evidence from National Health Accounts	BMC International Health and Human Rights. 2010. 10:27	ProQuest	Excluded with Reasons
Zwanziger J and Brammli-Greenberg S	Strong government influence over the Israeli health care system has led to low rates of spending growth.	Health Aff (Millwood). 2011 Sep;30(9):1779-85. doi: 10.1377/hlthaff.2010.0936.	MEDLINE	Excluded

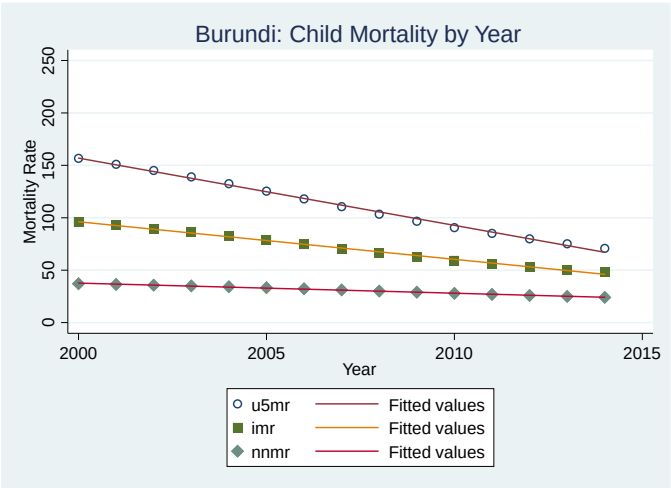
Appendix 4: Graphical Distribution of Under-five, Infant and Neonatal Mortality by Country

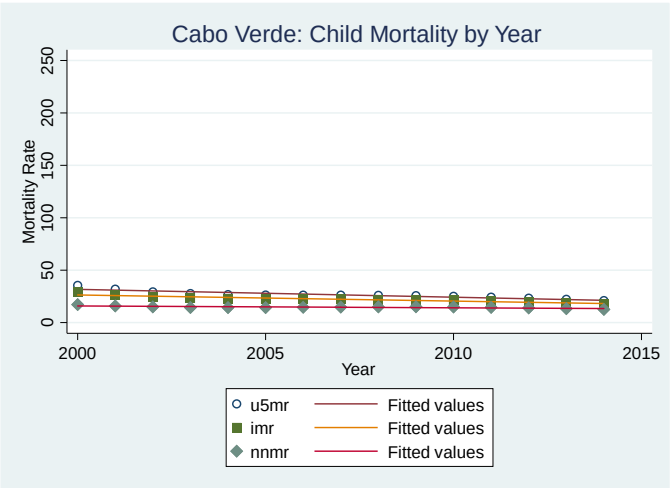


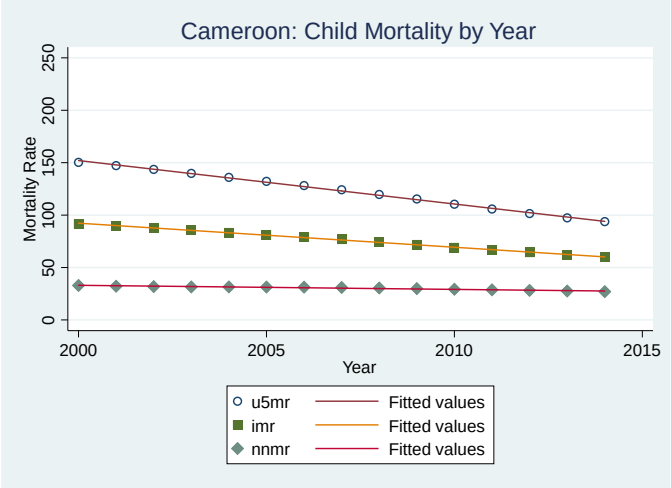


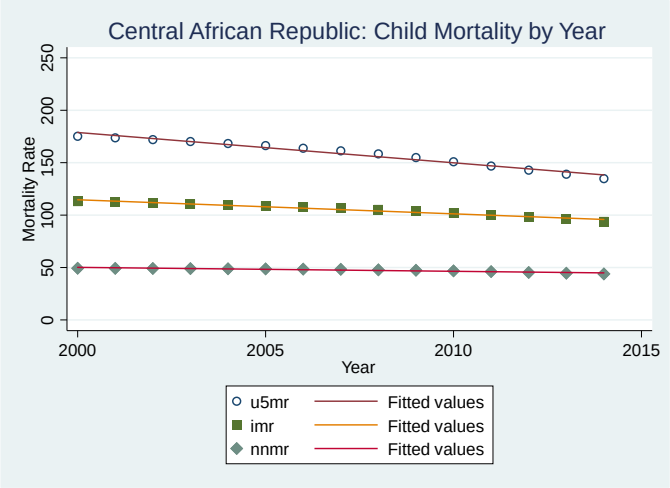









Cameroon: Child Mortality by Year
Mortality Rate
0
50
100
150
200
250
2000
2005
2010
2015
Year
u5mr
imr
nnmr
Fitted values
Fitted values
Fitted values


Central African Republic: Child Mortality by Year
Mortality Rate
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250
2000
2005
2010
2015
Year
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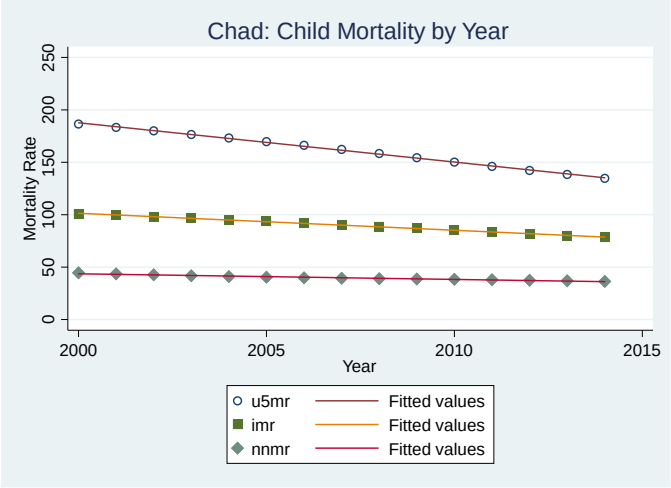
Fitted values


Chad: Child Mortality by Year
Mortality Rate
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200
250
2000
2005
2010
2015
Year
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imr
nnmr
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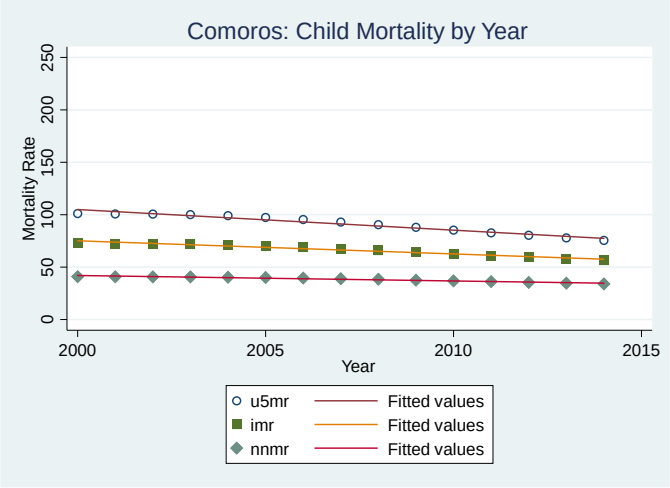
Fitted values


Comoros: Child Mortality by Year
Mortality Rate
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100
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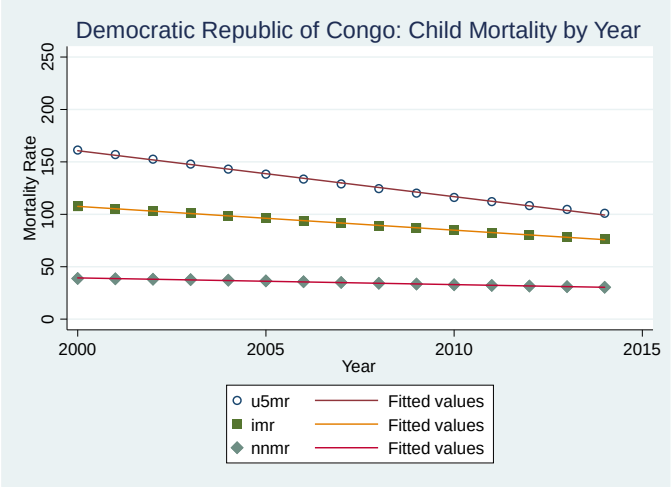
200
250
2000
2005
2010
2015
Year
u5mr
imr
nnmr
Fitted values
Fitted values
Fitted values


Democratic Republic of Congo: Child Mortality by Year
Mortality Rate
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200
250
2000
2005
2010
2015
Year
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imr
nnmr
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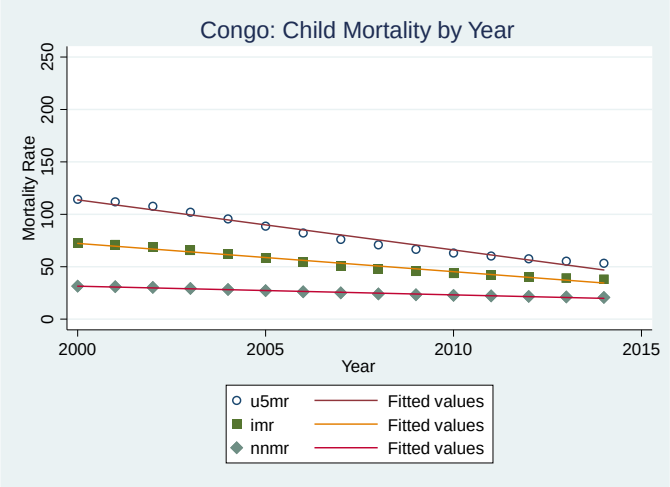
Fitted values
Fitted values


Congo: Child Mortality by Year
Mortality Rate
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200
250
2000
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2010
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Year
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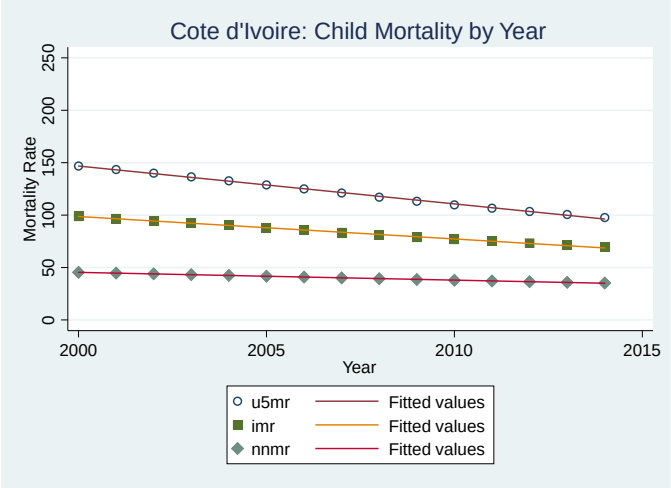
Cote d'Ivoire: Child Mortality by Year
Mortality Rate
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2000
2005
2010
2015
Year
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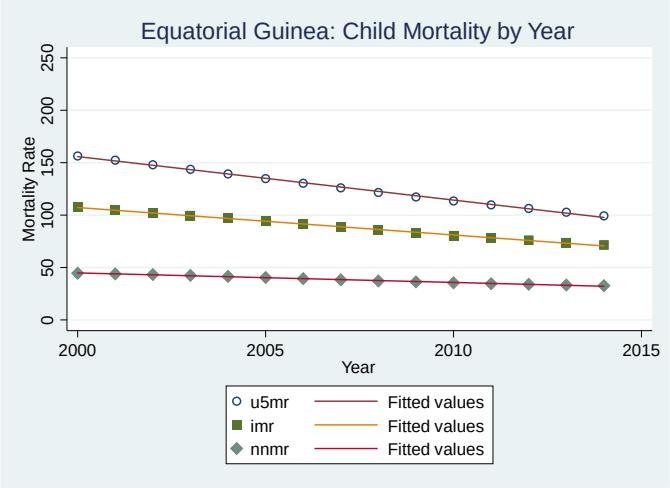
Equatorial Guinea: Child Mortality by Year
Mortality Rate
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2000
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2015
Year
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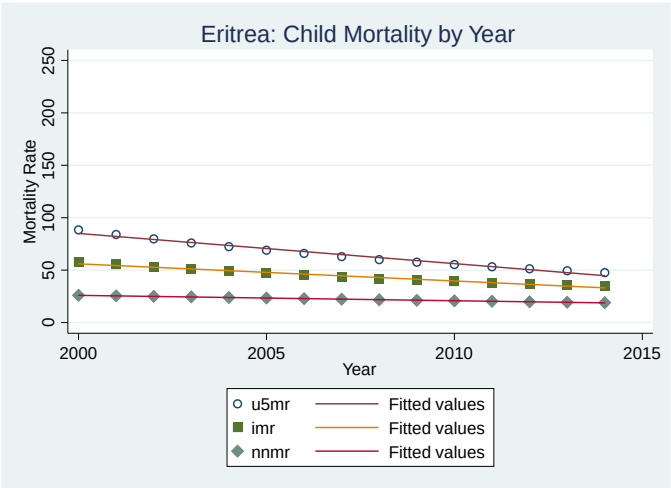
Eritrea: Child Mortality by Year
Mortality Rate
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2000
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2015
Year
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imr
nnmr
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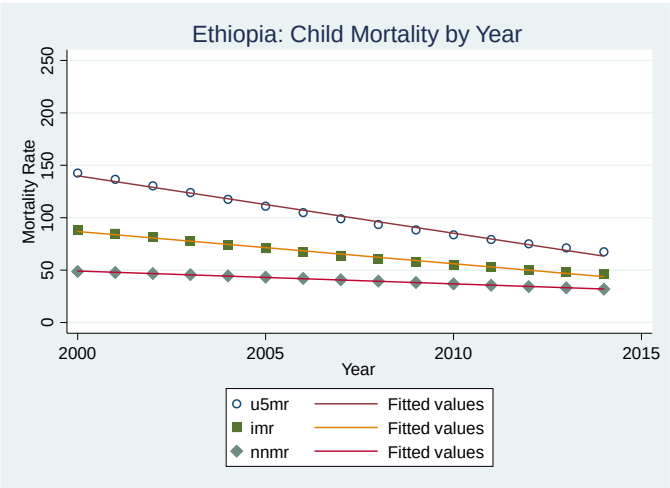
Ethiopia: Child Mortality by Year
Mortality Rate
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250
2000
2005
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2015
Year
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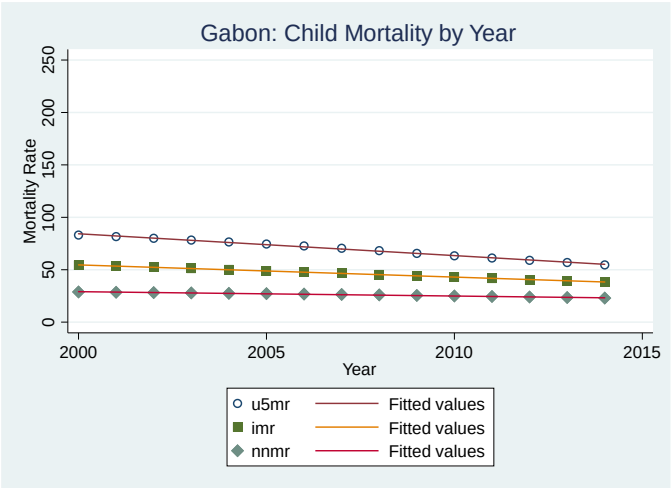
Gabon: Child Mortality by Year
Mortality Rate
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200
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2000
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Year
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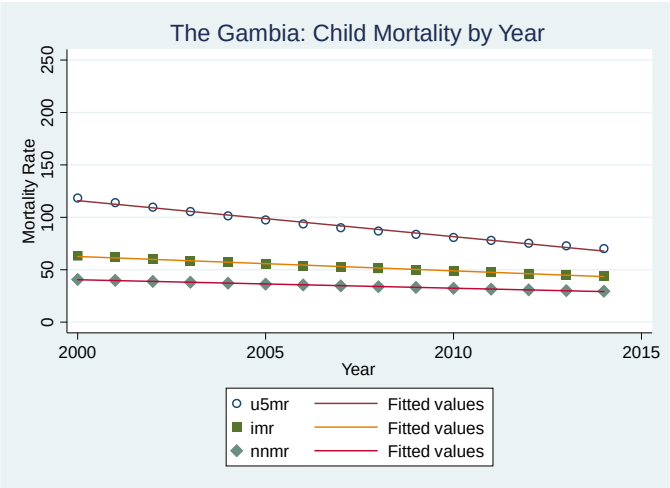
imr
nnmr
Fitted values
Fitted values
Fitted values


