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THE NEXUS BETWEEN INCLUSIVE HEALTHCARE SYSTEM AND ECONOMIC DEVELOPMENT: EVIDENCE FROM AFRICA

(YÜKSEK LİSANS)

Nimotullahi Abiodun OBASA

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Danışman:

Dr. Öğr. Üyesi Görkem BAHTİYAR

BURSA-2021

ÖZET

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KAPSAYICI SAĞLIK SİSTEMİ İLE EKONOMİK KALKINMA İLİŞKİSİ: AFRİKA ÜZERİNE BİR ÇALIŞMA

Sağlık, iş gücü üretkenliğinin temel gerekliliklerinden biridir. Sağlık hizmetlerinin sağlanmasının insanların ekonomiye katılımını optimize etmesi beklenmektedir. Dünyanın dört bir yanındaki sağlık sistemleri hastaları tedavi etmekle kalmayıp, aynı zamanda ülke ekonomisinin etkili işleyişi açısından da önemli bir merkezidir. Ne yazık ki Afrika, bir kıta olarak hala erişilebilir, uygun maliyetli ve kaliteli sağlık hizmetleri sunmayı zor bulmaktadır. Bu çalışma, 2002-2020 döneminde Afrika'da kapsayıcı sağlık sistemi ve ekonomik kalkınma arasındaki ilişkiyi araştırmayı amaçlamaktadır. Kapsayıcı sağlık sistemi indeksi, temel bileşen analizi ve tamamen bulanık analiz kullanılarak hesaplanmaktadır. Bu indeks sağlık sistemine erişimi, miktarı ve sağlık sisteminin kalitesini ölçen dokuz sağlık değişkeninden oluşmaktadır. Afrika'daki ülkelerin %43'i ve %65'i, temel bileşen analizinden ve tamamen bulanık analize göre kapsayıcı sağlık sistemi açısından mahrum kalmaktadır. Ek olarak, ekonomik kalkınma düzeyine ilişkin belirtilen iki modelin (kişi başına GSYİH ve İGE modelleri) panel veri regresyon analizi, kapsayıcı sağlık sisteminin nüfusun makul bir bölümünün sağlık durumunda ve üretkenliğinde ilerlemeye yol açmakta ve sonuç olarak gelir artışı yoluyla ekonomik refahın gelişmesine sebep olmaktadır. Afrika'daki ekonomik kalkınma düzeyinin makul bir etki oluşturması için bu çalışma, kıtadaki sağlık sisteminin niceliğini, kalitesini ve erişilebilirliğini geliştirmeye yönelik bilinçli, kasıtlı ve tutarlı bir çaba gösterilmesini önermektedir.

Anahtar Sözcükler: Afrika, Ekonomik Kalkınma, Kapsayıcı Sağlık Sistemi, Temel Bileşen Analiz, Tamamen Bulanık Analiz, Sağlık Sistemi, Panel Veri Regresyon Analizi

ABSTRACT

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THE NEXUS BETWEEN INCLUSIVE HEALTHCARE SYSTEM AND ECONOMIC DEVELOPMENT: EVIDENCE FROM AFRICA

Health is an essential requirement for labour productivity, and the provision of health care services is expected to optimize people's participation in the economy. Health systems around the world not only serve to treat the sick and prevent future diseases but are also central to the effective functioning of a country's economy. Unfortunately, Africa as a continent still finds it challenging to provide accessible and affordable quality healthcare services. This study intends to examine the nexus between inclusive healthcare system and economic development in Africa for the period 2002-2020. An inclusive health system index is computed using principal component analysis and totally fuzzy analysis. This index consists of nine health indicators measuring access to the health system, quantity, and quality of healthcare system. 43% and 65% of countries in Africa are deprived in terms of inclusive health systems according to principal component analysis and totally fuzzy analysis respectively. Furthermore, the panel data regression analysis of the two specified models of the level of economic development (GDP per capita and HDI models) shows that inclusive health system lead to greater improvement in the health status and productivity of a reasonable proportion of the population, which subsequently lead to improvement in economic well-being through increase in income. For efforts to improve the level of economic development in Africa to have an adequate impact, the study recommends that deliberate, targeted and consistent efforts should be made to improve the quantity, quality and accessibility of healthcare system on the continent.