The Gambia: Child Mortality by Year
Mortality Rate
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2000
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Year
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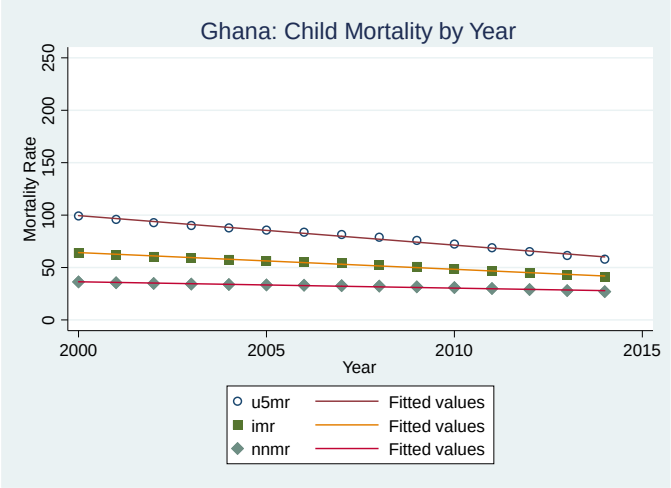
Ghana: Child Mortality by Year
Mortality Rate
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Year
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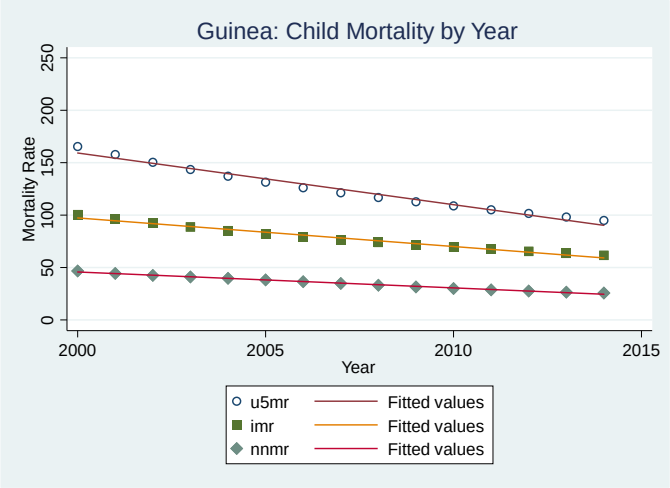
Guinea: Child Mortality by Year
Mortality Rate
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Year
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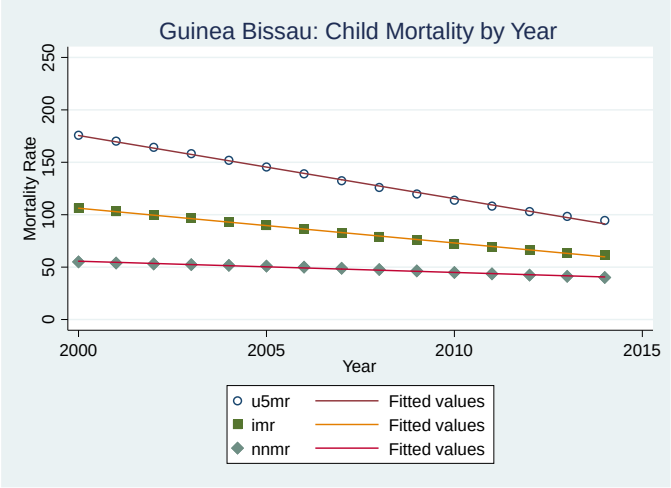
Guinea Bissau: Child Mortality by Year
Mortality Rate
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Year
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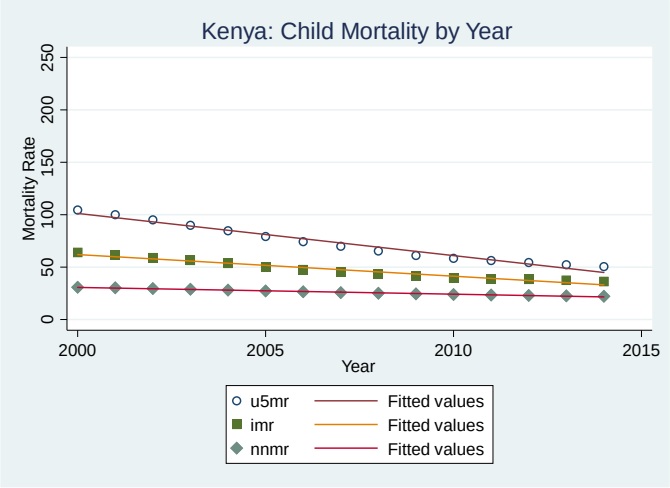
Kenya: Child Mortality by Year
Mortality Rate
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Year
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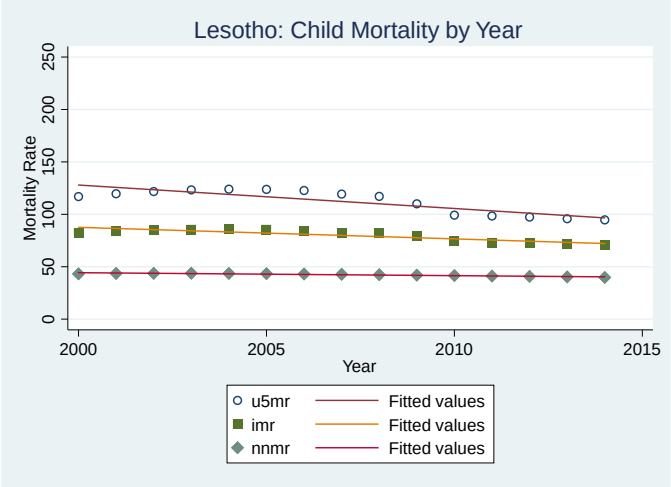
Lesotho: Child Mortality by Year
Mortality Rate
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Year
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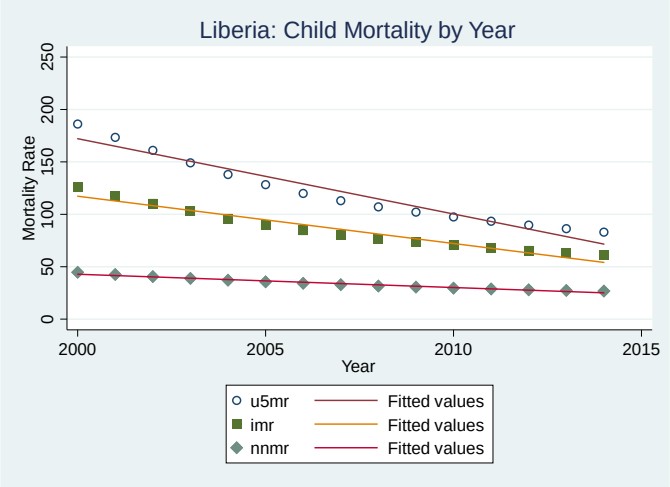
Liberia: Child Mortality by Year
Mortality Rate
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Year
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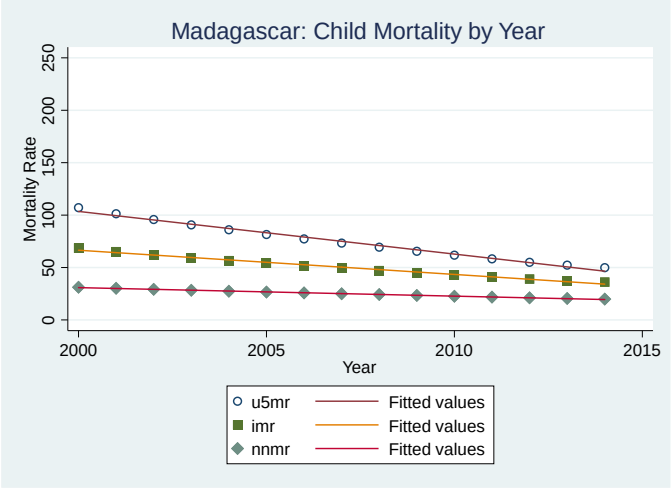
Madagascar: Child Mortality by Year
Mortality Rate
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Year
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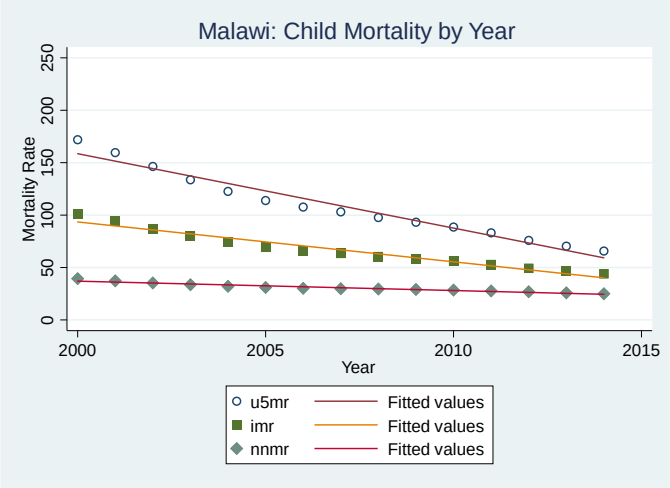
Malawi: Child Mortality by Year
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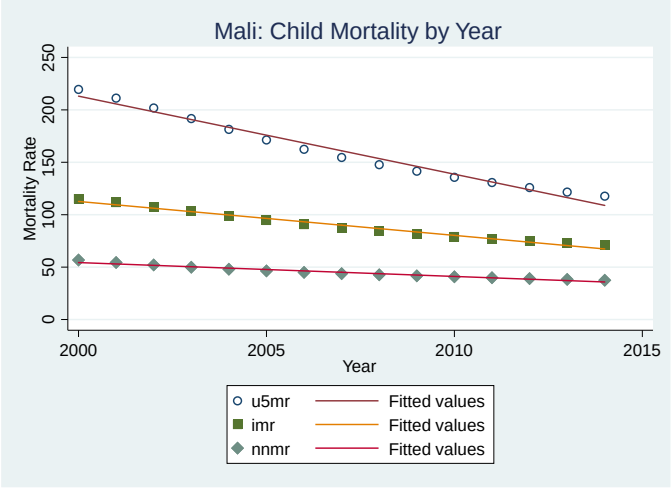
Mali: Child Mortality by Year
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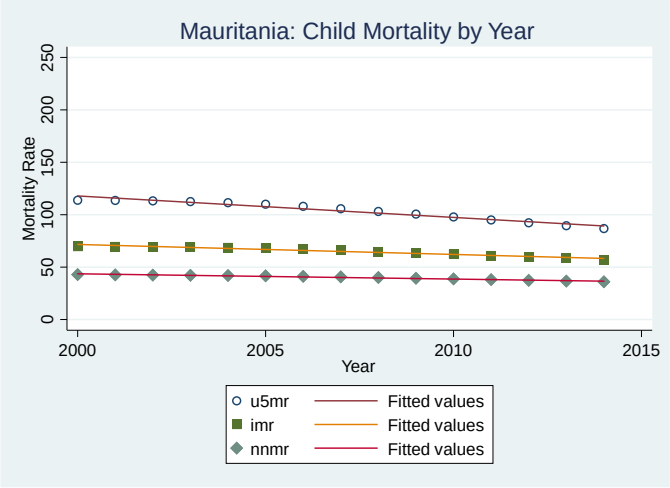
Mauritania: Child Mortality by Year
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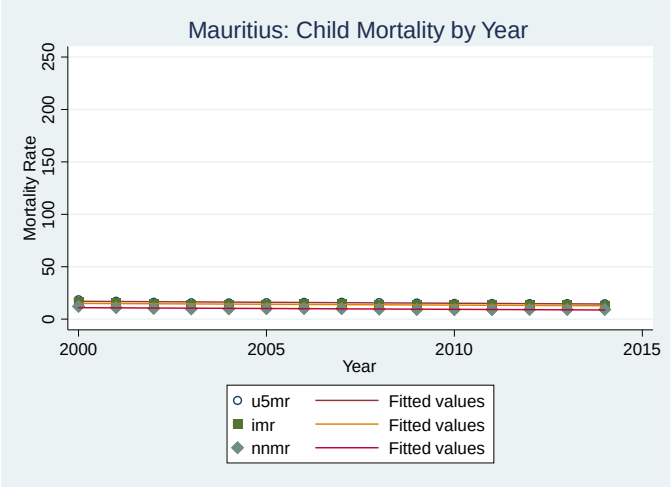
Mauritius: Child Mortality by Year
Mortality Rate
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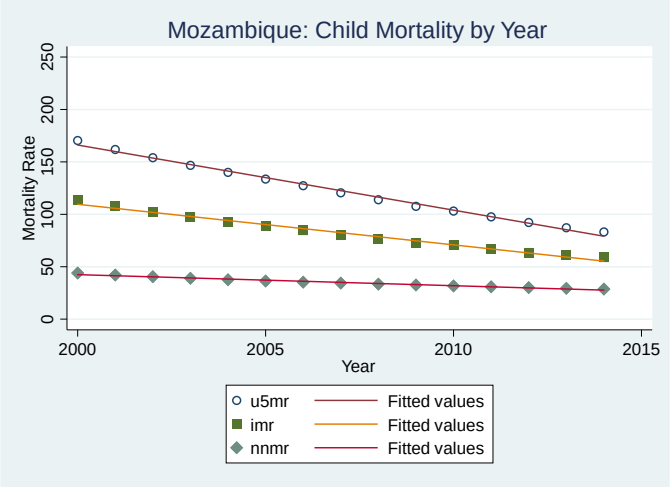
Mozambique: Child Mortality by Year
Mortality Rate
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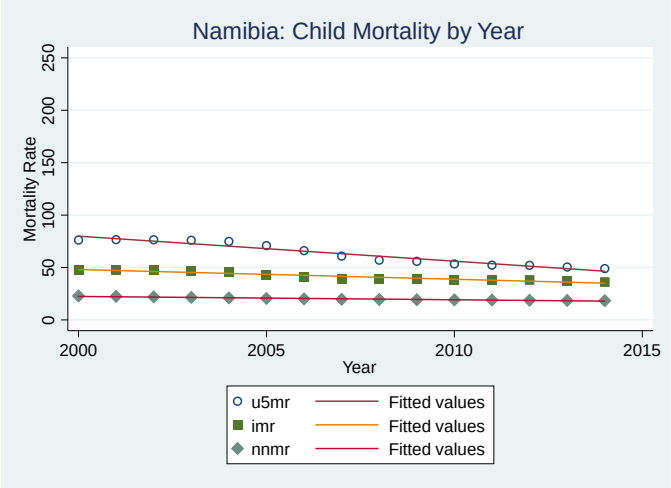
Namibia: Child Mortality by Year
Mortality Rate
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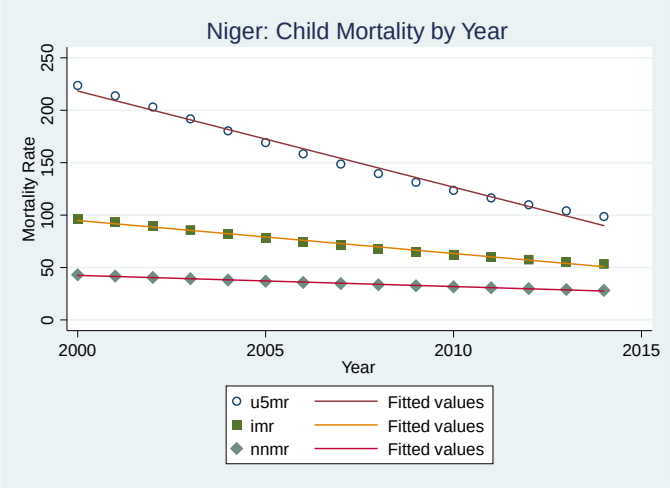
Niger: Child Mortality by Year
Mortality Rate
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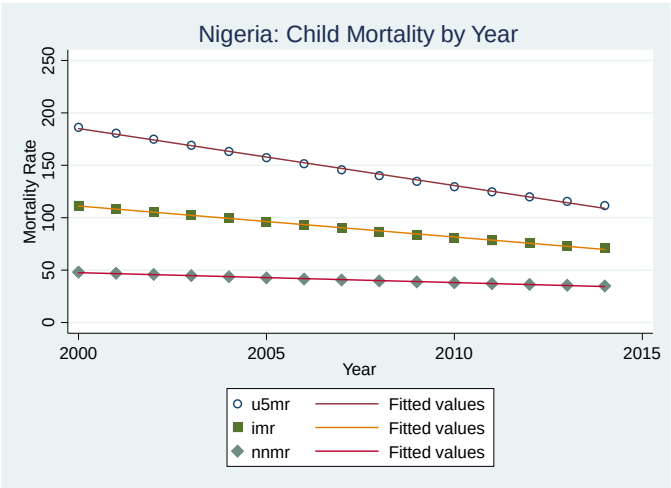
Nigeria: Child Mortality by Year
Mortality Rate
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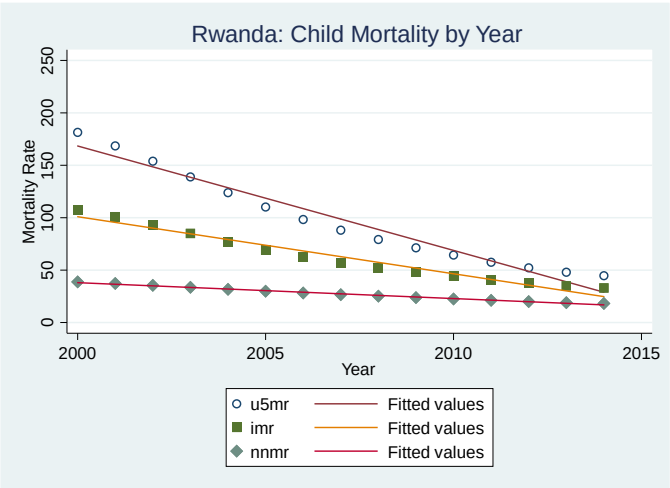
Rwanda: Child Mortality by Year
Mortality Rate
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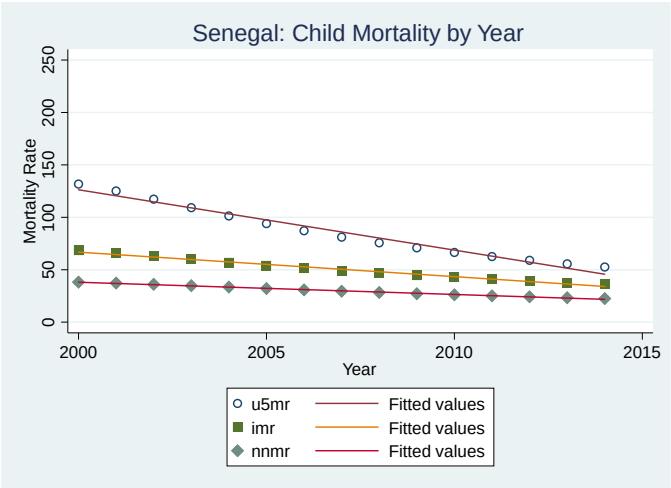
Senegal: Child Mortality by Year
Mortality Rate
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2000
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Year
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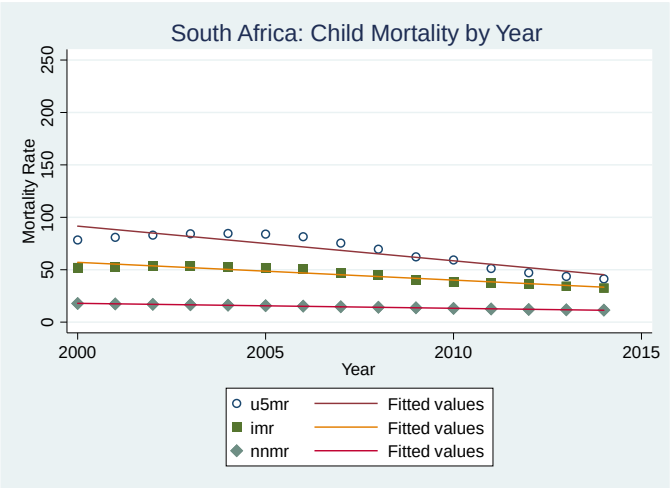
South Africa: Child Mortality by Year
Mortality Rate
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Year
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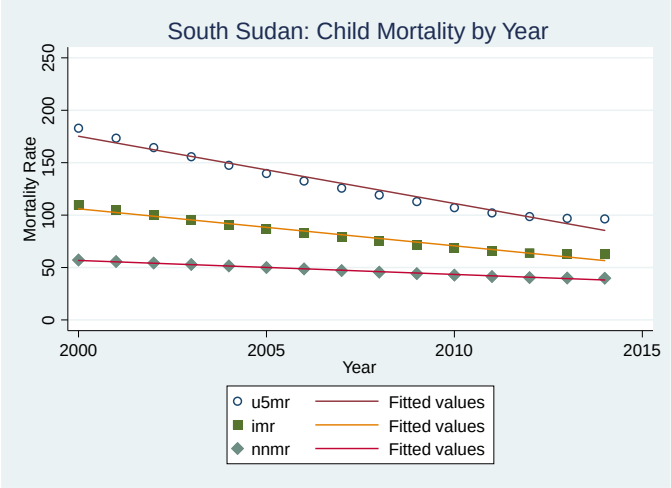
South Sudan: Child Mortality by Year
Mortality Rate
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2000
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Year
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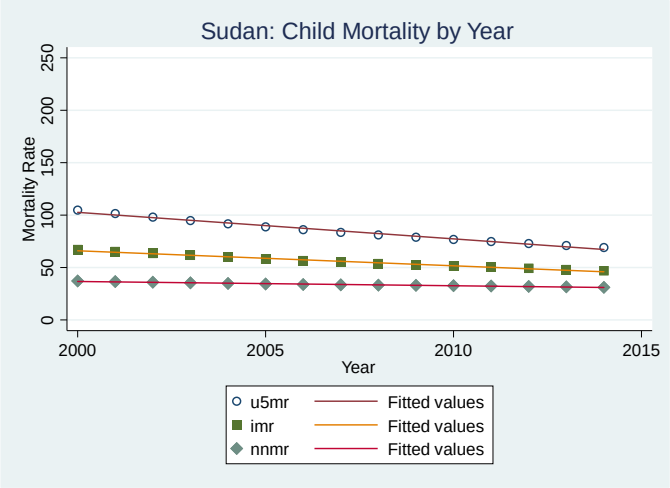
Sudan: Child Mortality by Year
Mortality Rate
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Year
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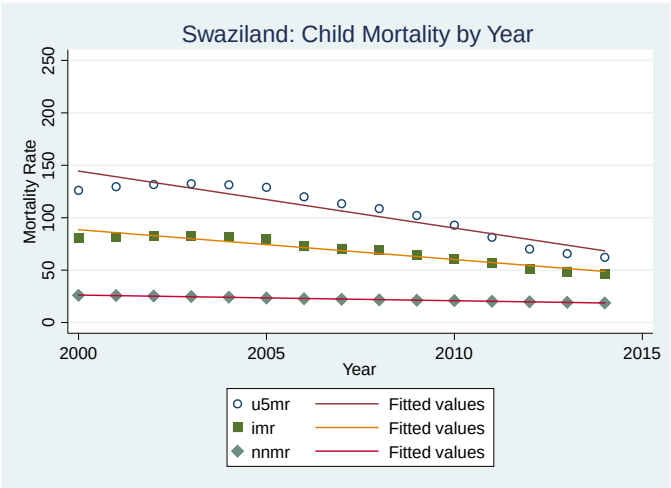
Swaziland: Child Mortality by Year
Mortality Rate
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2000
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Year
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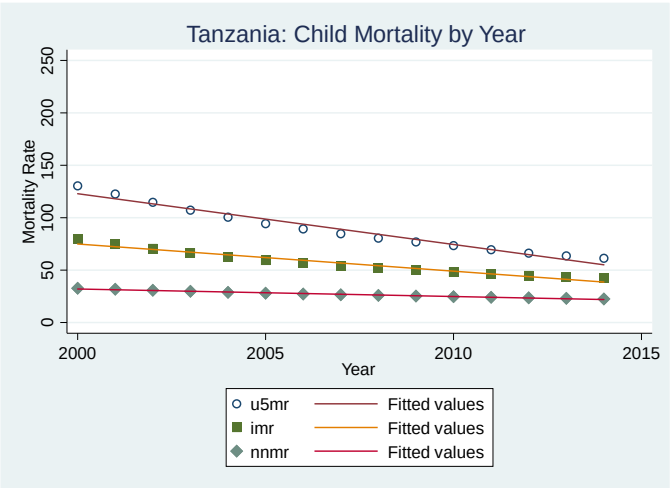
Tanzania: Child Mortality by Year
Mortality Rate
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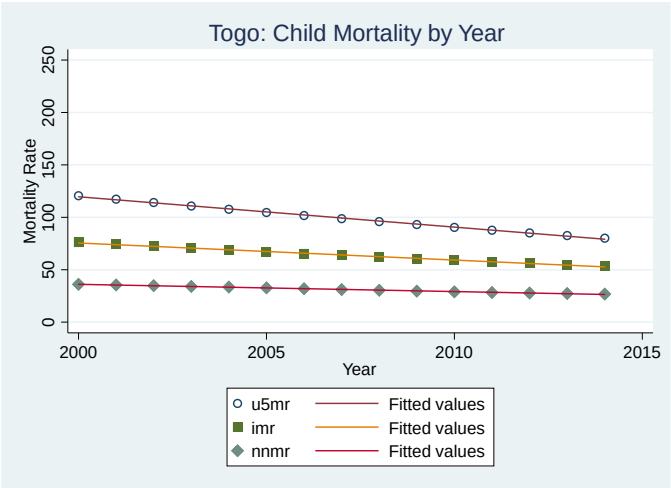
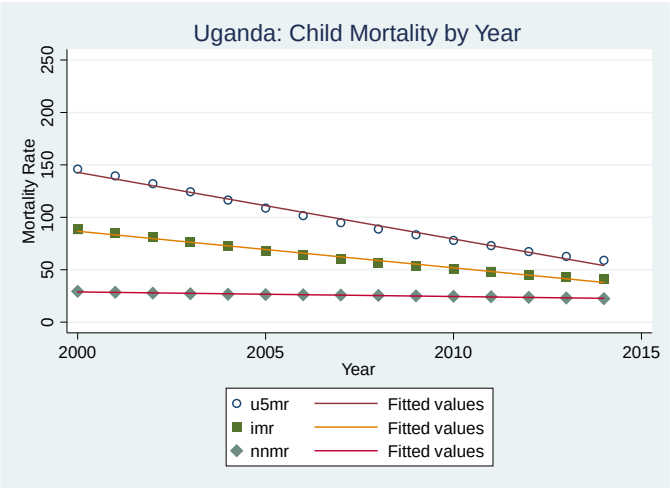
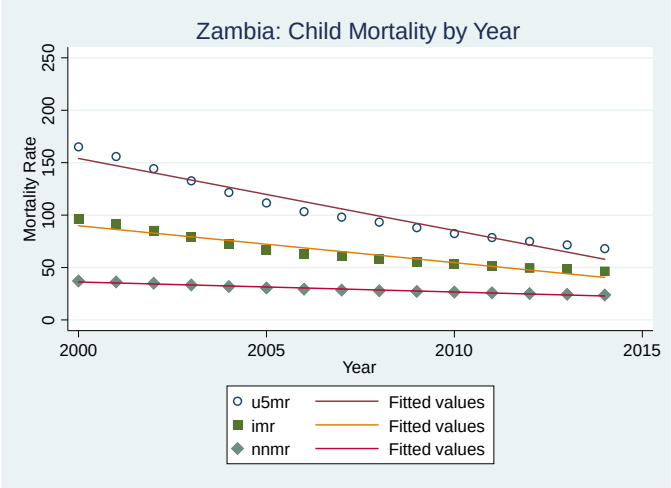
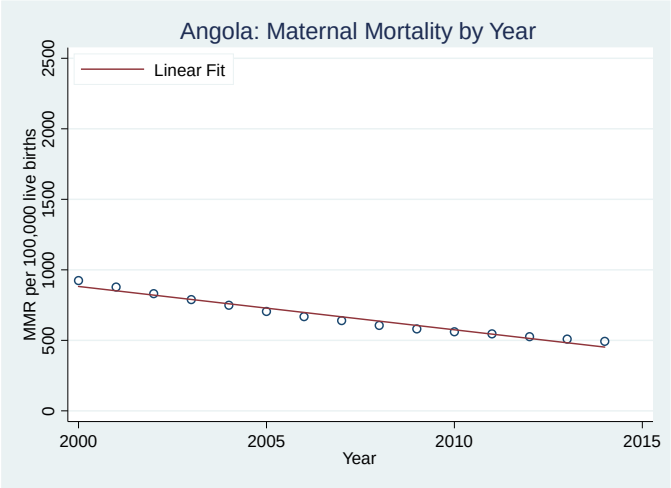
150
200
250
2000
2005
2010
2015
Year
u5mr
imr
nnmr
Fitted values
Fitted values
Fitted values

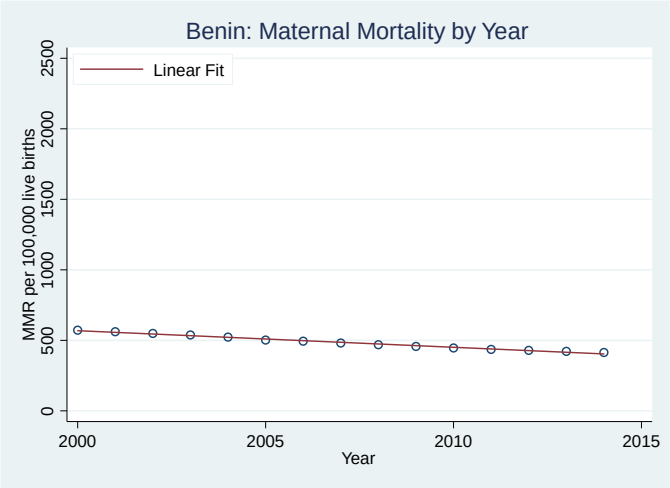

Togo: Child Mortality by Year
Mortality Rate
0
50
100
150
200
250
2000
2005
2010
2015
Year
u5mr
imr
nnmr
Fitted values
Fitted values
Fitted values

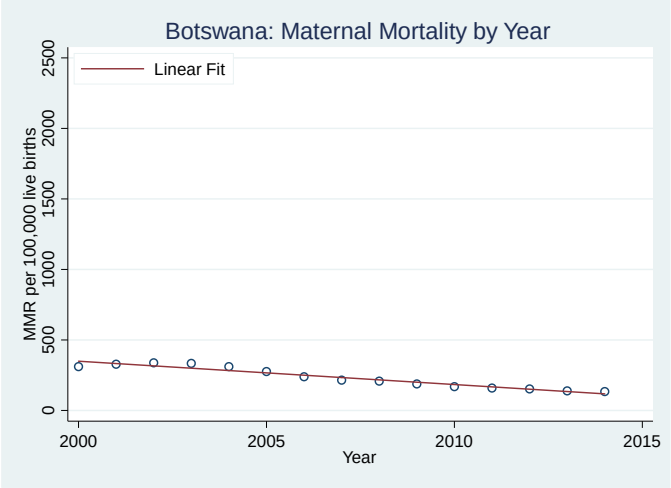

Uganda: Child Mortality by Year
Mortality Rate
0
50
100
150
200
250
2000
2005
2010
2015
Year
u5mr
imr
nnmr
Fitted values
Fitted values
Fitted values

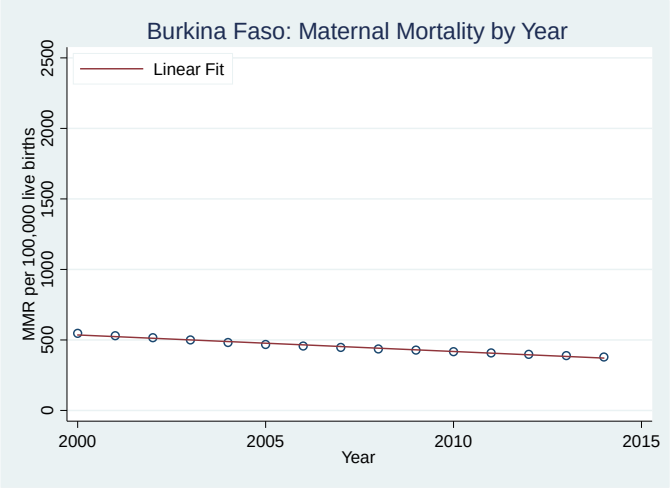

Zambia: Child Mortality by Year
Mortality Rate
0
50
100
150
200
250
2000
2005
2010
2015
Year
u5mr
imr
nnmr
Fitted values
Fitted values
Fitted values

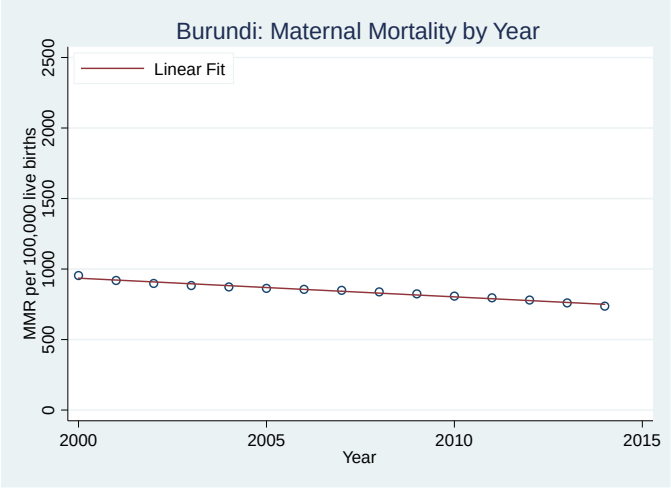
Appendix 5: Graphical Distribution of Maternal Mortality by Country

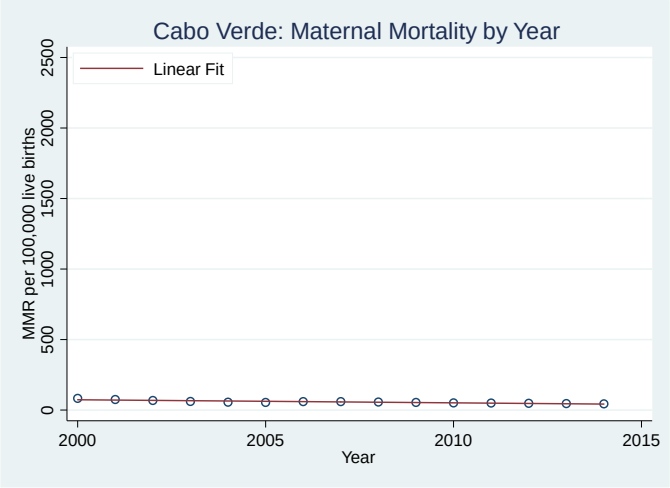


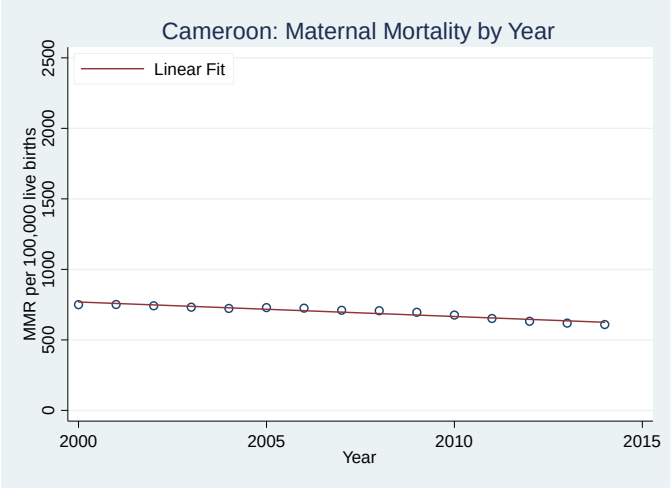


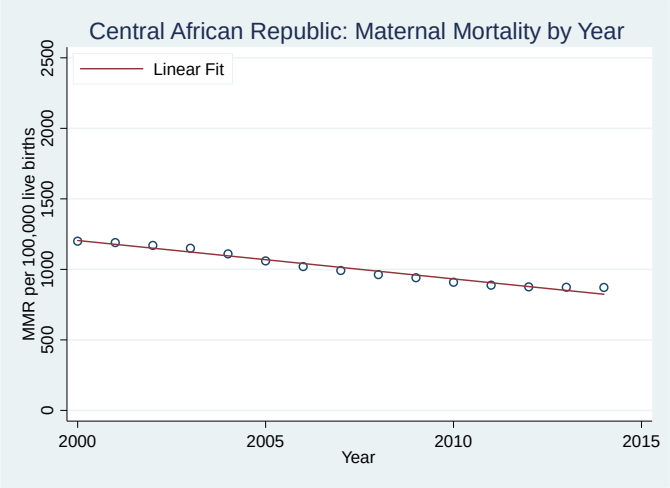


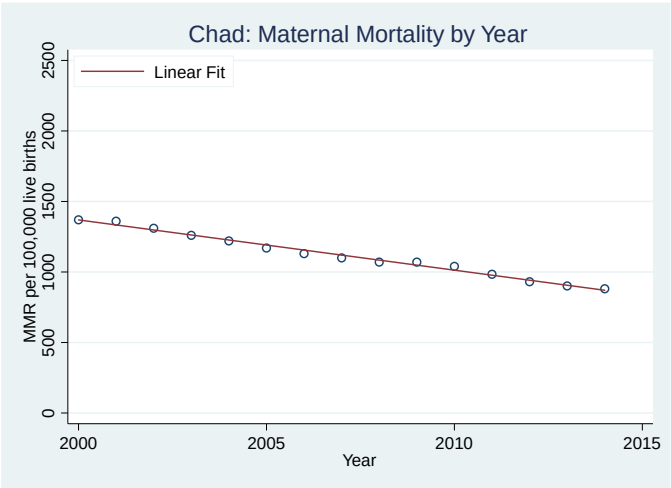


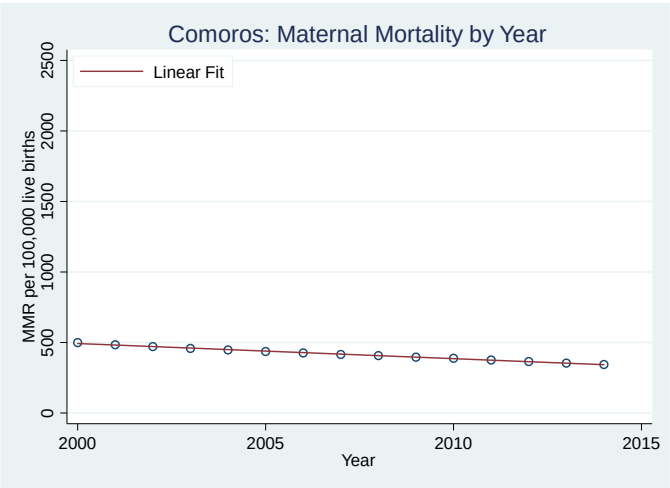


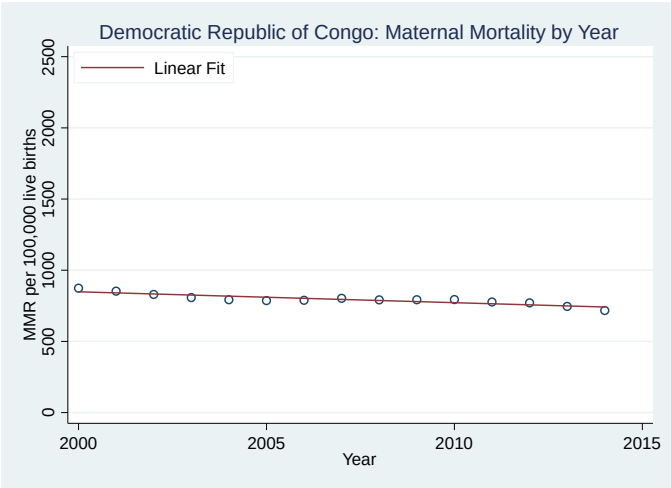


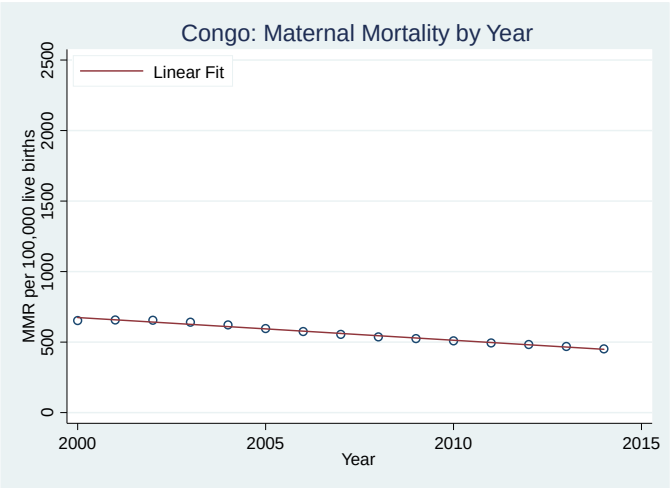

Cameroon: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

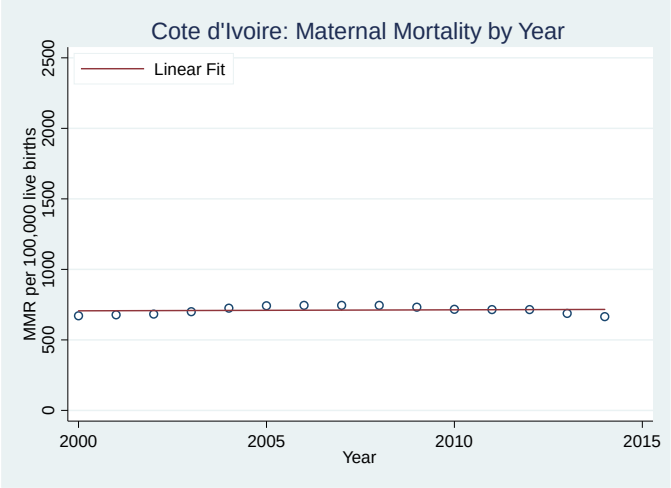

Central African Republic: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

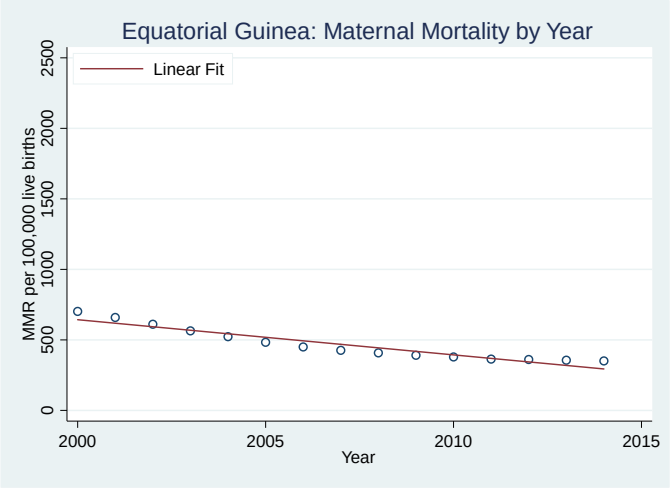

Chad: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

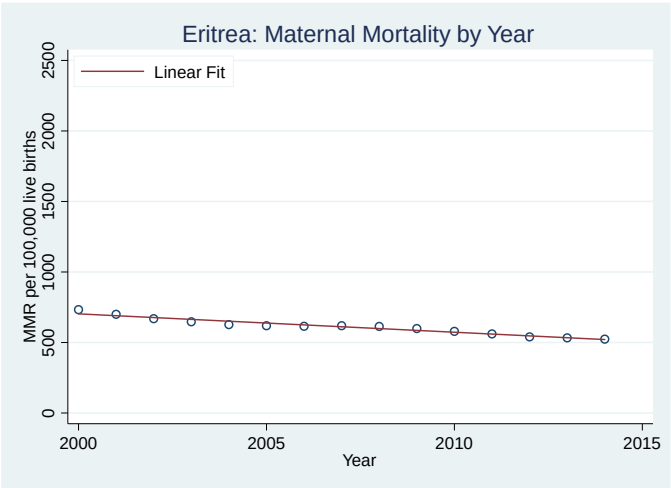

Comoros: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

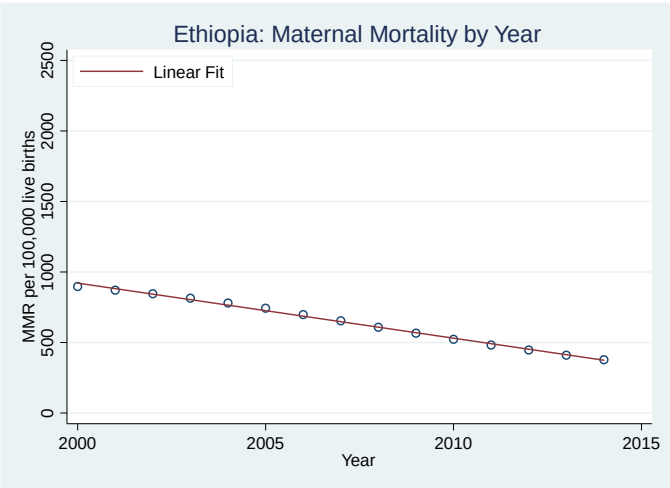

Democratic Republic of Congo: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