Keywords: Africa, Health System, Inclusive Healthcare System, Principal Component Analysis, Totally Fuzzy Analysis, Panel Data Econometric Analysis, Economic Development.

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ABBREVIATIONS/ACRONYMS

CAP	Capital Formation
CDCP	Centres for Disease Control and Prevention
COVID-19	Coronavirus Disease 2019
DPT	Diphtheria, Pertusis and Tetanus
DTPB	Diphtheria, Tetanus toxoid and Pertussis
FEEMISE	Euro-Mediterranean Forum of Institutes of Economic Sciences
GDI	Gender-related Index
GDP	Gross Domstic Product
GDPPC	Gross Domestic Product Per Capita
GEE	Government Expenditure on Education
GEF	Government Effectiveness Index
GLS	Generalized Least Squares
GNI	Gross National Income
HDI	Human Development Index
HPI	Human Poverty Index
IHI	Inclusive Health system Index
IHS	Inclusive Health System
LED	Level of Economic Development
MDGs	Millenium Develeopment Goals
MENA	Middle East and North Africa
MERS	Middle East Respiratory Syndrome
MMR	Maternal Mortality Ratio
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OOP	Out-of-Pocket Expenditures
PCA	Principal Component Analysis
PG	Population Growth
SDGs	Sustainable Development Goals

SSA	Sub-Saharan Africa
TB	Tuberculosis
TFA	Totally Fuzzy Analysis
UHC	Universal Health Coverage
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UNSD	United Nations Statistics Division
WHA	World Health Assembly

INTRODUCTION

1.1. Background of the Study

Andy Lewis (as cited in Ogbobine, 2012) defines economic development "as the process of retaining, expanding, and attracting jobs, income and wealth in a manner that improves individual economic opportunities and the quality of human life". Although the term is sometimes used synonymously with economic growth, it should be noted that the two terms are not the same. While economic growth involves quantitative improvements, economic development involves both quantitative and qualitative improvements. Economic growth, as described by the renowned Indian economist Amartya Kumar Sen (1983), is one aspect of economic development. Thus, a country can experience economic growth without experiencing economic development, but it is entirely impossible to achieve economic development without experiencing economic growth. For example, Nigeria's growth rates for over two decades (between 1996 and 2015) were indicative of a robust and fast-growing economy. However, these growth rates have not reduced poverty, reduced inequalities in incomes earned, increased employment rates, created better and more economic opportunities for all, and ultimately promoted economic development (Onyimadu, 2015).

Among the many indicators that stimulate the growth and development of an economy, human capital is perhaps the most important and indispensable of them all. Human capital helps increase labour productivity, accelerate the level of output and improve the efficiency of available resources. According to the theoretical framework of human capital, "human capital development is achieved through education and health. Health and education are indispensable factors for economic growth and development; thus, investment in both is necessary for the development of any nation. Investments in health and education generate future income streams high enough to compensate for all costs incurred during the investment process. Healthy and educated people are more efficient at absorbing knowledge and achieving higher productivity levels to promote economic development" (Bloom & Canning, 2000).

Health is a fundamental prerequisite for sustainable "economic growth and development. It is one of the critical determinants of economic performance at both micro and macro

levels through investment in human capital, productivity, population growth, physical capital accumulation and female labour force participation" (Strittmatter & Sunde, 2011). According to Bloom and Canning (2003), "health is both a direct component of human well-being and a form of human capital that enhances individuals' capabilities".

It is well documented in relevant literature that health is a causative factor of a country's aggregate economic growth and level of development. A large body of macro evidence suggests that "improvement in health significantly and positively contributes towards economic development through increased factor productivity" (Weil 2006, Bloom & Canning 2008, DSAED 2010, Kumar & Kober 2012, Saha 2013).

By extension, "a healthy population is an effective instrument for increasing economic productivity" (WHO, 2002). The health of citizens significantly improves the economic development potential of countries (Bhargava, Jamison, Lau, & Murray, 2001). Better health reflects improvements in the quality of life of citizens as well as the prosperity of a nation, as expressed in the popular saying "health is wealth". Health is a prerequisite for participation in many aspects of life, and no real enjoyment can be attained without good health.

It is worth noting that the existing and widening disparities in economic growth and development across countries and regions can be explained by several factors, of which health disparities play an essential role. According to the World Health Organization (2005), "about fifty per cent of economic growth differentials between developed and developing countries are due to diseases and low life expectancy. Over the decades, the role of health in economic growth and development has been explored widely through a growing body of theoretical and empirical literature and cannot be overemphasised". Health has a significant impact on education, labour productivity, savings and investment, life expectancy, and life-cycle behaviour.