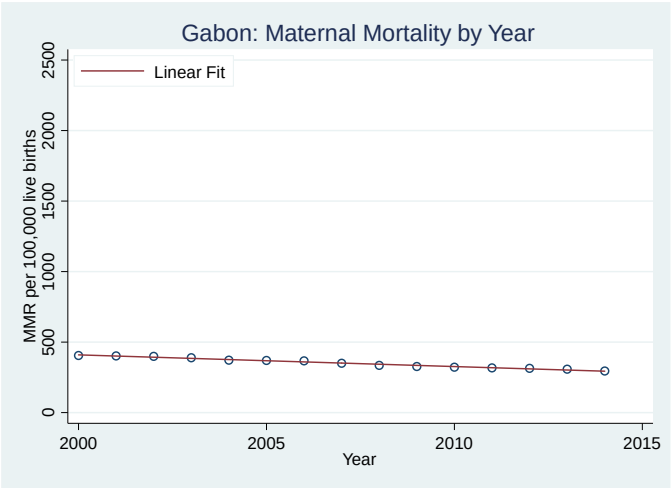

Congo: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

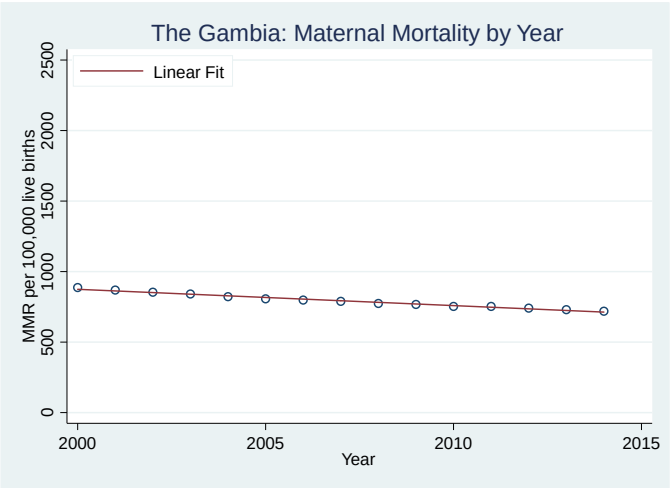

Cote d'Ivoire: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

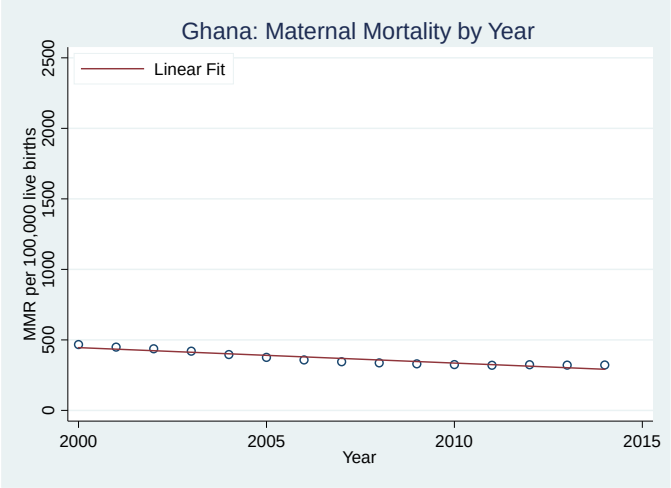

Equatorial Guinea: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

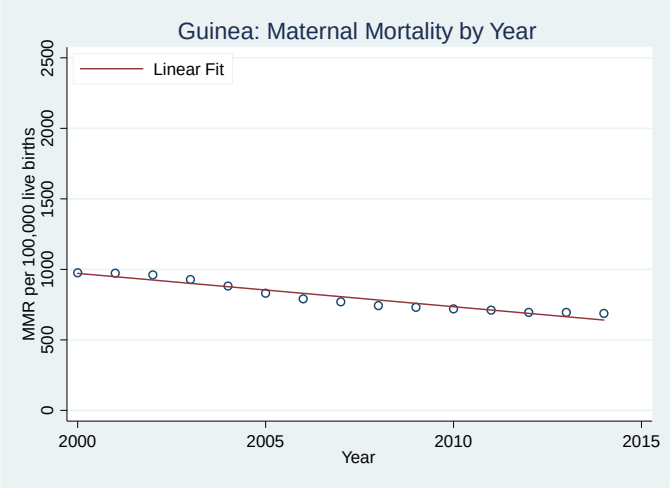

Eritrea: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

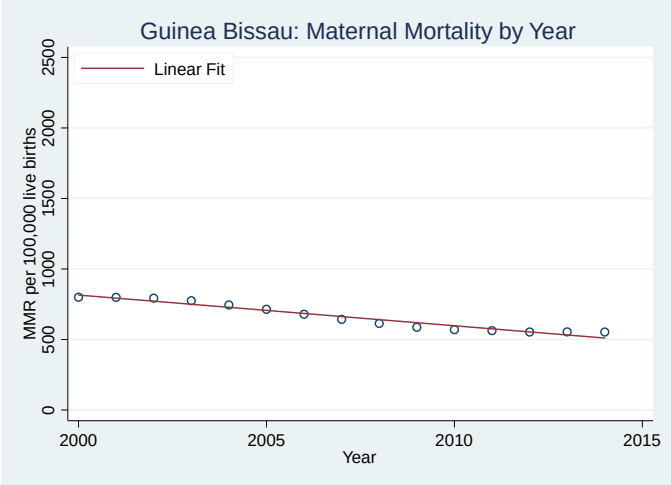

Ethiopia: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

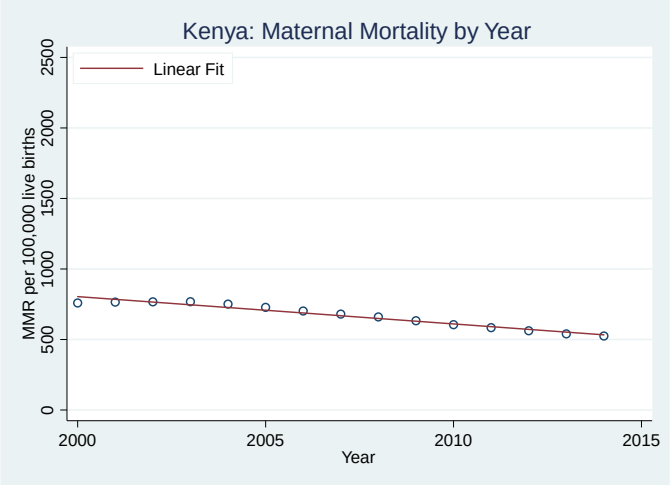

Gabon: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year


The Gambia: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

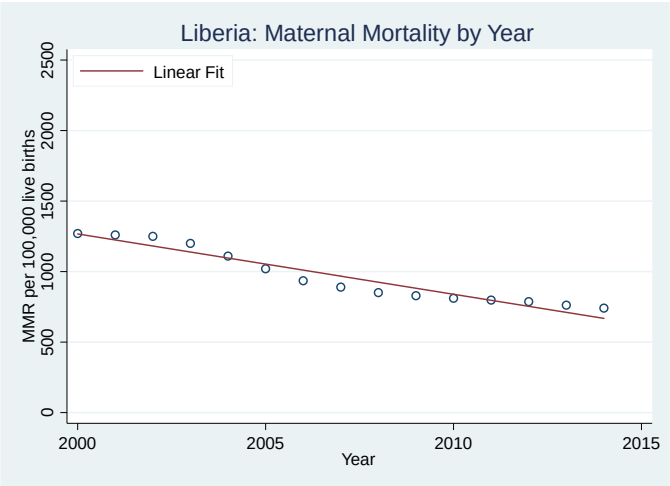

Ghana: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

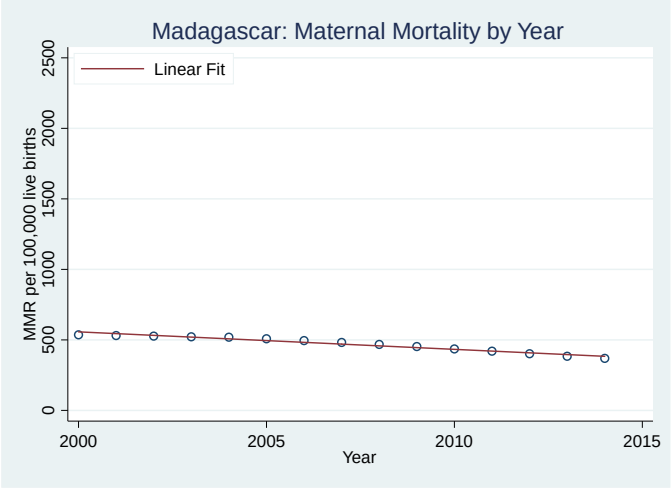

Guinea: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

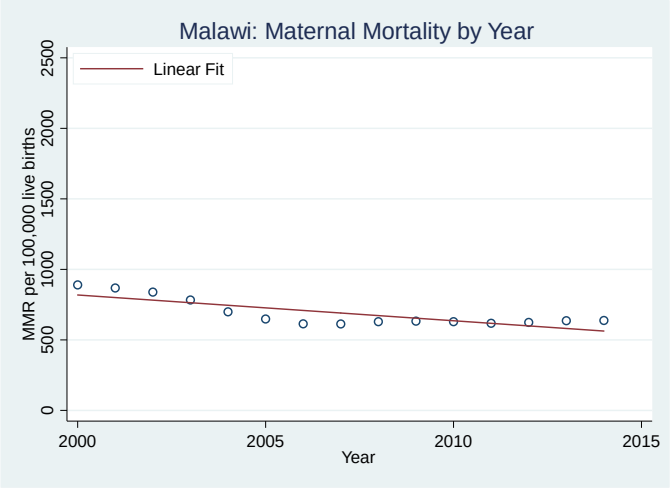

Guinea Bissau: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

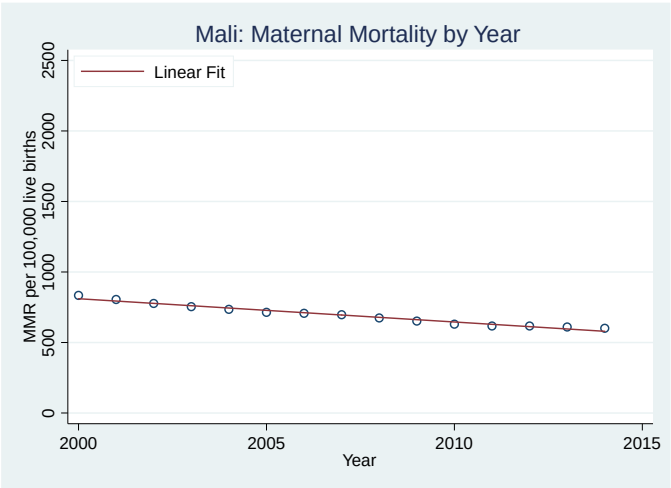

Kenya: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

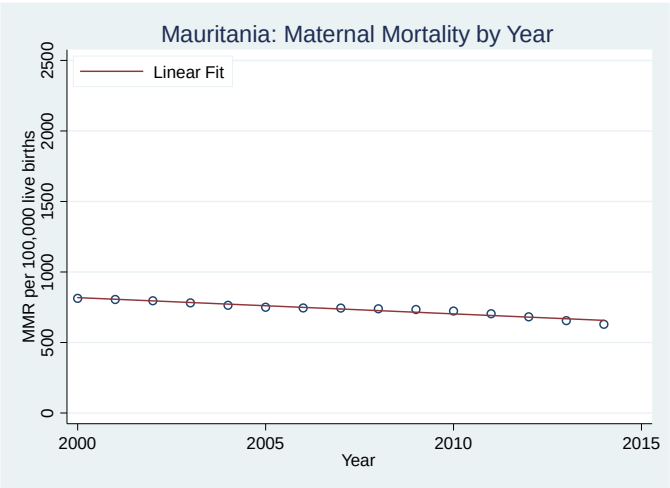

Lesotho: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

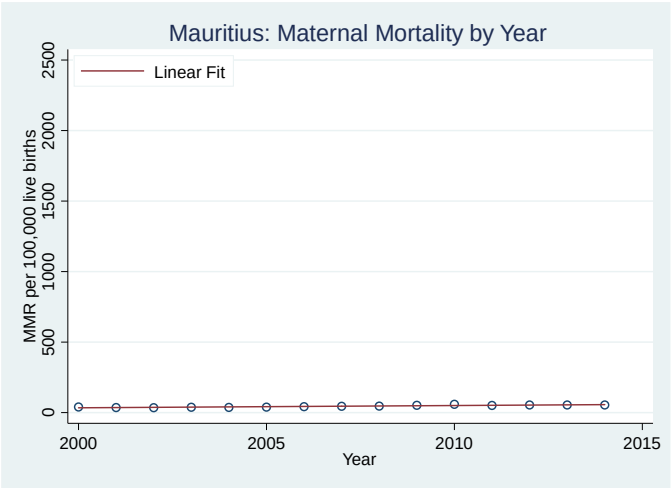

Liberia: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

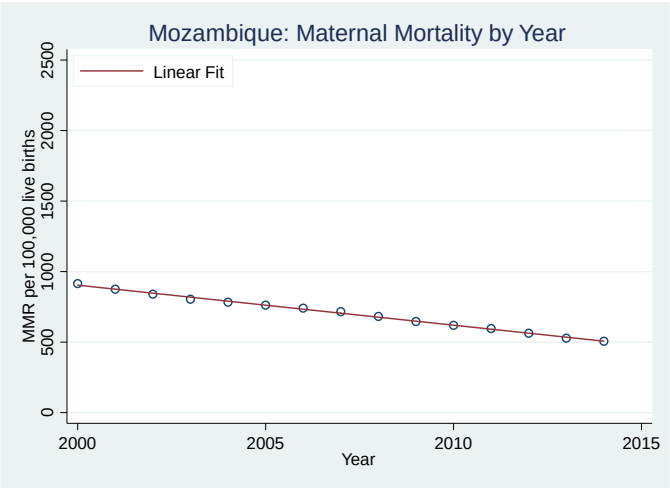

Madagascar: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

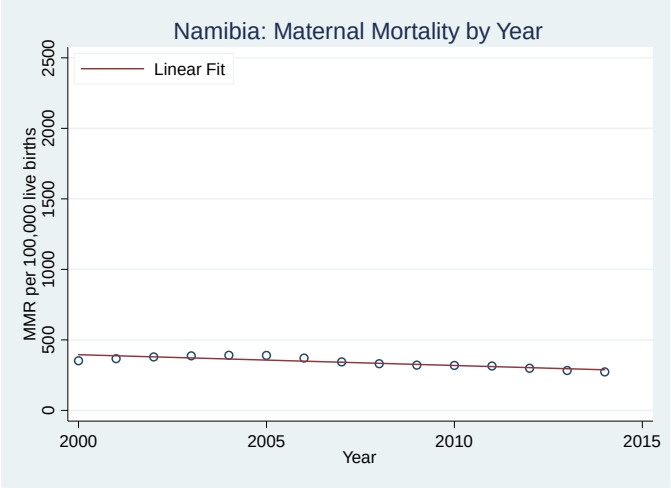

Malawi: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

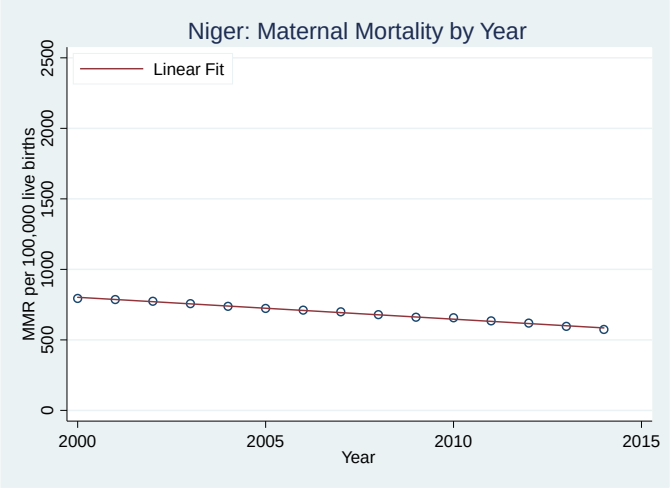

Mali: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

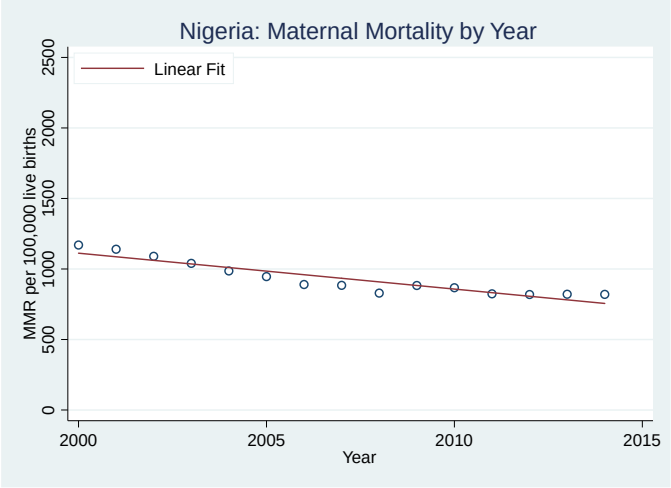

Mauritania: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

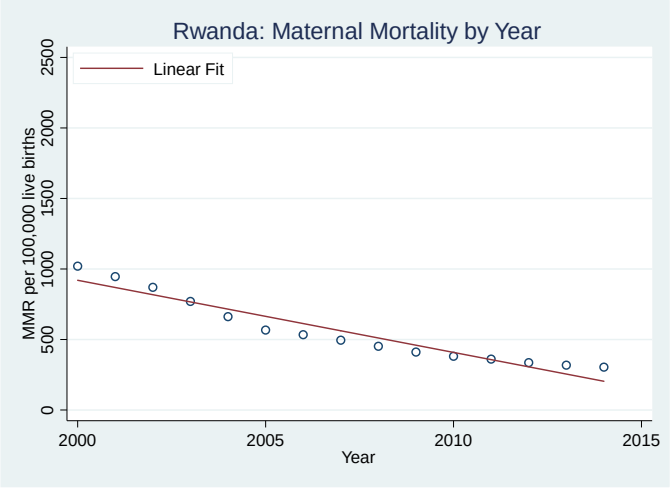

Mauritius: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

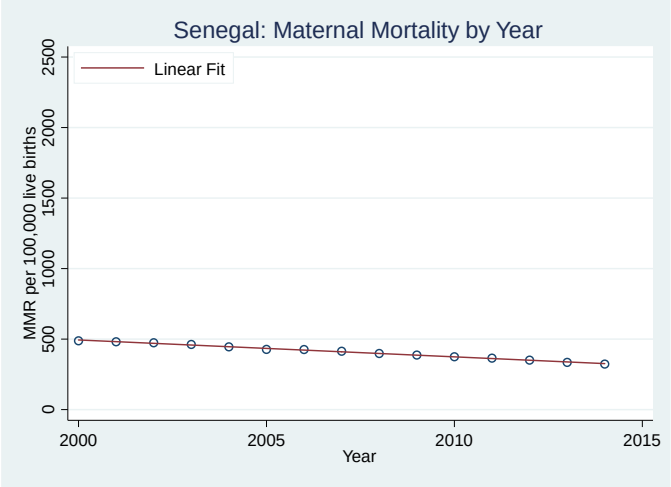

Mozambique: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

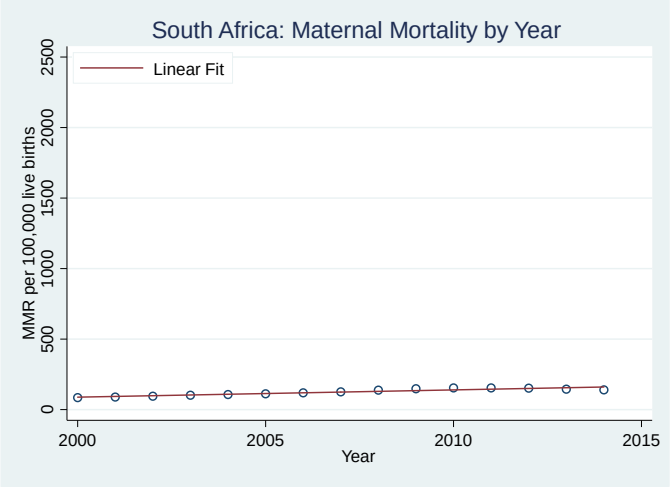

Namibia: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

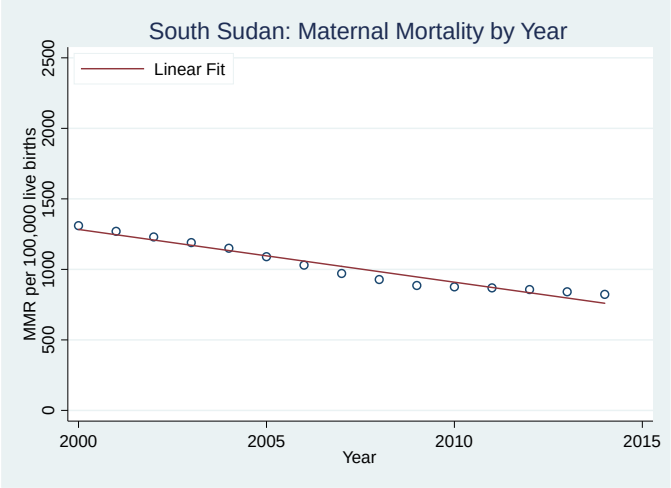

Niger: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

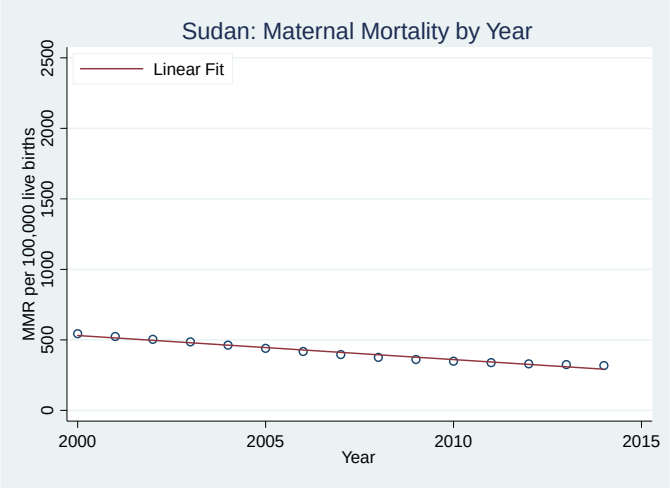

Nigeria: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

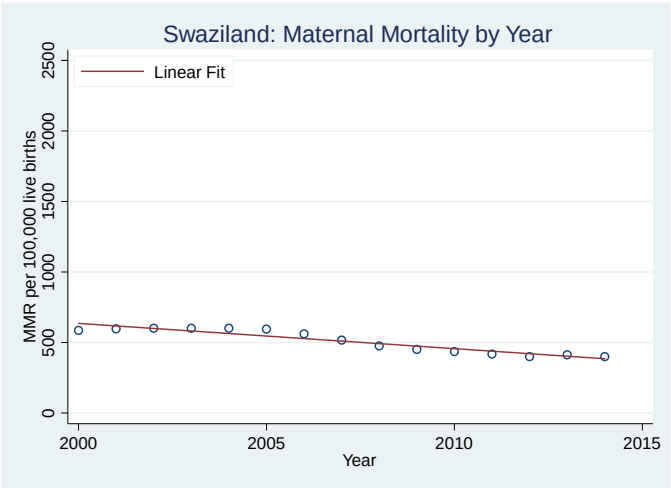

Rwanda: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

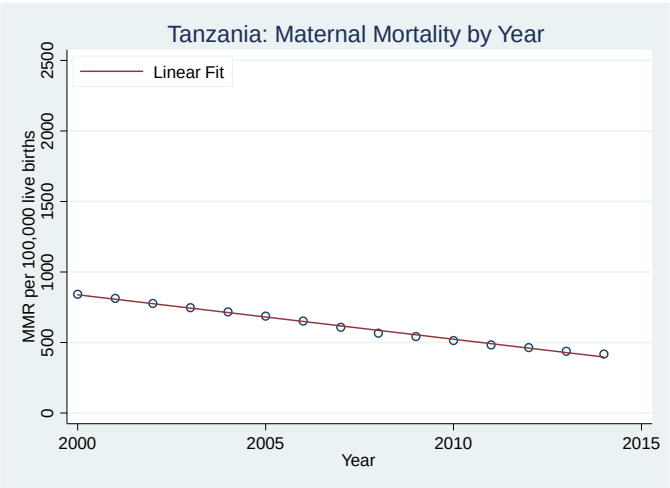

Senegal: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

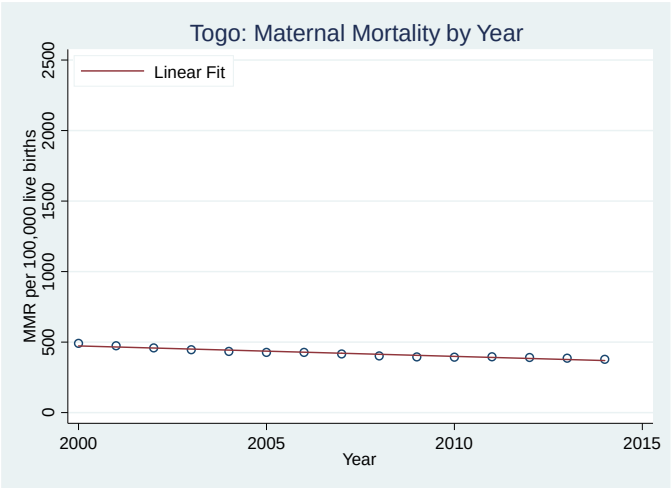

South Africa: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

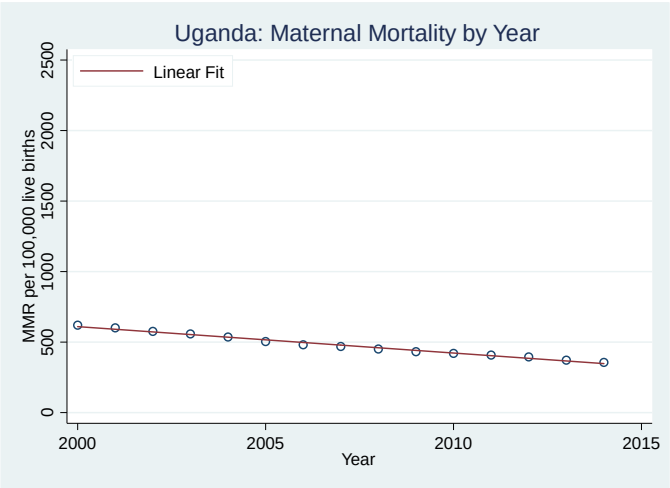

South Sudan: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

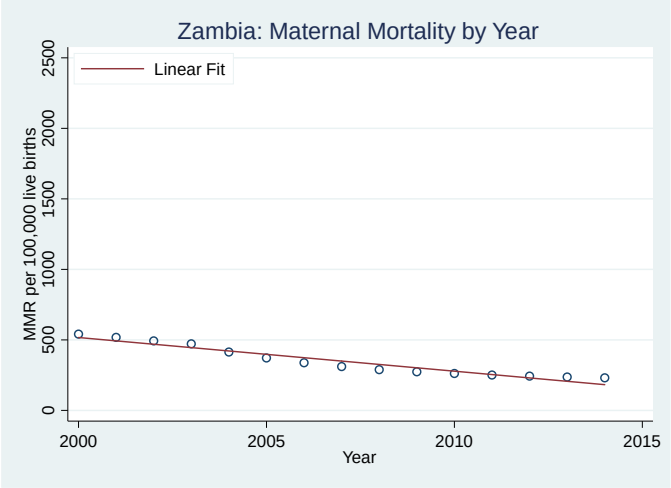

Sudan: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year


Swaziland: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

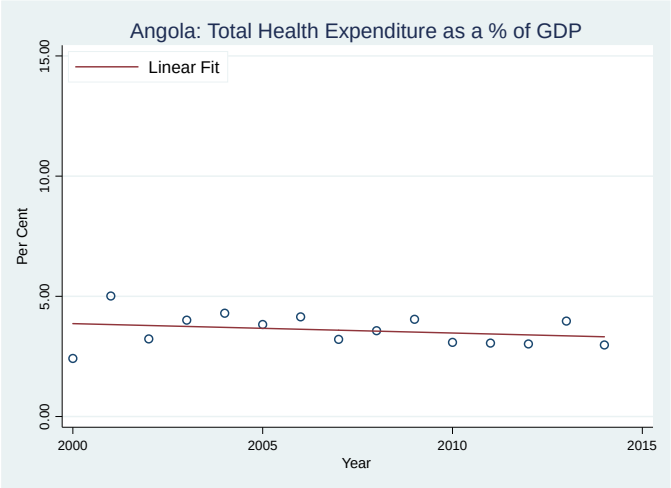

Tanzania: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

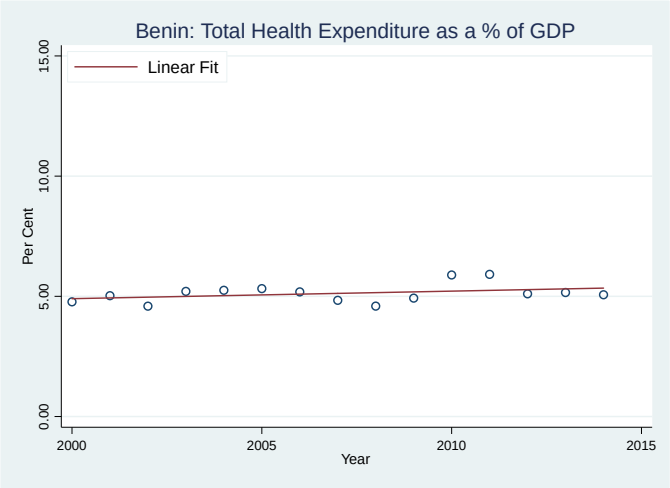

Togo: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

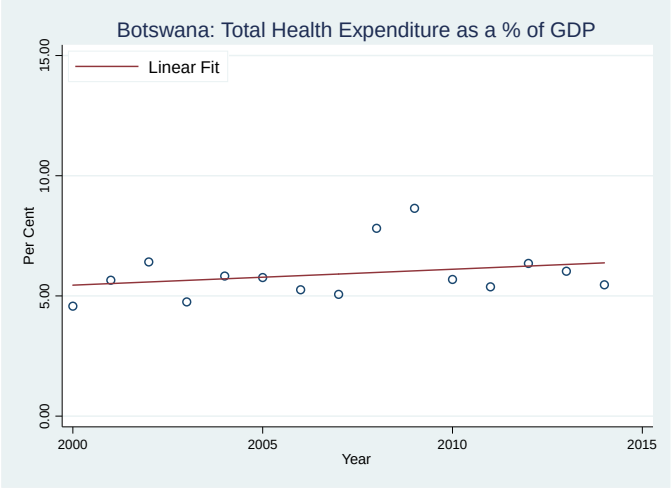

Uganda: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

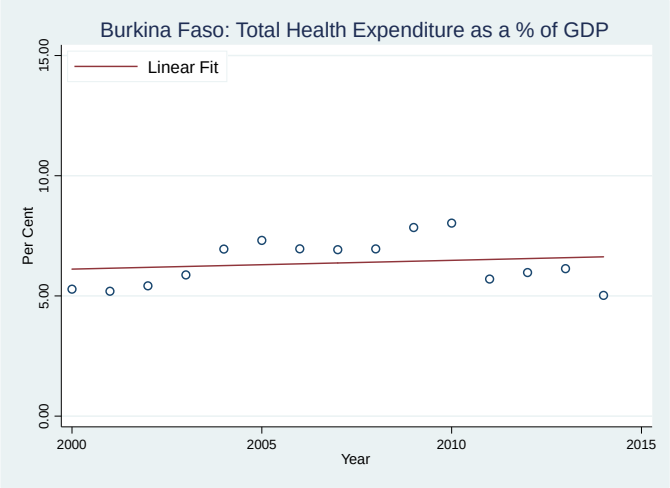

Zambia: Maternal Mortality by Year
Linear Fit
MMR per 100,000 live births
0
500
1000
1500
2000
2500
2000
2005
2010
2015
Year

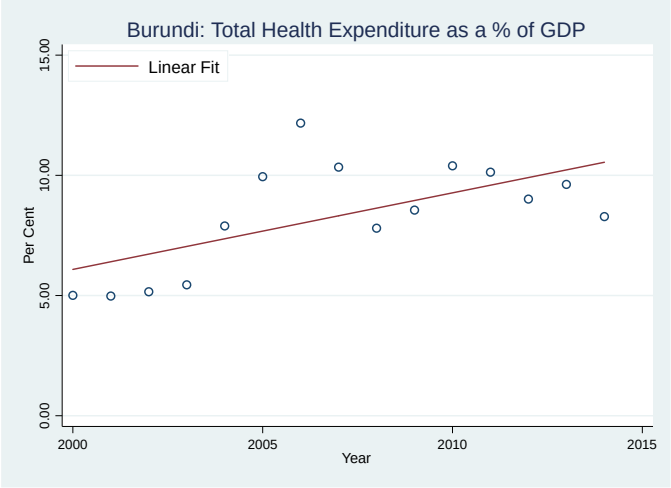
Appendix 6: Graphical Distribution of Total Health Expenditure as a % of GDP

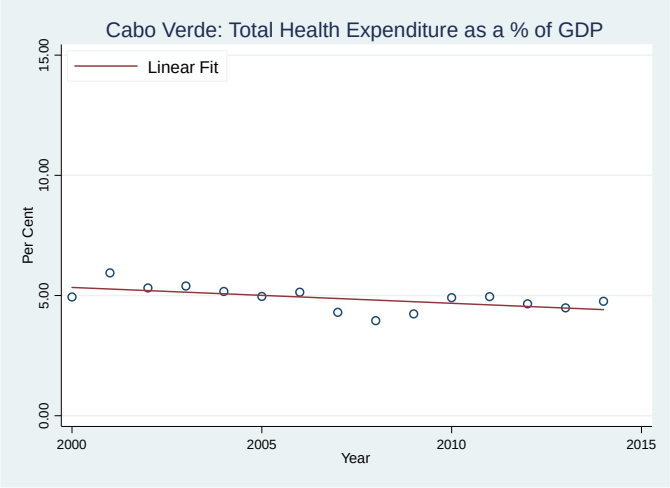


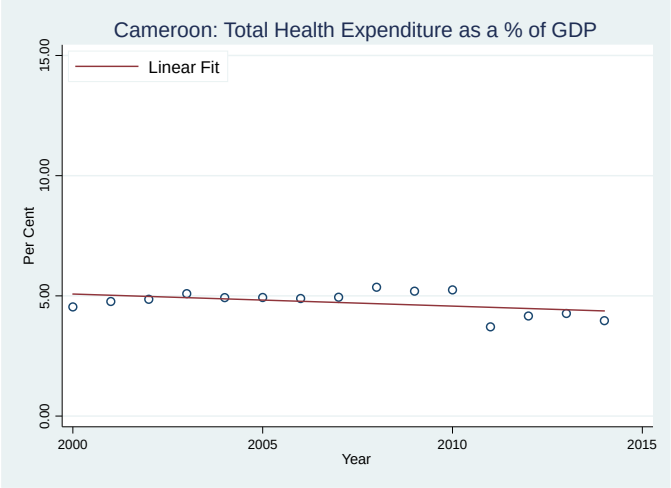


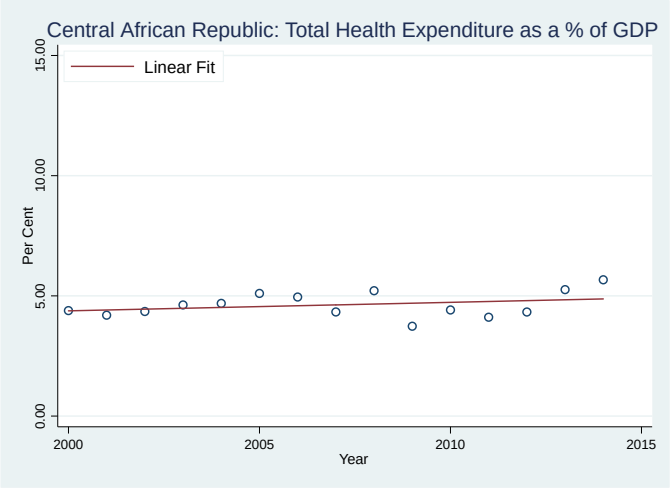


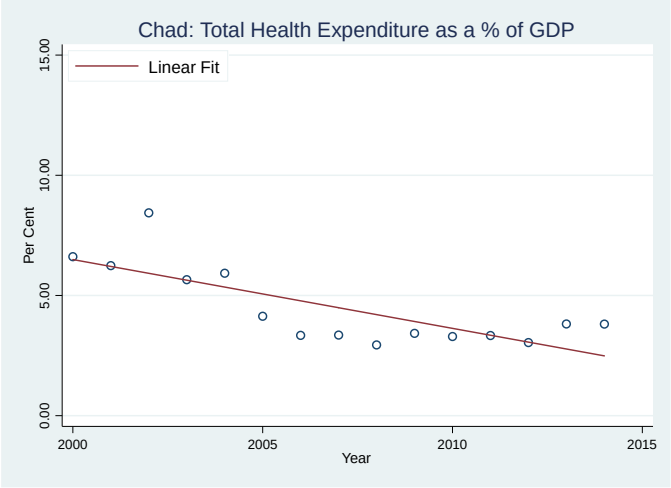


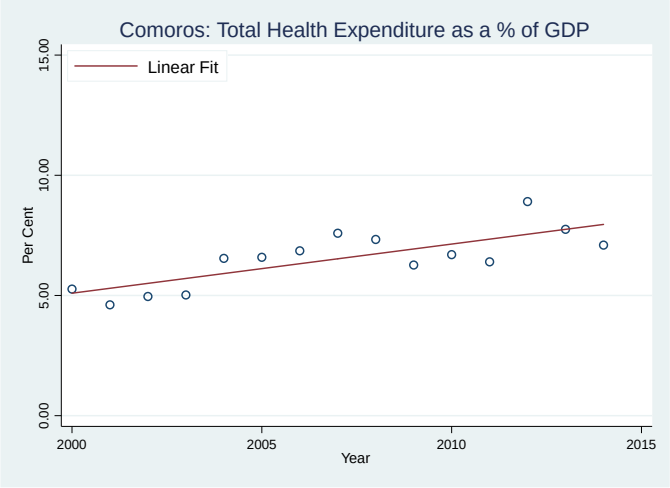


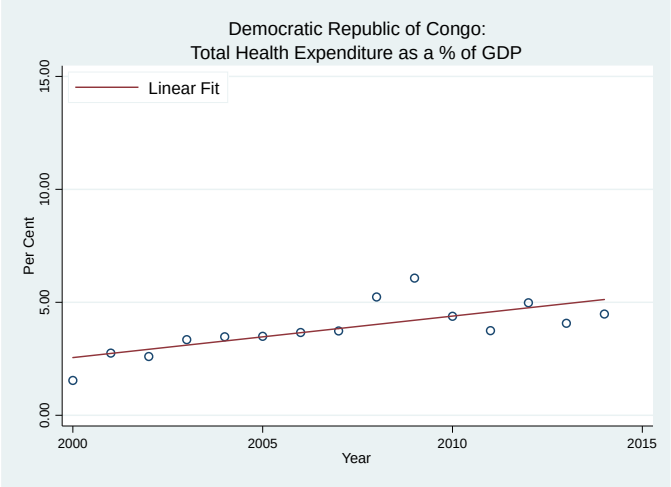


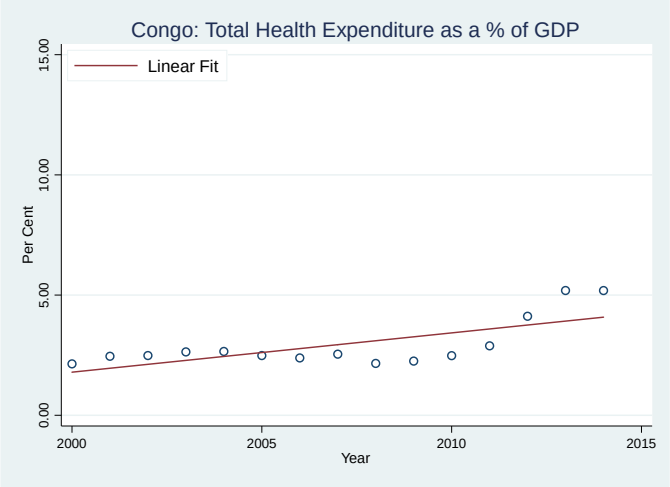

Cameroon: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

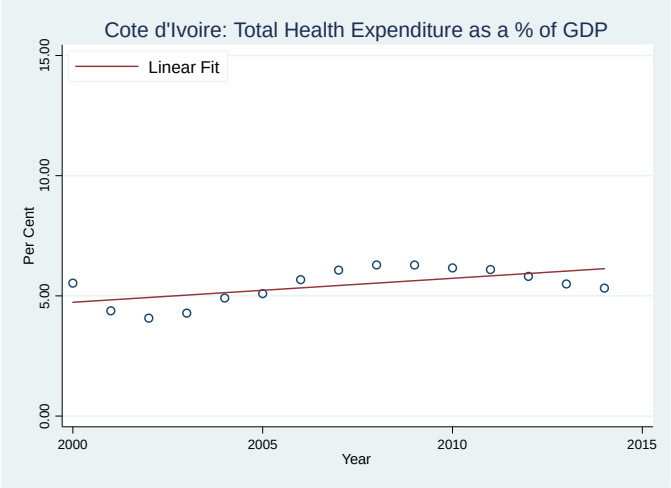

Central African Republic: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

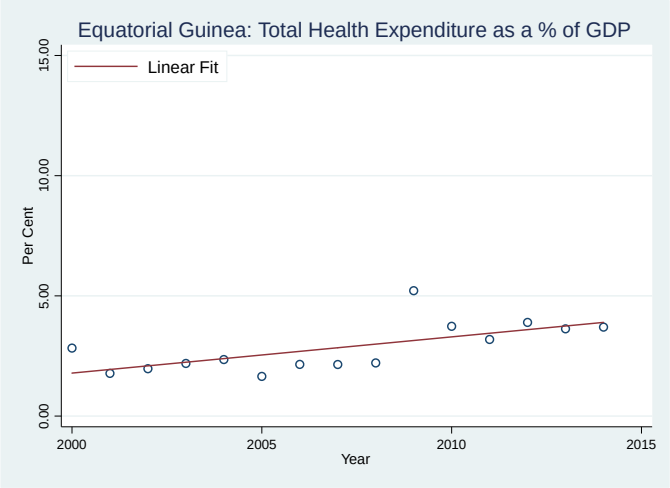

Chad: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

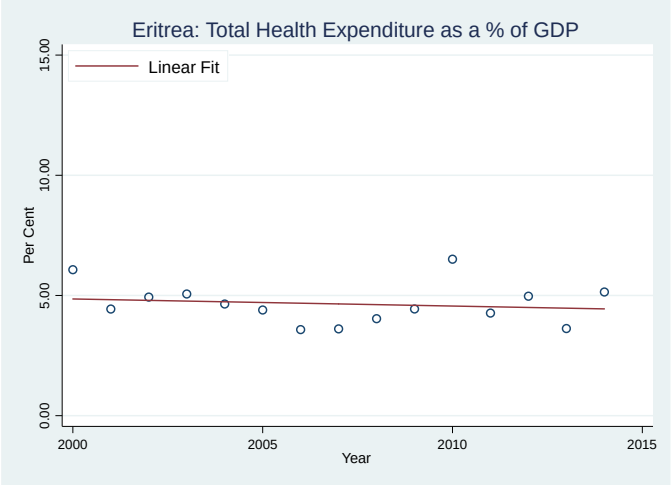

Comoros: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

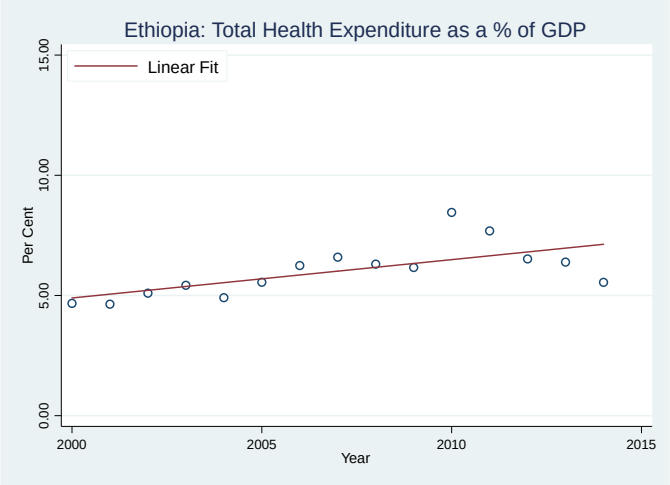

Democratic Republic of Congo:
Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