Healthier students have higher cognitive performance, less absenteeism and thus receive a better education, which in turn increases the propensity to earn a higher income for the individual as well as for the economy as a whole. Better health has a positive, substantial and statistically significant impact on overall output through labour productivity. Better health increases both the quantity and quality of the labour force and thus increases national income. "Compared to sick workers, healthy workers tend to have higher

productivity because they are physically and mentally more energetic and alert and less likely to be absent from work due to illness" (Bloom & Canning, 2000). Savings, which constitute a large percentage of investment funds, is directly affected by health. The frequency with which households spend on health expenditures reduces their ability to save. "Poor health and the prevalence of diseases also affect foreign direct investment as foreign investors tend to avoid areas where diseases are rampant and coupled with poor and limited access to health care. Early deaths, chronic diseases, and disabilities reduce individuals' lifetime income, the country's annual income and the prospects for economic growth and development" (Ogbonibe, 2012).

The World Health Organization (1946) constitution defines "health as a state of complete physical, mental and social well-being rather than merely the absence of disease or infirmity". The constitution of the World Health Organization states that "the highest attainable standard of health is a fundamental right of every human being. This right to health includes access to acceptable, affordable, and timely health care of adequate quality" (WHO, 1946). This implies that the government must undertake measures to create conditions in which everyone can be as healthy as possible and ensure that everyone receives the health services they need, when they need them and without financial hardship.

It is a fundamental human right that people, regardless of age, gender, race and socioeconomic status, have unlimited access to the resources and services they need to reach their full health potential (i.e., health outcomes). According to the Centres for Disease Control and Prevention (CDCP), "health equity exists when every person has the opportunity to attain his or her full health potential and no one is disadvantaged from achieving this potential because of social position or other socially determined circumstances" (CDCP, 2021). This connotes that everyone has the same right to health and no one should be left behind. To ensure equity of the health system, financial barriers to health care should be reduced as much as possible, if not eliminated altogether. The World Health Assembly (WHA) passed a resolution in 2005 calling on member states to strive for universal health coverage for their populations. This makes it a critical goal of health systems in all countries, regardless of income status (WHO, 2013). This is also included in the goals for health in the Sustainable Development Goals.

Based on the foregoing, it is highly imperative to conduct empirical research to determine which countries are on the path to achieving inclusive health systems in Africa and further investigate whether there is a relationship with the level of economic development in the region.

1.2. Statement of the Research Problem

Given the great importance of health to economic growth and development, several countries have made national and international commitments to allocate a significant number of resources to improve their health sector. These include the Roll Back Malaria initiative, launched jointly in October 1998 by the World Health Organisation, the World Bank, the United Nations Children's Fund (UNICEF) and the United Nations Development Programme (UNDP) to halve the suffering caused by malaria by 2010 (Nabarro, 1999). "The Stop TB Partnership, established in 2000, aimed to eliminate tuberculosis as a public health problem. In the Abuja Declaration of 2001, most countries in the region committed to spending at least 15% of the national budget on health. By 2014, government spending on health was slowly increasing but was far from the Abuja Declaration target. In fact, only four countries were above the Abuja target" (World Bank; World Health Organization; JICA; the Global Fund to Fight AIDS, Tuberculosis and Malaria; and the African Development Bank, 2016).

"191 Member States of the United Nations consented in September 2000 to achieve the Millennium Development Goals (MDGs) by 2015. To emphasize the importance of health, three of the eight MDGs focused specifically on improving health: reducing the under-five mortality rate by two-thirds between 1990 and 2015; reducing the maternal mortality rate by three-quarters between 1990 and 2015; and halting the spread of HIV/AIDS, malaria and other major diseases by 2015" (United Nations MDGs).

"In the year 1990, child mortality stood at 178 per 1000 live births in sub-Saharan Africa, 65 per 1000 live birth in Middle East and North Africa, 32 per 1000 live births in Europe, 57 per 1000 live births in Asia and 54 per 1000 live births in the Caribbean. During the year, the continent is still the region with the highest under-five mortality rate in the world. However, the situation has changed slightly, with under-five mortality falling by 12% to 155 per 1000 live births in sub-Saharan Africa and by 35% to 42 per 1000 live

births in the Middle East and North Africa, while the world average has fallen from 90 per 1000 live births in 2000 to 75 per 1000 live births" (WHO, 2014a).