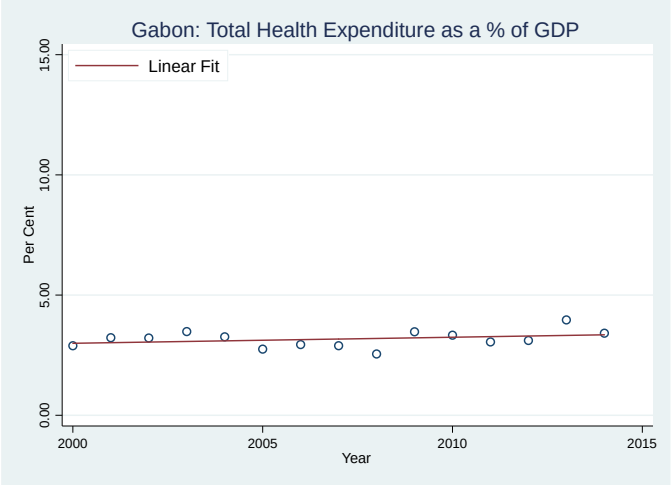

Congo: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

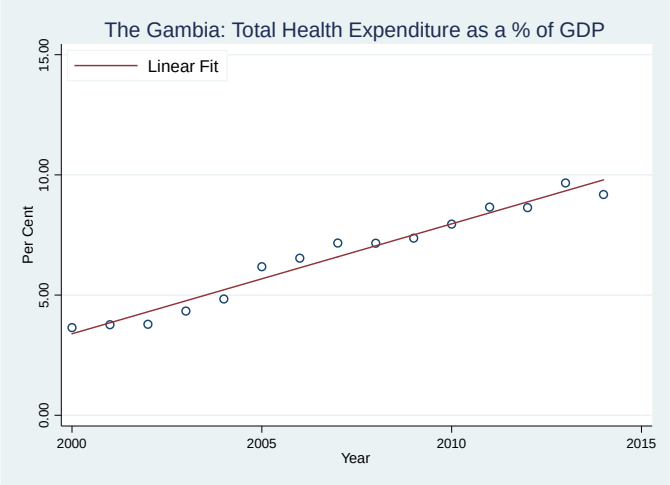

Cote d'Ivoire: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

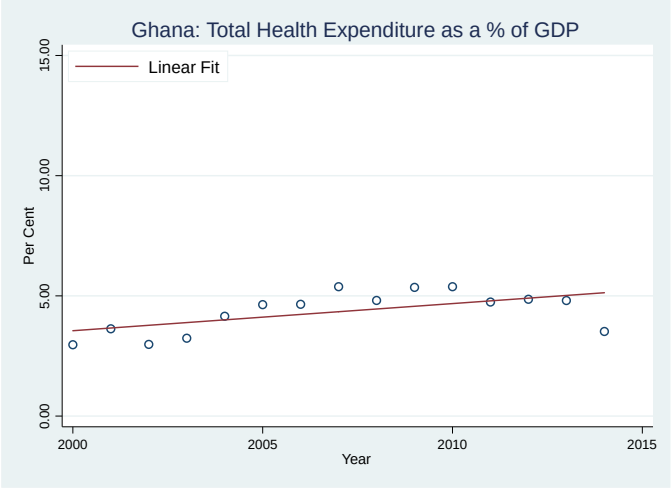

Equatorial Guinea: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

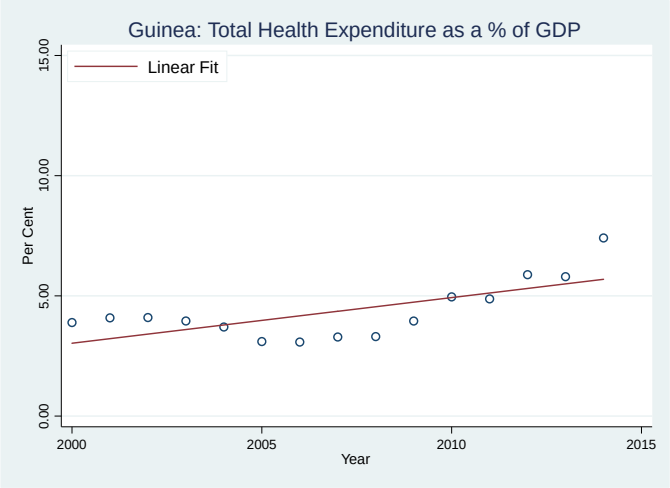

Eritrea: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

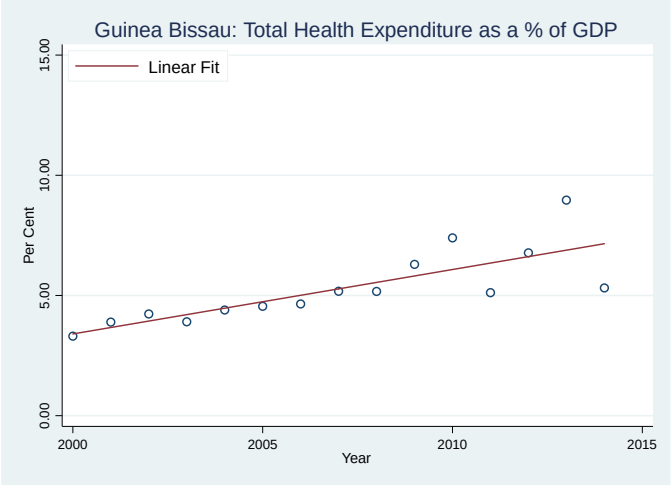

Ethiopia: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

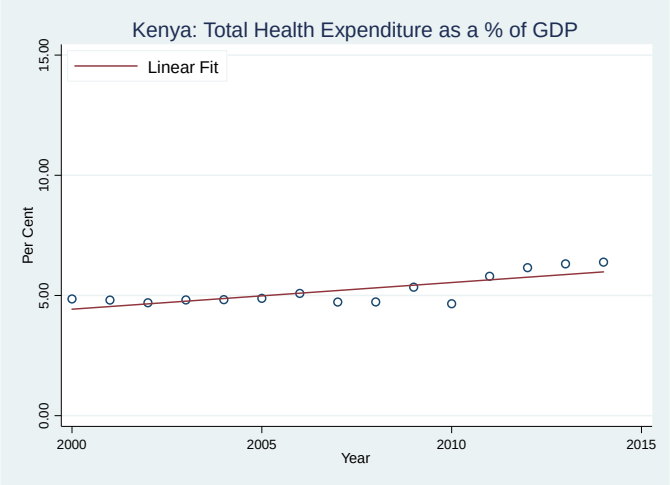

Gabon: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

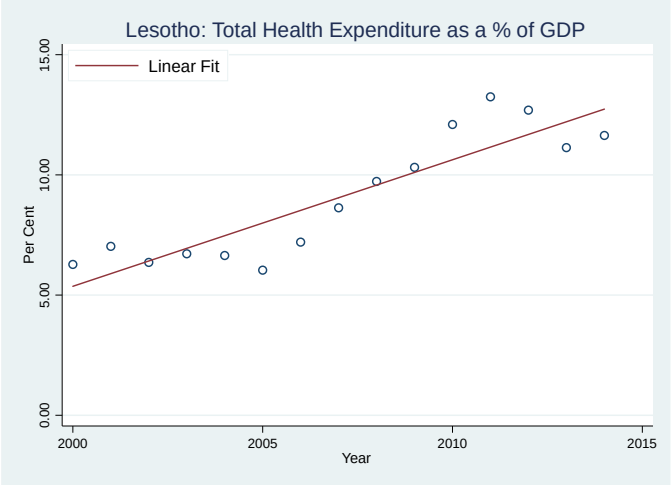

The Gambia: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

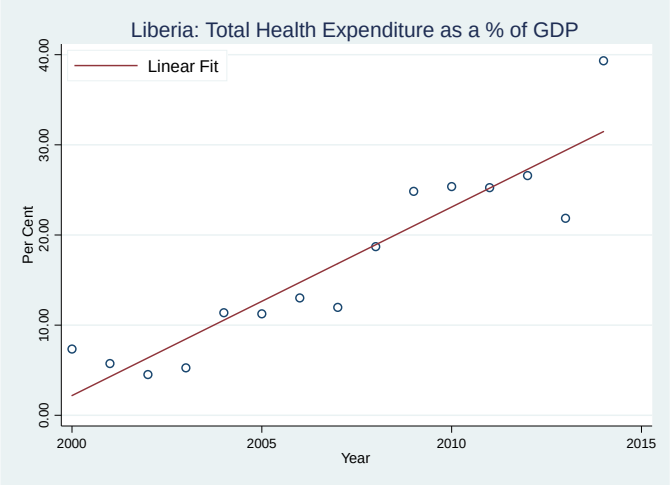

Ghana: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

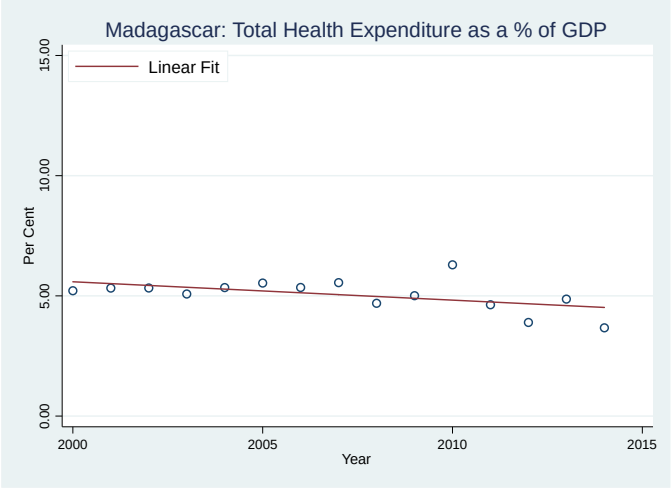

Guinea: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

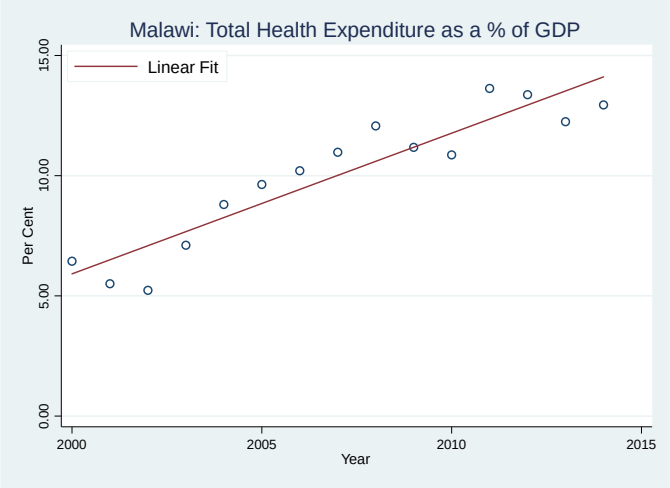

Guinea Bissau: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

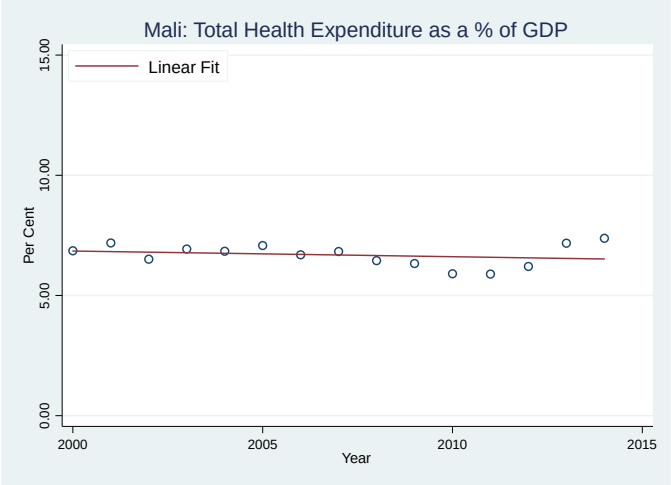

Kenya: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

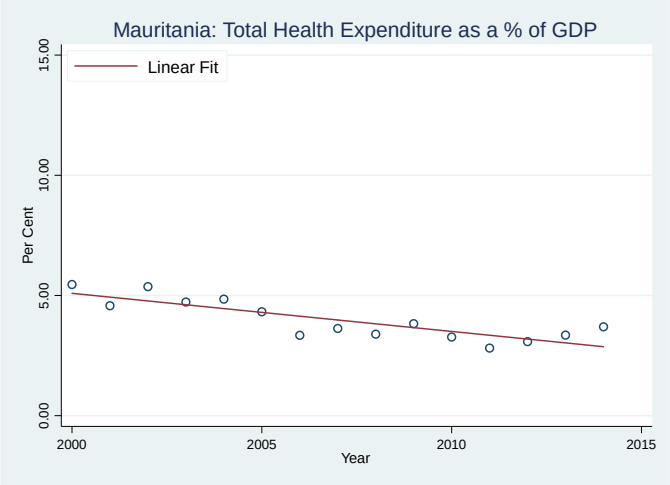

Lesotho: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

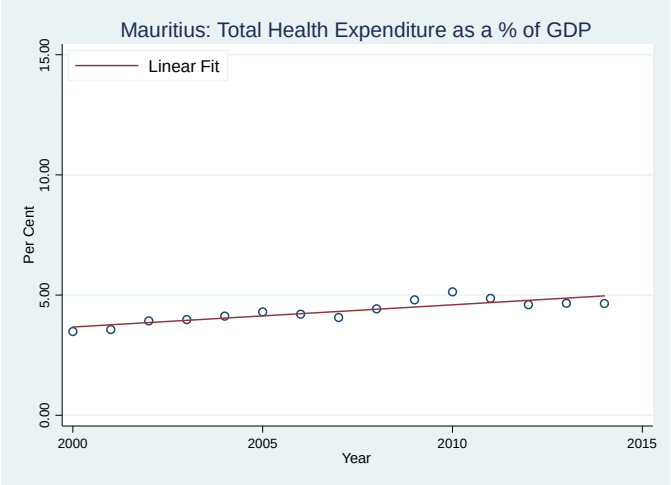

Liberia: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
10.00
20.00
30.00
40.00
2000
2005
2010
2015
Year

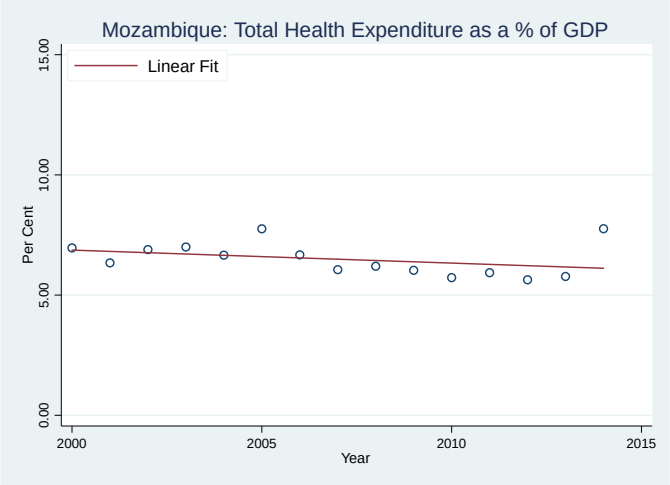

Madagascar: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

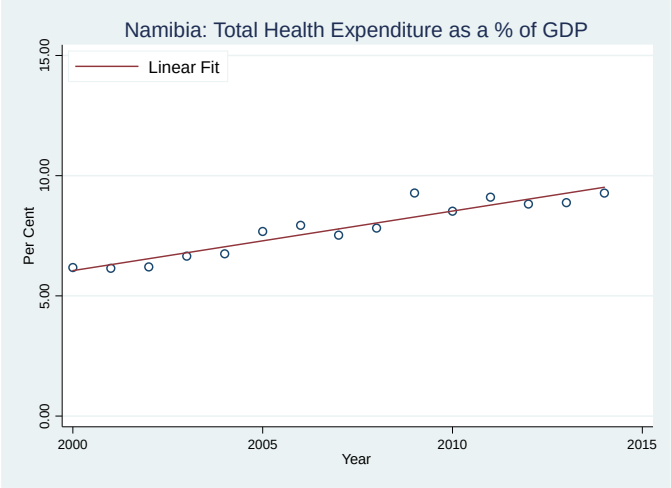

Malawi: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

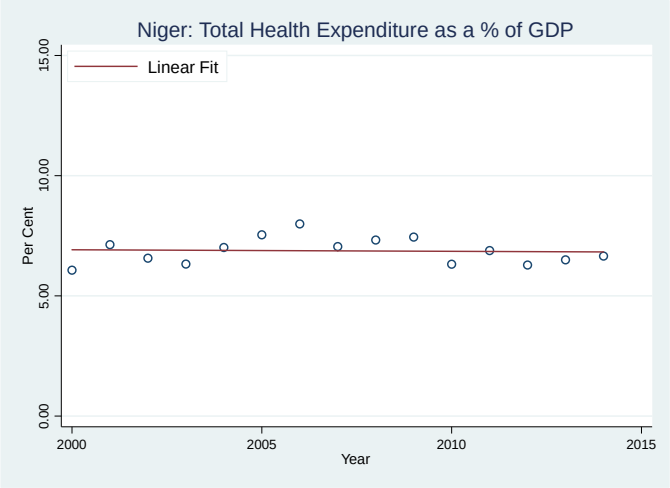

Mali: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

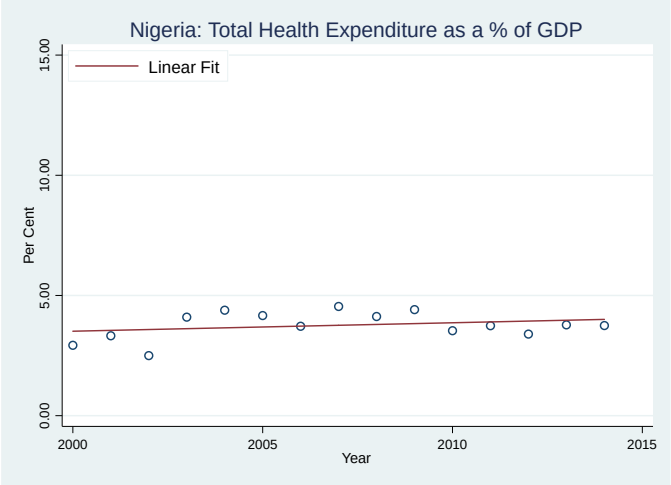

Mauritania: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

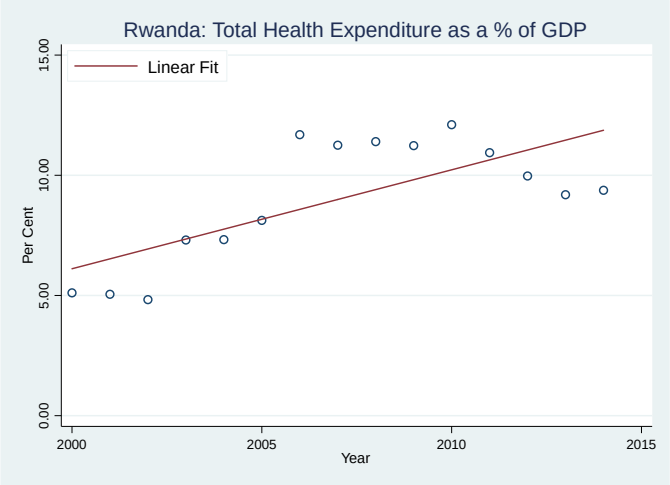

Mauritius: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

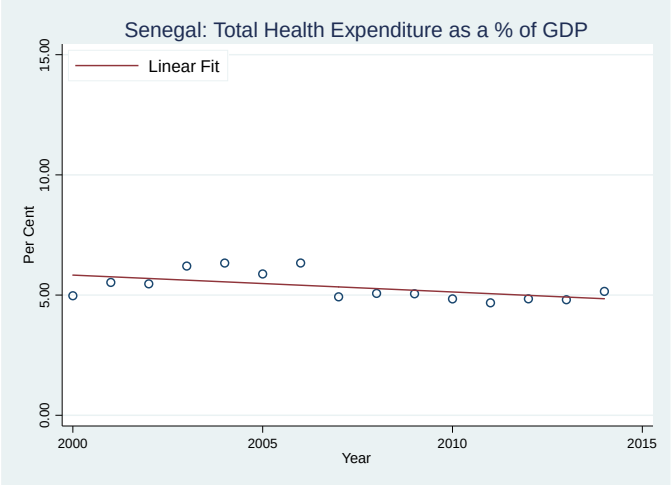

Mozambique: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

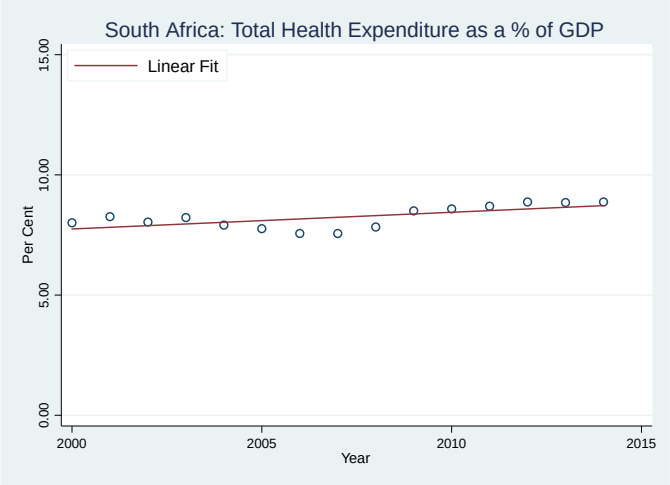

Namibia: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

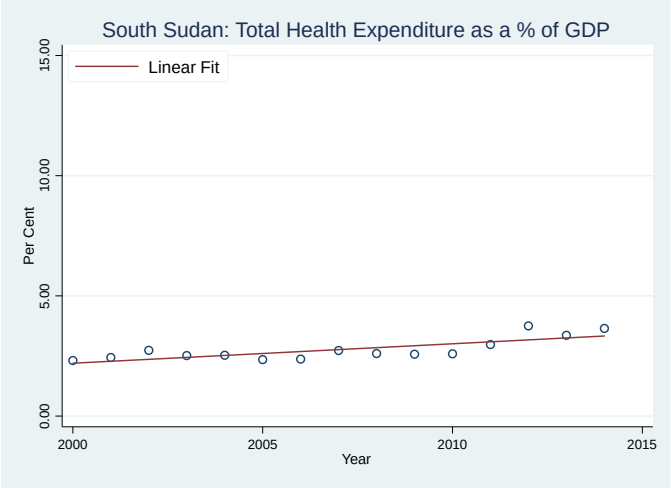

Niger: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

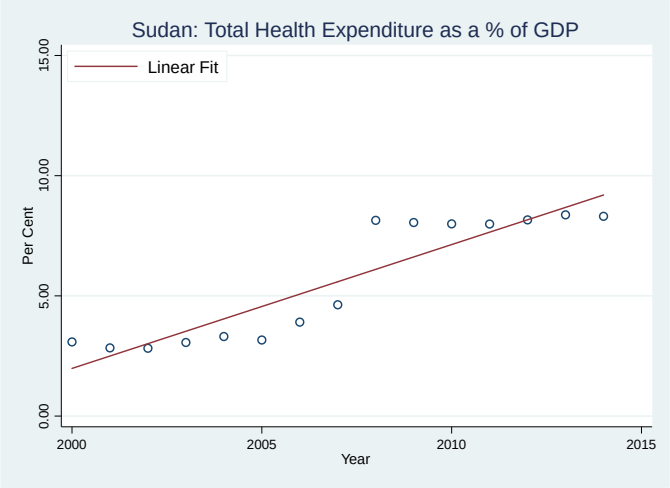

Nigeria: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

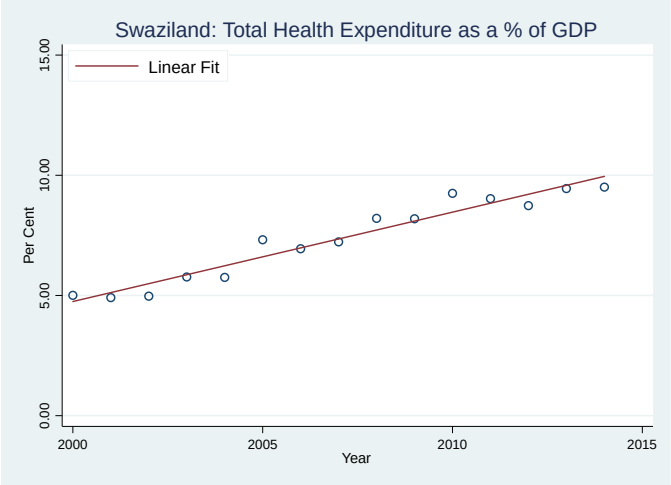

Rwanda: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

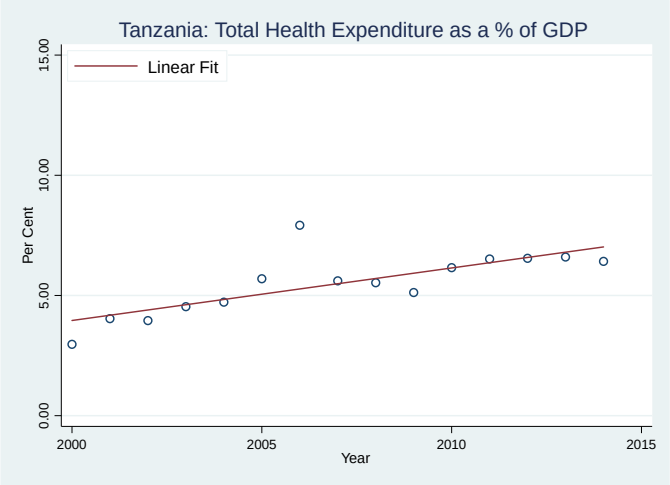

Senegal: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

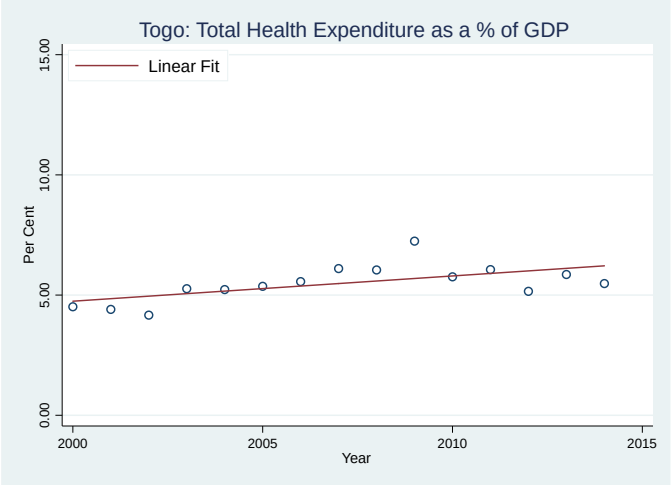

South Africa: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

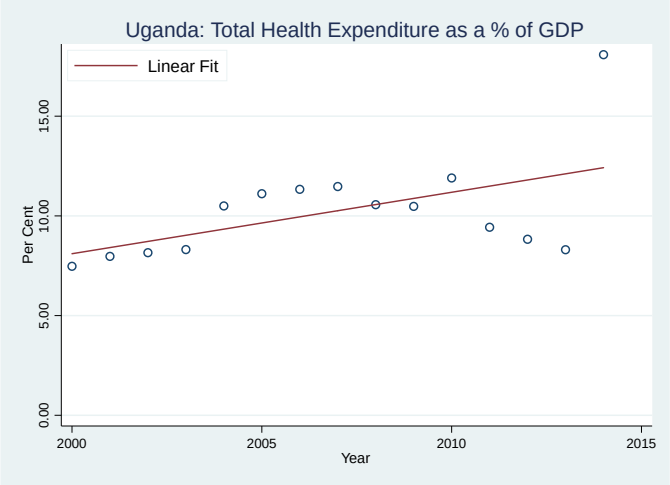

South Sudan: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

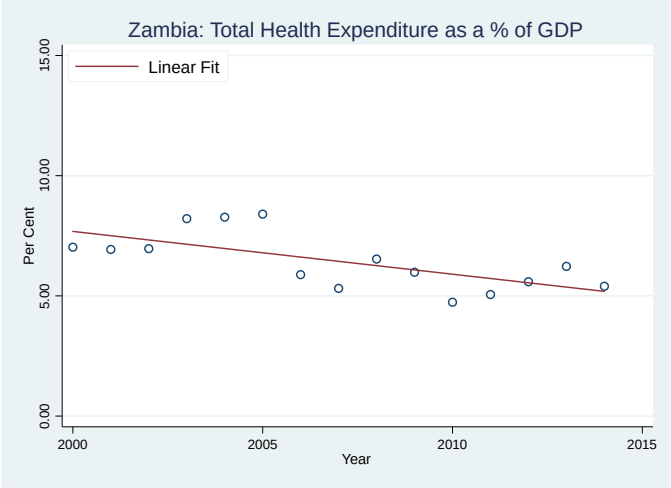

Sudan: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year


Swaziland: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

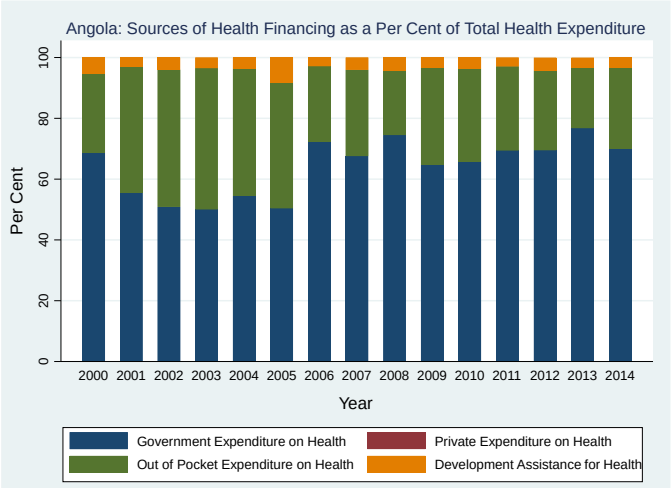

Tanzania: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

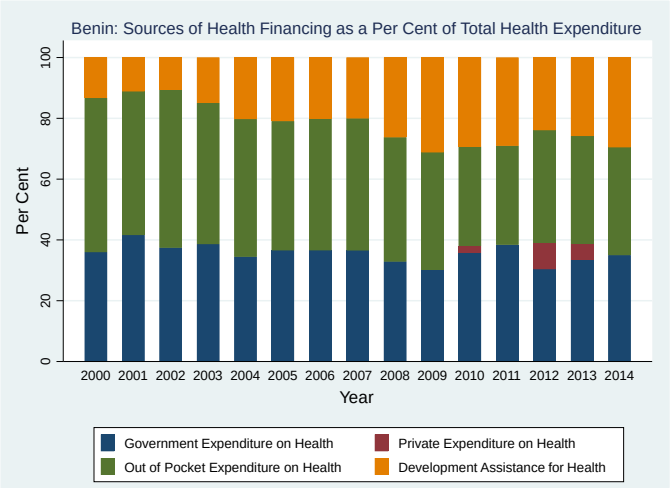

Togo: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

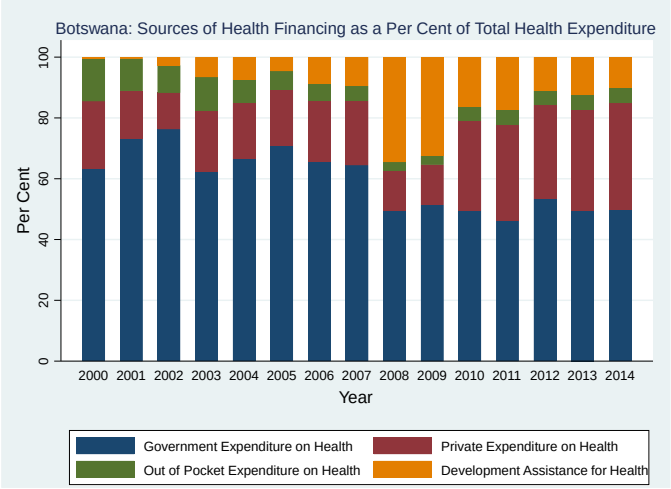

Uganda: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

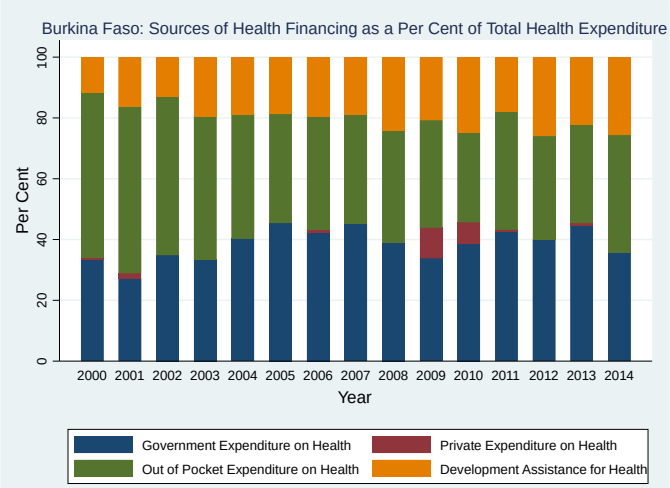

Zambia: Total Health Expenditure as a % of GDP
Linear Fit
Per Cent
0.00
5.00
10.00
15.00
2000
2005
2010
2015
Year

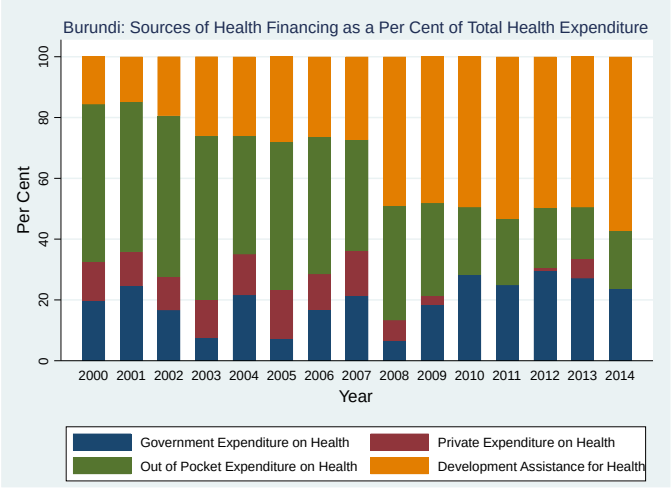
Appendix 7: Graphical Distribution of Sources of Health Financing