As cited in (Ogundipe, Olurinola, & Ogundipe, 2016), "according to the WHO Global Health Observatory report, 6.3 million children under the age of five died in 2013, which is almost 17000 per day. The risk of a child dying from easily preventable infectious diseases before reaching the age of five is still highest in Africa (180 per 1000 live births), about 14 times higher than in the European region (12 per 1000 live births). Despite the global decline in child mortality, the mortality rate in Africa is still comparatively high, with an average under-five mortality rate of 91 children per thousand live births". In West Africa, "the average under-five mortality rate is 110 per thousand live births, while the lowest average under-five mortality rate is 57 per thousand live births is recorded in North Africa. Africa remains the continent with the highest risk of child survival" (Ibukun & Osinubi, 2020).

Worldwide, "WHO reported 800 maternal deaths per 100,000 live births daily in 2013 alone. It is noted that the risk of a woman dying from maternal death in a developing country, particularly in Africa, is about 23 times higher than for a woman living in a developed country" (WHO, 2014a). According to the United Nations Statistics Division (UNSD) data, "there were 289 maternal deaths per 100,000 live births in Africa, compared to the global average of 210 maternal deaths per 100,000 live births in 2013. In the same year, developed regions of the world reported the lowest maternal mortality rate (16 deaths per 100,000 live births), followed by Eastern Asia (33 deaths per 100,000 live births) and the Caucasus and Central Asia (39 deaths per 100,000 live births). Maternal mortality in Africa has mainly been with three types of delays in the birth process - delays in seeking health care, delays in reaching caregivers and delays in seeking care" (ECA et al., 2011).

Between 2001 and 2013, "the incidence of HIV/AIDS among adults, i.e., the number of new HIV infections per year per 100 people aged 15-49 years, more than halved in Southern, West and Central Africa, decreased by 46 per cent in East Africa and remained constant at the low level of 0.01 per cent in North Africa. As a result of the decline in new infections, HIV prevalence among adults in Africa, excluding North Africa, fell from 5.6 to 4.7 per cent from 2005 to 2013, and AIDS-related deaths in the population (all ages)

fell by 40 per cent, from 1.8 million people to 1.1 million people. In North Africa, the prevalence of HIV among adults was 0.1 per cent over the same period; however, the AIDS-related deaths in the population (all ages) increased slightly from 6,700 to 10,100 people" (UNSD, 2014).

According to the UNAIDS Gap Report 2014, "approximately 24.9 million people live with HIV in Africa, of which only 154,000 are in North Africa. The rest are spread across the four other geographical sub-regions, with Nigeria and South Africa alone accounting for up to 38.4 per cent of people living with HIV. More specifically, 81 per cent of people living with HIV in Africa are concentrated in ten countries, namely Ethiopia, Kenya, Malawi, Mozambique, Nigeria, South Africa, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe. Africa, excluding North Africa, accounts for about 71 per cent of all people living with HIV worldwide" (UNAIDS, 2014).

"The global burden of malaria mortality and morbidity is highest in Africa, with the exception of North Africa. In 2013, 90 per cent of all malaria deaths occurred in Africa, excluding North Africa. Both the Democratic Republic of Congo and Nigeria alone accounted for 34 per cent of all malaria deaths in 2013" (WHO, 2014b). Northern African countries, in particular, are making progress in eliminating malaria. In 2013, Egypt and Morocco were among 11 countries that managed to stabilise the number of malaria cases. "In addition to Egypt and Morocco, Algeria, Botswana, Cabo Verde, Eritrea, Namibia, Rwanda, Sao Tome and Principe, South Africa, and Swaziland also reduced their malaria cases by no less than 75 per cent between 2000 and 2013" (WHO, 2014b).

The people of Africa are among the most medically underserved in the world. The unaffordability of health care services accounts for the main reason why a large percentage of citizens do not receive the medical care they need. "Millions of people do not have access to quality health care and suffer higher rates of preventable diseases and premature death. Many health systems in Africa are characterised by significant inefficiencies. Between 20 to 40 per cent of total health expenditure is wasted, with inefficiencies related to human resource management, improper use of medicines, medical errors and suboptimal quality, as well as corruption and fraud being the main causes" (WHO, 2010).