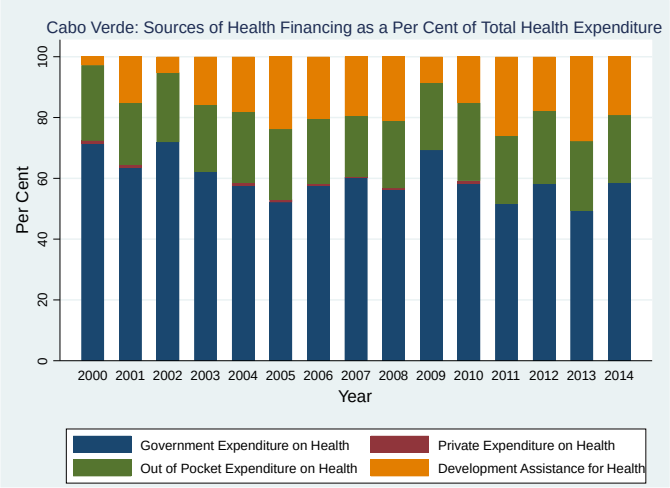


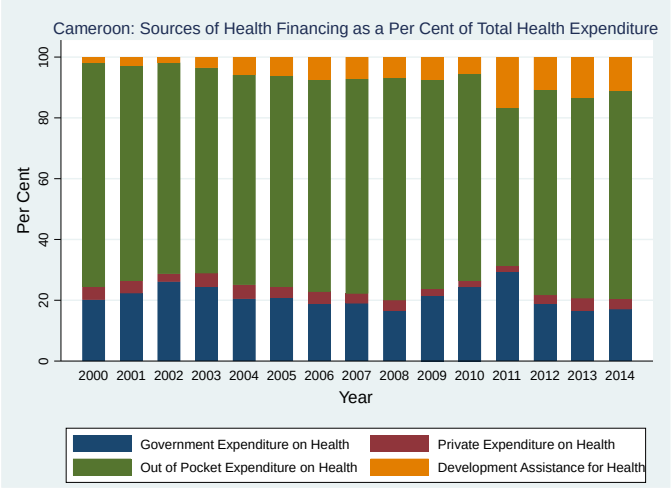











Cameroon: Sources of Health Financing as a Per Cent of Total Health Expenditure
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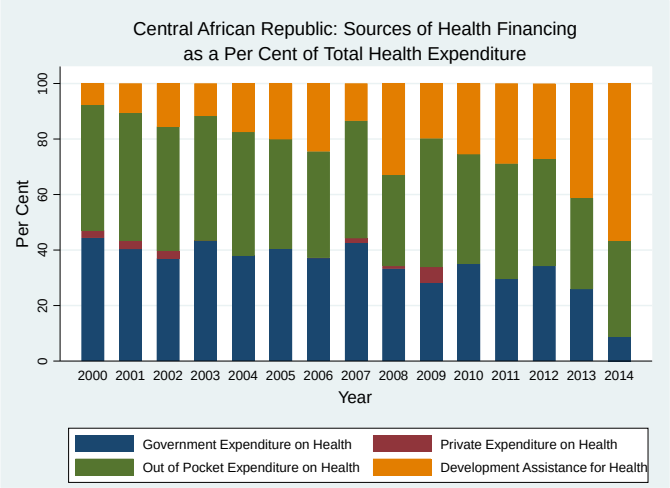
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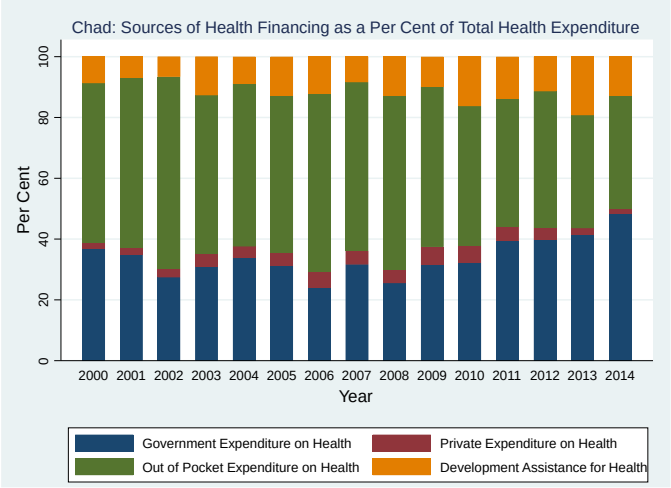
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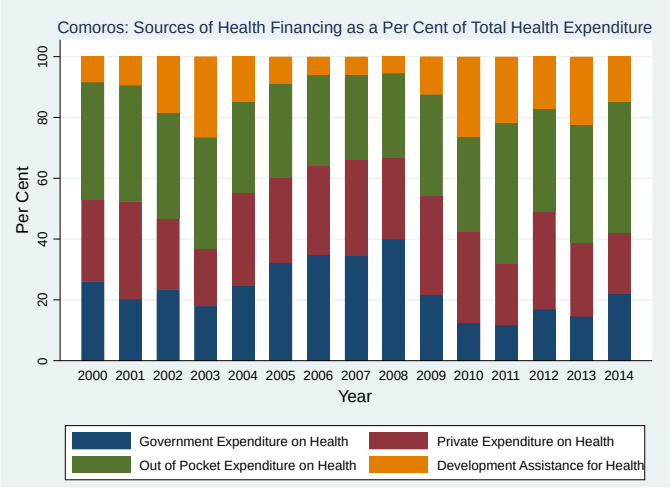
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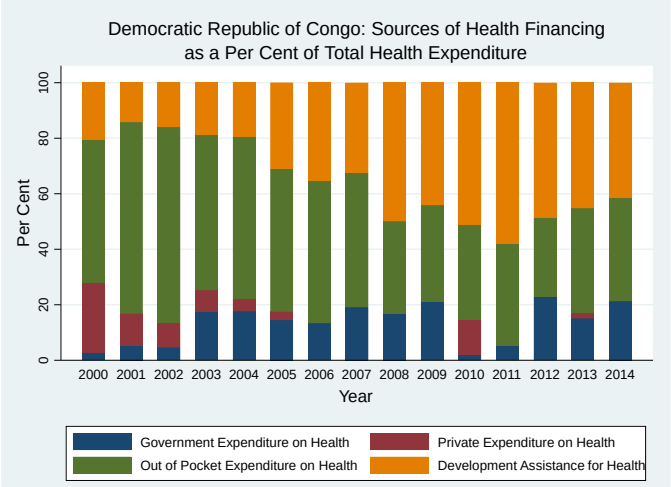
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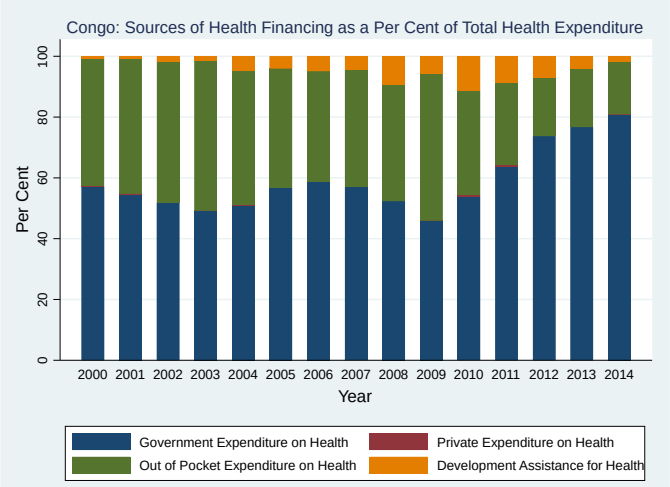
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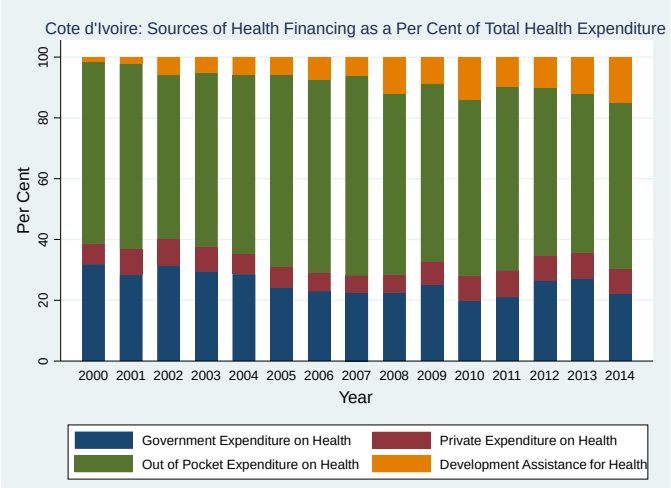
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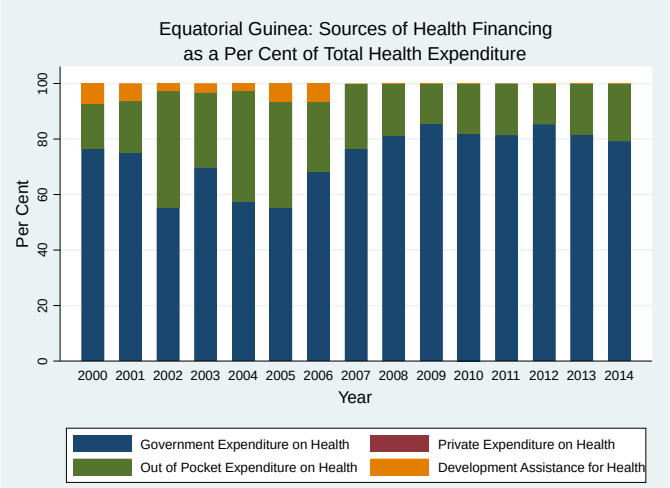
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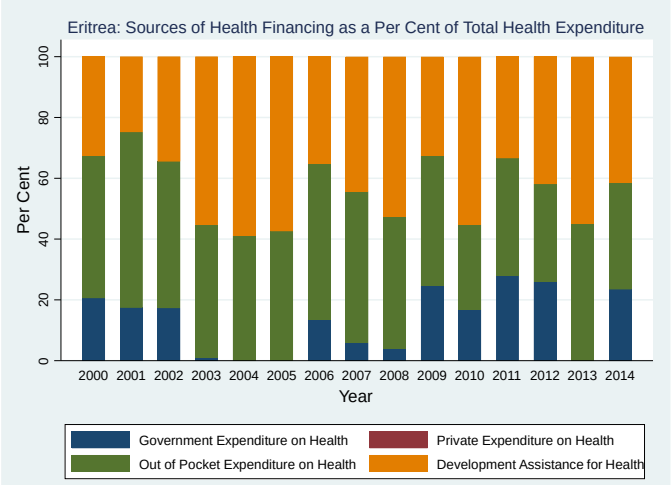
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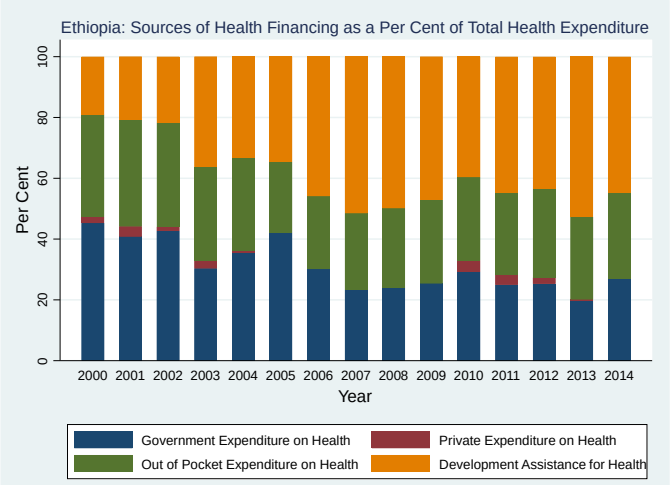
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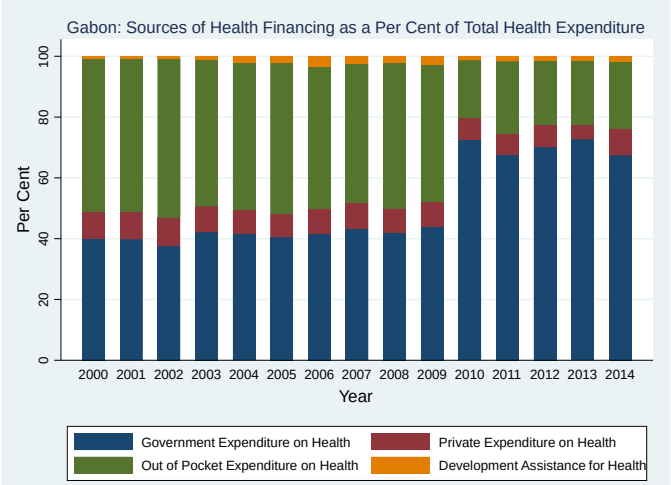
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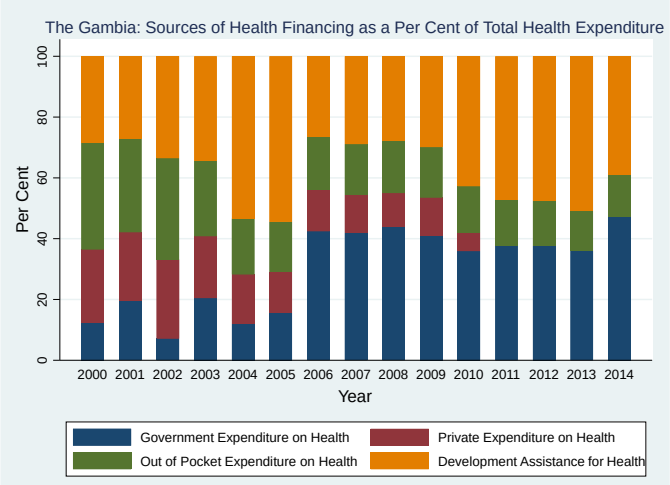
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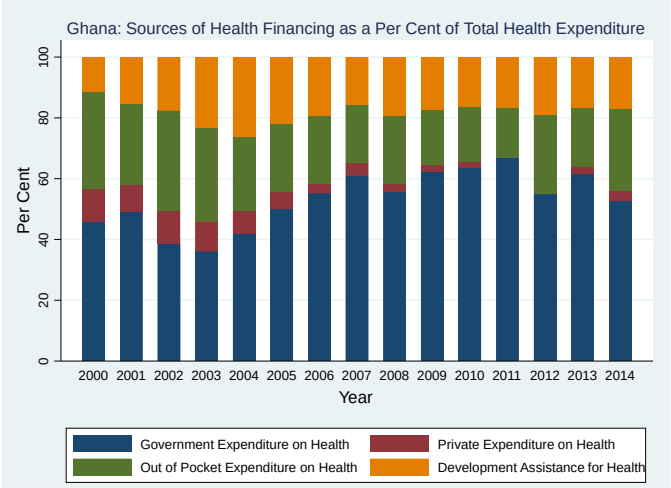
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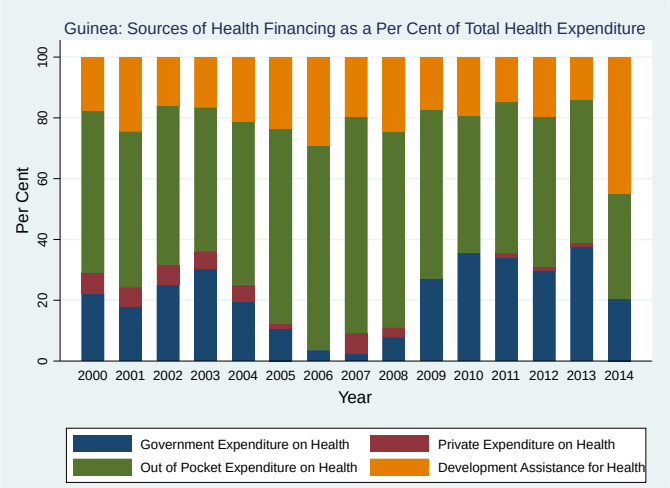
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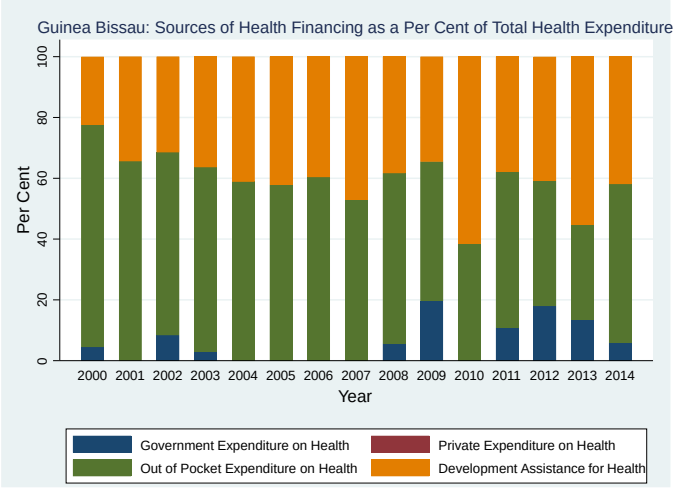
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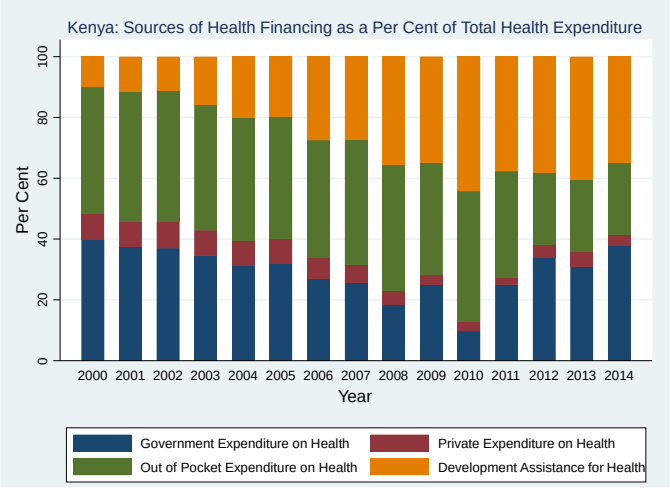
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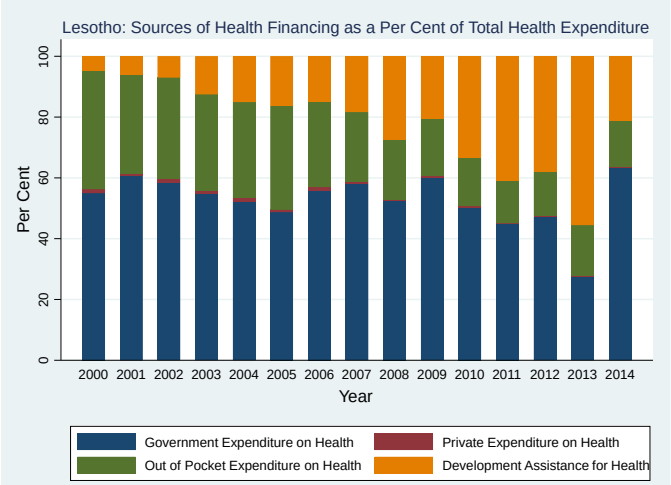
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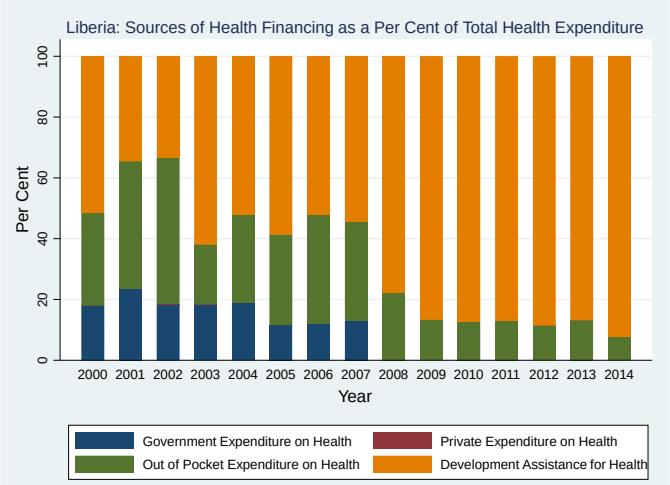
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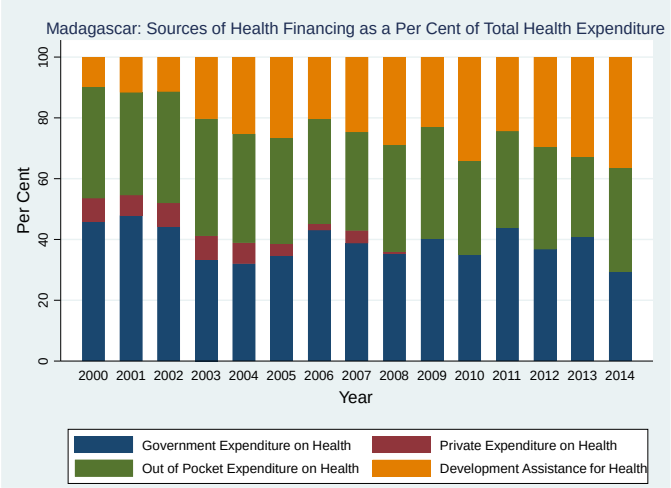
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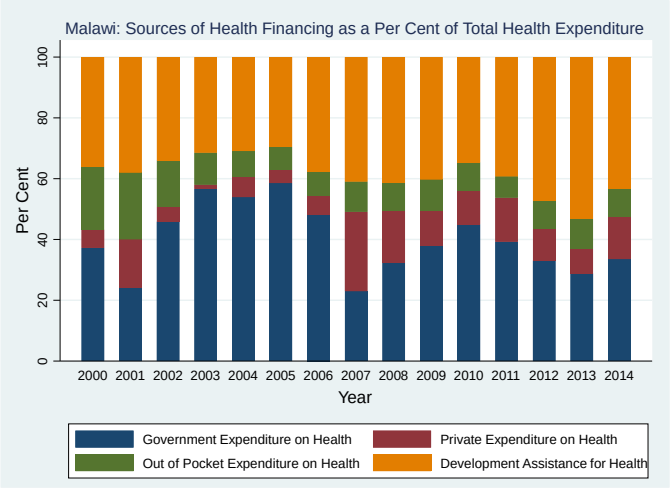
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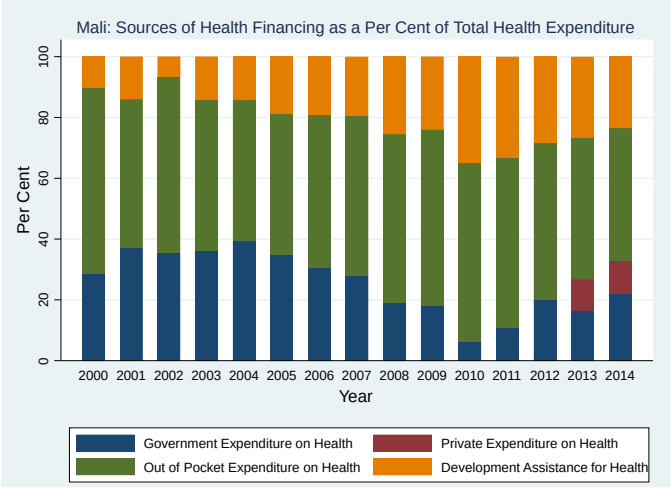
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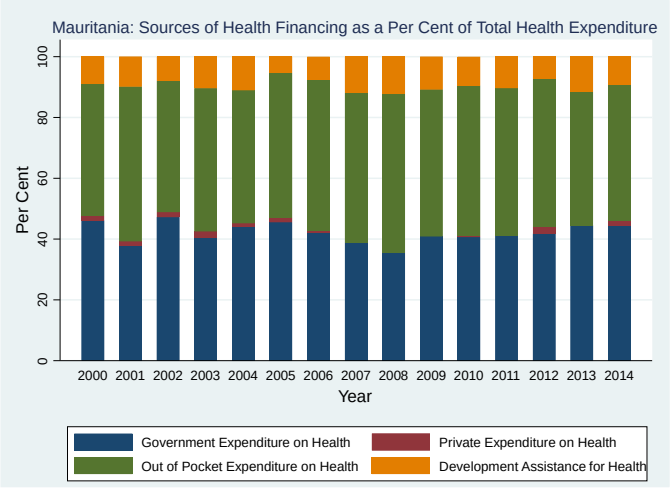
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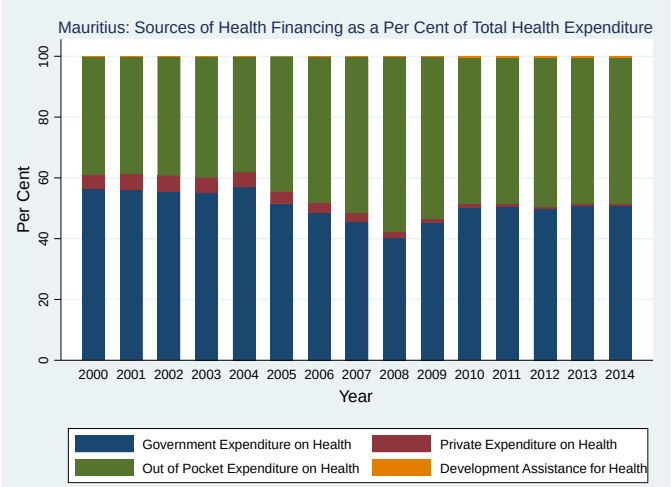
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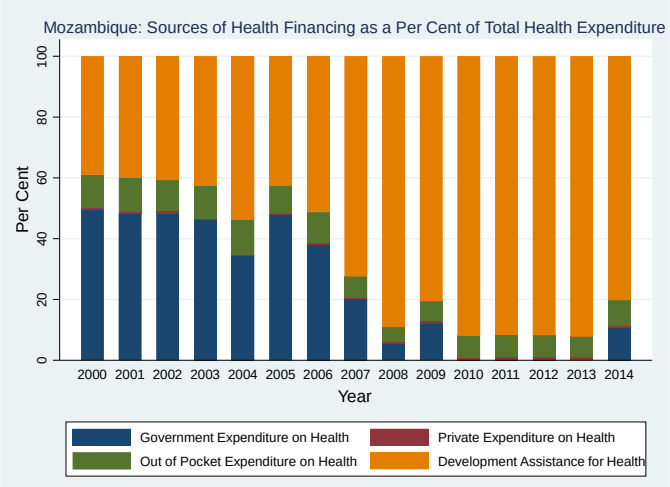
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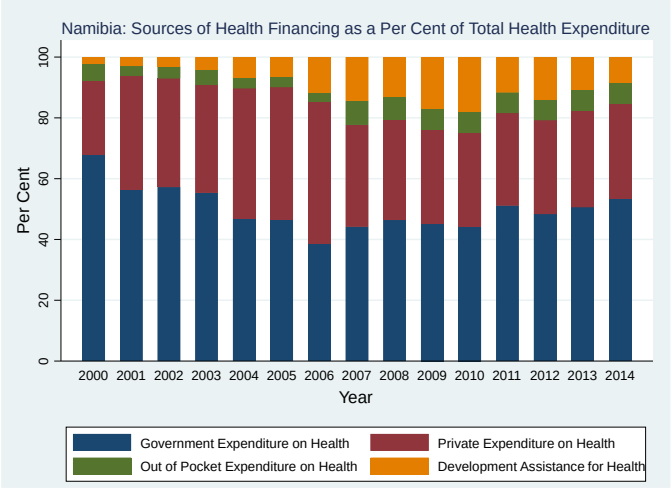
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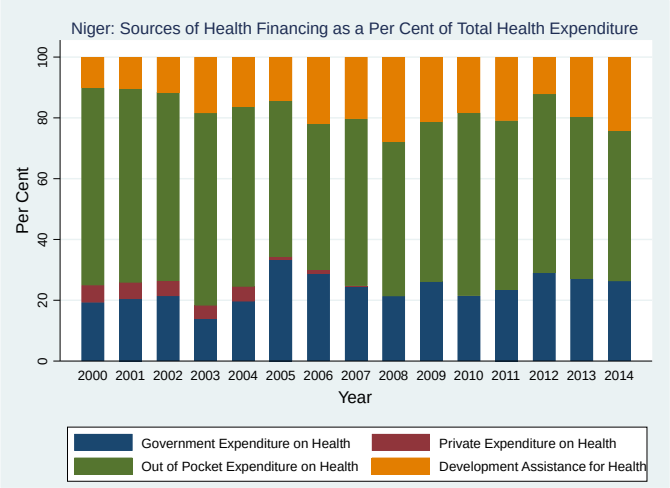
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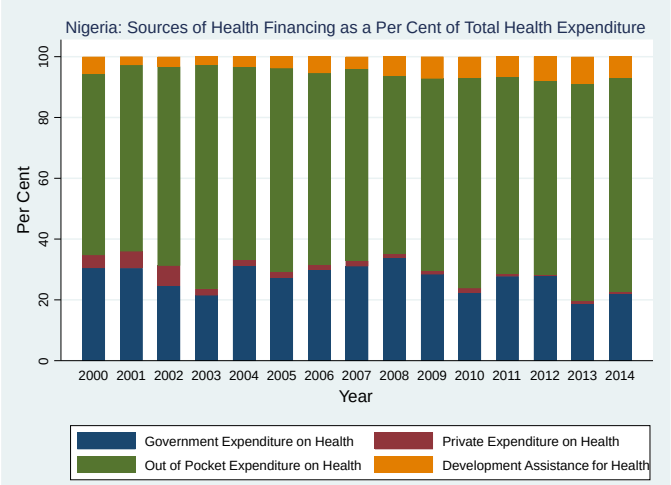
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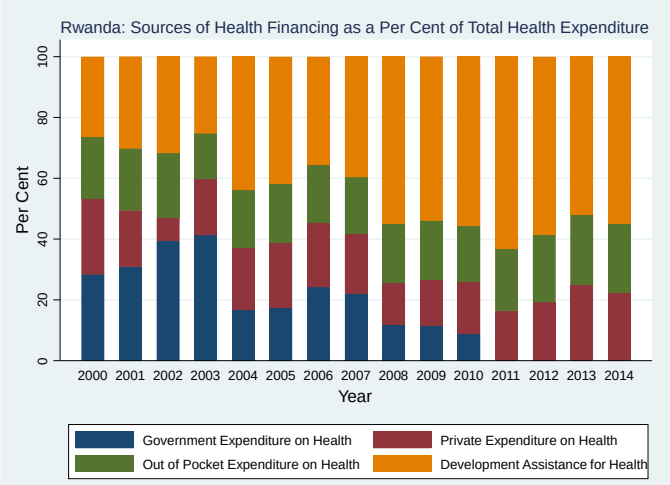
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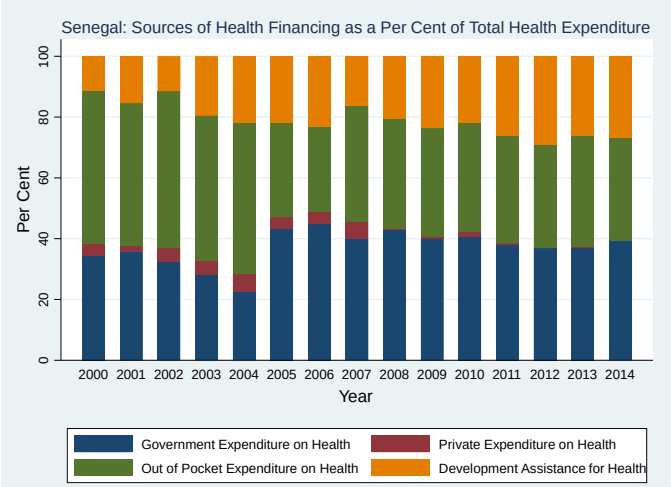
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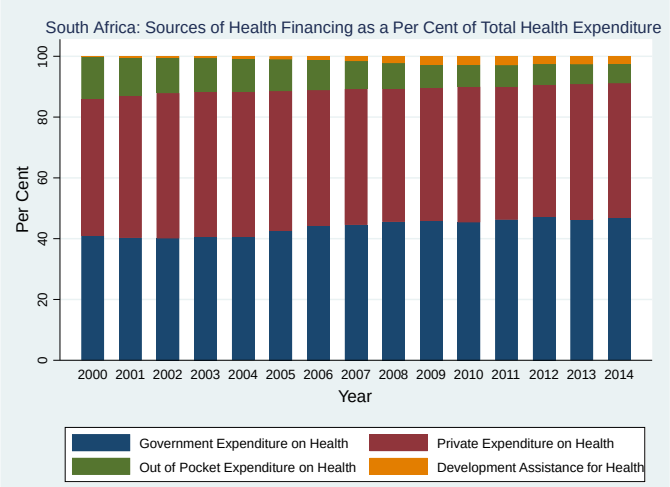
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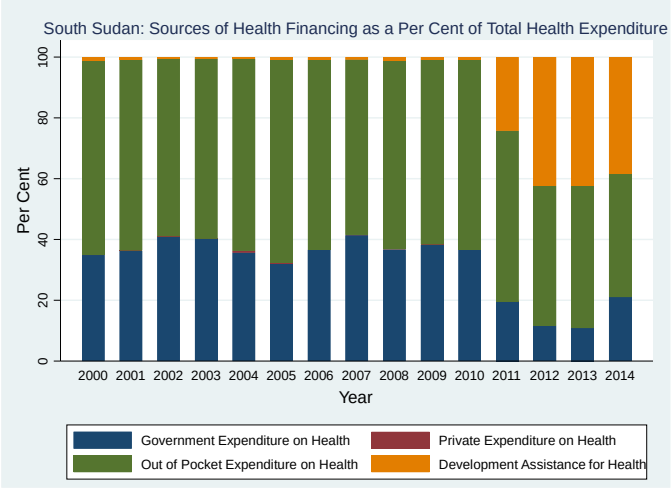
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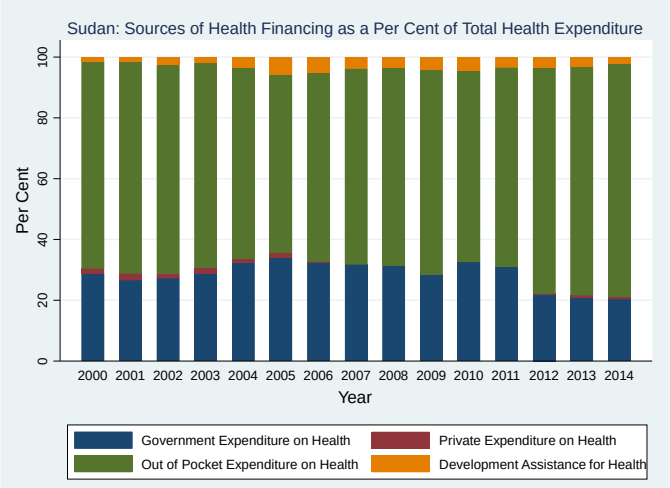
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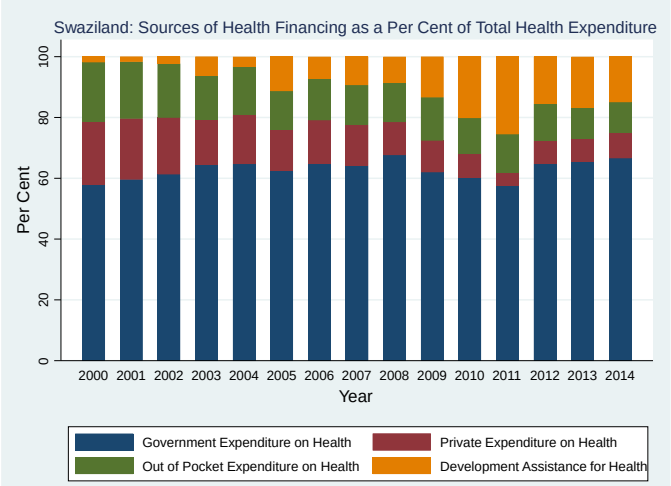
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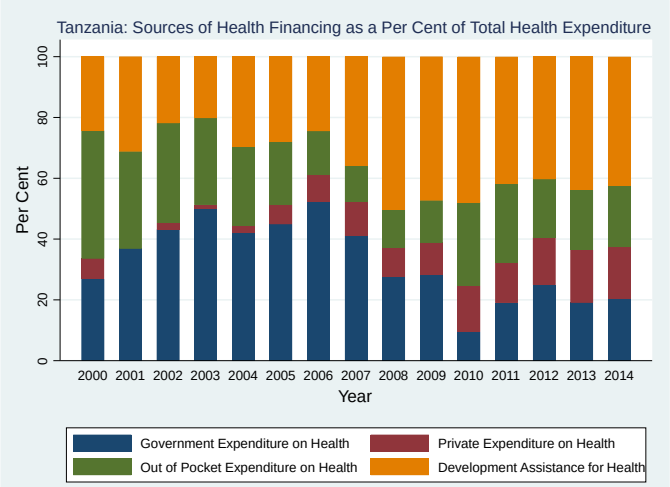
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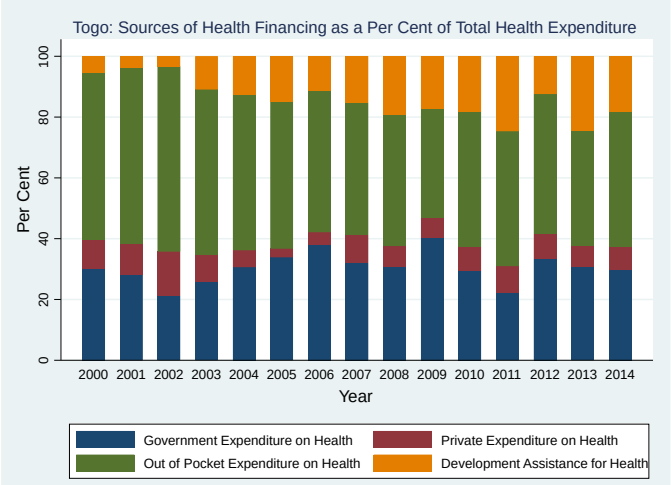
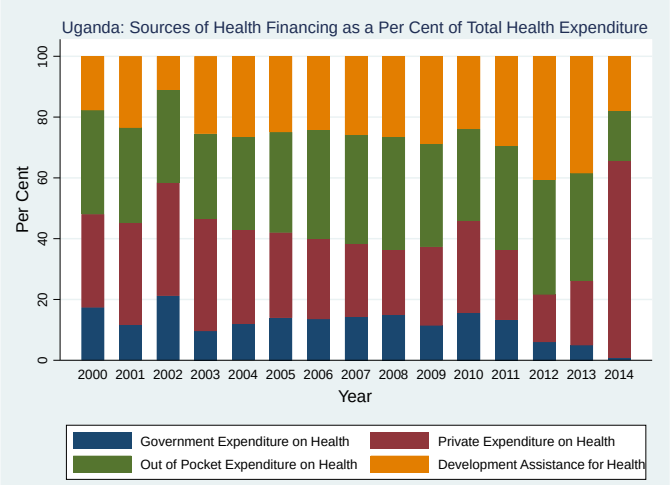
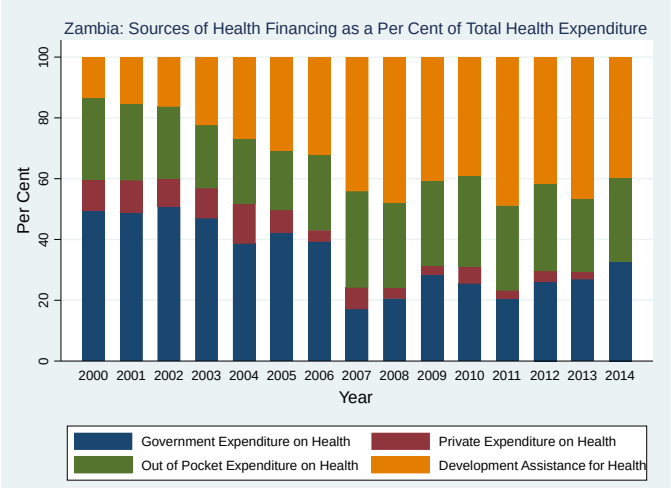

Togo: Sources of Health Financing as a Per Cent of Total Health Expenditure
Per Cent
0 20 40 60 80 100
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
Government Expenditure on Health
Private Expenditure on Health
Out of Pocket Expenditure on Health
Development Assistance for Health


Uganda: Sources of Health Financing as a Per Cent of Total Health Expenditure
Per Cent
0 20 40 60 80 100
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
Government Expenditure on Health
Private Expenditure on Health
Out of Pocket Expenditure on Health
Development Assistance for Health


Zambia: Sources of Health Financing as a Per Cent of Total Health Expenditure
Per Cent
0
20
40
60
80
100
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
Government Expenditure on Health
Private Expenditure on Health
Out of Pocket Expenditure on Health
Development Assistance for Health