While developed countries spend a high proportion of their gross domestic product (GDP) on public health care, the proportion allocated to the health sector by most African countries is relatively insignificant compared to some other countries. The level of health spending is insufficient to address the health challenges faced. A large part of the financial burden in the health sector falls on households in the form of out-of-pocket payments for health services. Prioritisation of other sectors over the health sector, inadequate health financing, shortage of skilled health workers, insufficient access to essential drugs and medical equipment, poor management, rapid population growth, political instability, bribery and corruption and other factors hinder the improvement of the health sector in Africa.

The health status of African countries "fell short of the Millennium Development Goals targets. High incidence of infant and maternal mortality, malaria, tuberculosis, hepatitis, HIV/AIDS, civil wars and conflicts have unprecedented negative impacts on health in the region" (Ogunleye, 2011). The heavy burden of vaccine-preventable and infectious diseases such as the Ebola virus, malaria, tuberculosis and HIV/AIDS play an important role in Africa's poor performance on the path to sustainable growth and development, as poor health severely hinders human capital development. African countries urgently need to take pragmatic measures to improve the quality of their healthcare systems (both public and private), promote access to healthcare, especially for the vulnerable and poor and ensure effective coverage of healthcare services in the region.

In September 2015, global leaders adopted the "17 Sustainable Development Goals (SDGs) as part of the 2030 Agenda for Sustainable Development. The third goal (SDG 3) is: Ensure healthy lives and promote well-being for all ages. The health targets for SDG 3 include but are not limited to the following; to reduce by 2030 the global maternal mortality ratio to less than 70 per 100,000 live births, to end by 2030 preventable deaths of new-borns and children under- five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-five mortality to at least as low as 25 per 1000 live births, to end by 2030 the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases, to achieve universal health coverage, including financial risk protection, access to quality essential health-care services and

access to safe, effective, quality and affordable essential medicines and vaccines for all" (United Nations, 2018).

By the end of 2019, progress had been made in many health areas, but the pace was not enough to meet most of the targets in Goal 3. In 2017, despite significant progress in maternal health, about "810 women died every day from complications related to pregnancy and childbirth. Sub-Saharan Africa and southern Asia account for about 86 per cent of global maternal deaths. In this same year, an estimated 219 million malaria cases and 435,000 deaths from the disease were reported. Sub-Saharan Africa accounts for more than 90 per cent of the world's malaria cases. In 2018, 5.3 million children passed away before reaching their fifth birthday. Sub-Saharan Africa remains the region with the highest under-five mortality rate: in 2018, 1 in 13 children died before they turned 5. This figure is 16 times higher than the average in high-income countries. Also, in 2018, HIV incidence was 0.24 per 1,000 uninfected population, the number of new HIV infections was estimated at 1.7 million, and 61 per cent of all new HIV infections occurred in Africa" (UN, 2020).

In 2016, among African countries, "only Sierra Leone spent more than 15% of its GDP on health care, Lesotho, Liberia, Malawi, Namibia, Sierra Leone, South Africa and Zimbabwe spent more than 8% of their GDP on health care, while countries such as Algeria, Angola, Benin, Democratic Republic of Congo, Equatorial Guinea, Eritrea, Mali, Nigeria and Seychelles spent less than 4% of their GDP on health care. From 2000 to 2018, the average health expenditure per capita in Africa is 100USD. However, within the region, the highest average of 202USD is recorded in Southern Africa, while the lowest average of 45USD is recorded in West Africa" (Ibukun & Osinubi, 2020).

This suggests that the share of per capita health expenditure in national income varies widely across countries and regions in Africa. These inequalities have also led to differences in health outcomes across countries and regions of the continent. "Due to insufficient government spending on health expenditure, it is not surprising that financial protection in Africa is generally low, health insurance coverage is extremely low and most patients pay for health services out of their household income. The regional average out-of-pocket (OOP) expenditures have increased from 15USD per capita in 1995 to 38USD in 2014. As a result, 11 million Africans become poor every year due to high out-

of-pocket expenditures. High financial barriers to health services have disastrous consequences for households, as they either forgo the care they need or fall into debt or poverty" (World Bank et al., 2016).

Virus outbreaks such as Ebola, avian influenza, Zika virus, Middle East Respiratory Syndrome (MERS), yellow fever, HIV/AIDS, and, more recently, COVID -19 demonstrate that the cost of the health crisis to socio-economic activities is enormous and can rapidly escalate in the absence of a robust health system that can adequately and effectively care not only for the wealthy but also for the poor and rural populations. The disruption and economic implications of health pandemics can be dramatically reduced with improved health systems that can prevent, identify, and respond early and efficiently to pandemics or other health emergencies. However, many health systems' readiness for health emergencies is still in its infancy, as can be seen all around the world.

The rising burden of diseases and Africa's population expansion (expected to reach 2.5 billion people by 2050) are driving up demand for health services and putting strain on health systems. In the face of these issues, governments must urgently invest efficiently in their health systems. The goal of inclusive health is inscribed in the national health plans and policies of the majority of countries in the region. They have, however, been slow to translate these commitments into more equitable health care and financial security. There are still major disparities in health-care access.

A few existing literatures have been able to establish a causality or relationship between health system and economic development. However, none has specifically addressed the nexus between inclusive health care system and economic development in Africa. This study aims to fill this gap. This research paper attempts to provide answers to the following research questions: Is there an index for inclusive health care system? What is the status of inclusive health systems in African countries? Is there a relationship between inclusive health care system and economic development? The main objective of the study is to determine the nexus between inclusive health care system and economic development in Africa. The specific objectives of this study are: to compute an index for inclusive health care system, to empirically investigate the state of inclusive healthcare system across countries in Africa and to determine the relationship between inclusive health care system, and economic development in Africa

1.3. Justification of the Study

Although there has been general progress in Africa, there are still major unmet health needs in many countries in the region. The region is far from achieving the 2030 Sustainable Development Goals target of providing 80 per cent of the population with essential health services. To put Africa on the path to sustainable growth and development, the health system must be strengthened and extend its coverage of health services to all and sundry, regardless of demographic differences.

The objectives of this work is to produce results that can be used by different countries to effectively monitor the state of their health systems in comparison to other countries and to make informed health-related decisions. It will assist healthcare organisations and policymakers in better understanding the relationship between inclusive health systems and economic development so that appropriate policies may be implemented to remove obstacles and promote access to health care for all. The empirical findings of the study will contribute to the existing body of knowledge about the relationship between inclusive health systems and economic development. The study's empirical findings will serve as a reference point for health policy and systems researchers, as well as an additional source of information for interested groups and students in health economics and economic development.

1.4. Scope of the Study

The study is carried out across 51 countries in Africa over 18 years (2002-2020). The choice of this scope is largely hinged on the availability of data and to enhance the performance of the panel data econometric analysis. The study focuses on statistically establishing the nexus between inclusive healthcare system and economic development in Africa.

1.5. Organization of the Study

This research work is divided into the introduction and four other chapters. The introduction includes the background of the study, the statement of the research problem, the research questions, the objectives of the study, the justification of the study, the scope of the study and the organisation of the study.

Chapter one clarifies some conceptual issues that are of utmost importance to the study. It also includes a review of relevant literature and the identified research gap. Chapter two describes the research methodology, the nature and sources of data, model specification, method of estimation and analysis. Chapter three deals with the data analysis, presentation and interpretation of the results. Chapter four provides a summary of the findings of the study, conclusions and recommendations in line with the findings of the study.

CHAPTER ONE

This chapter provides a conceptualisation of the health care system, its building blocks, its inclusiveness and its relationship to economic development. It also includes a review of the relevant literature and the identified research gap.

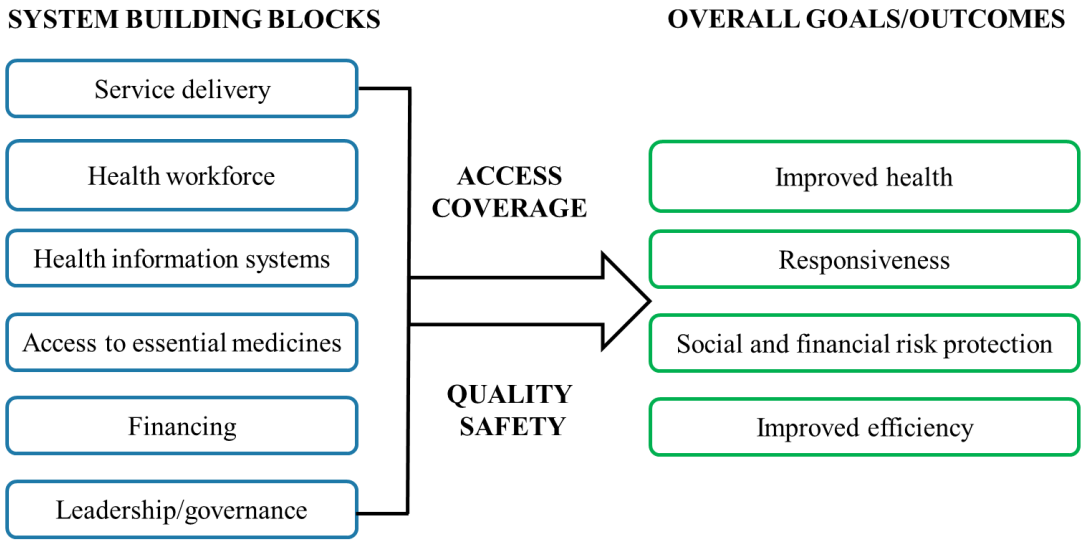
2.1. Conceptual Clarification

2.1.1. Healthcare System and Building Blocks

A health system, sometimes referred to as healthcare system or as health care system, "consists of all the organizations, institutions, and resources whose primary purpose is to improve, restore or maintain health" (WHO, 2007). A health system oversees the delivery of health care services to meet the health needs of the population. Essentially, the health system must provide services that are responsive and financially fair while treating people with respect.

The healthcare system "delivers preventive, promotive, curative and rehabilitative interventions through a combination of public health actions and the pyramid of health care facilities that deliver personal health care. A health system needs funds, information, personnel, supplies, transportation, communication and overall guidance and leadership to function effectively" (WHO, 2010).

FIGURE 1: The WHO Healthcare System Framework



Source: WHO, 2007.

According to the WHO healthcare system framework shown in Figure 1, the overall outcomes or goals of the health system are defined as follows: “Improving health and health equity in a way that is responsive, financially equitable and makes the best or most efficient use of available resources. There are also important intermediate goals: The path from inputs to health outcomes is through increased access to and coverage of effective health interventions, without compromising efforts to improve the quality and safety of providers” (WHO, 2007).

To achieve these goals, all healthcare systems must fulfil some essential functions, which the World Health Report 2000 refers to as a set of six essential "building blocks". The six global building blocks of a health system are:

a. Service delivery: “Good health services deliver effective, safe, quality personal and non-personal health interventions to those who need them, when and where needed, and with minimal waste of resources”.
b. Health workforce: “Given the resources and circumstances available, an effective and efficient health workforce works responsively, fairly and efficiently to achieve the best possible health outcomes. This means there is a sufficient number and a mix of competent, responsive and productive staff”.
c. Health information systems: “A well-functioning health information system ensures the production, analysis, dissemination and use of reliable and timely information on health determinants, health systems performance and health status”.
d. Access to essential medicines: “A well-functioning health system ensures equitable access to essential medical products, vaccines and technologies of assured quality, safety, efficacy and cost-effectiveness, and their scientifically sound and cost-effective use”.
e. Financing: “A sound health financing system raises adequate funds for health so that people have access to the healthcare services they need and are protected from falling into financial disaster or impoverishment, even if they have to pay for them”.
f. Leadership/governance: “Leadership and governance involves having a strategic policy framework in place, combined with effective oversight, coalition building,

provision of appropriate regulations and incentives, attention to system design and accountability".

2.1.2. Healthcare System and Economic Development

Over the years, there have probably been as many definitions of economic development as there are people who practise it. Economic development practitioners are still trying to define the field more concretely and succinctly. One of the most prominent definitions of economic development is the one proposed by Amartya Sen.

According to Sen (1999), "development is about creating freedom for people and removing obstacles to greater freedom. Greater freedom enables people to choose their own path. Obstacles to freedom, and hence to development, include poverty, lack of economic opportunities, corruption, poor governance, lack of education and little access to health, sanitation or clean water".

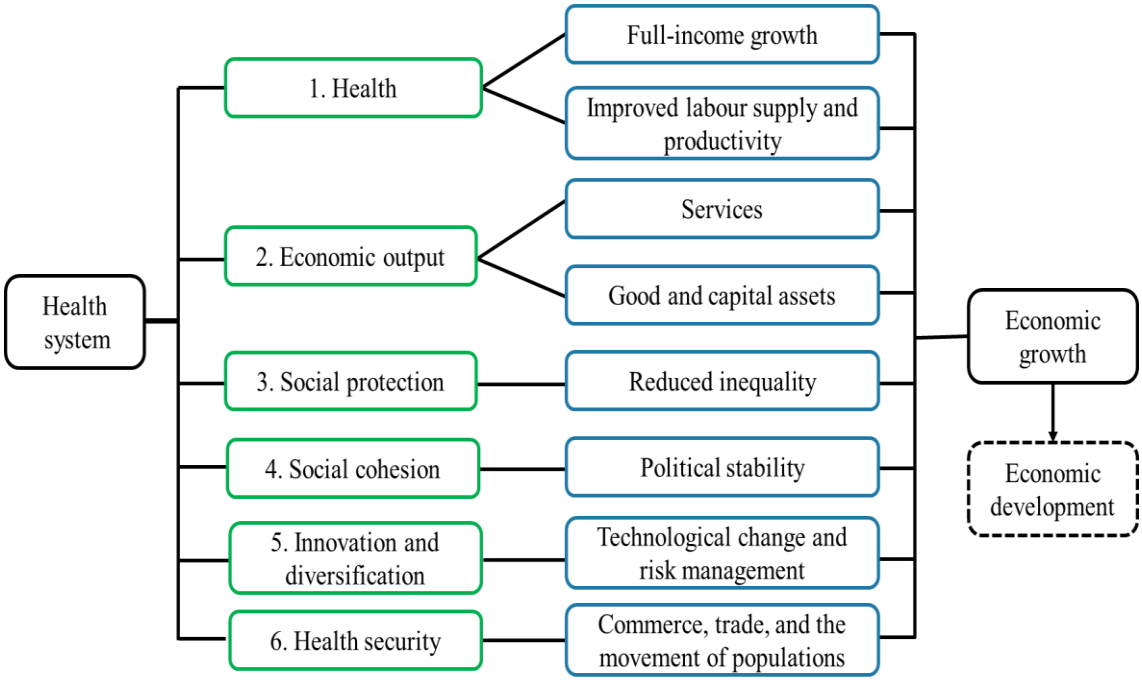
Todaro and Smith (2009) also defines economic development as "an increase in living standards, improvement in self-esteem needs and freedom from oppression as well as a greater choice". As cited in Renny (2012), Andy Lewis defines economic development as "the process of retaining, expanding, and attracting jobs, income and wealth in a manner that improves individual economic opportunities and the quality of human life".

Economic development and economic growth are frequently used interchangeably. While both have similarities, the distinctions between economic growth and economic development are vital to understand since the two concepts are crucial in creating economic change. Economic development is a broader concept than economic growth. Economic growth is usually measured by changes in GDP (gross domestic product). The Human Development Index (HDI), Human Poverty Index (HPI), Gender-Related development Index (GDI), and literacy rate of a community are examples of economic development indicators. While economic growth is concerned with quantitative changes in the economy, such as increase in economy's output. Economic development on the other hand is concerned with qualitative and structural changes in the economy. Notwithstanding, economic growth is a necessary but not sufficient condition for economic development.

The role of health in economic growth and development has been dealt upon by a strand of literature. Health, as a form of human capital plays obvious role in determining physical capacities and mental capacities, the improvement of which, all other things being equal, enhances worker's productivity. However, for people to function to his fullest capacities, the use of health facilities is crucial.

The primary objective of a healthcare system is to prevent disease, to protect individuals from environmental health risks, to encourage healthy mental and physical behaviours, and to ensure the provision of accessible, affordable, and high-quality health care services. When viewed as an economic sector, the health system contributes to economic growth and development by generating a number of additional spill-over benefits at no additional cost, in addition to playing a crucial role in enhancing health outcomes and population well-being (that is, positive externalities). As shown in Figure 2, Lauer, Soucat, Araujo, and Weakliam (2016) analysed six pathways through which the activities of the health system lead to economic growth and development: "health, economic output, social protection, social cohesion, innovation and diversification and health security".

FIGURE 2: Pathways to Economic Growth



Source: Lauer et al, 2016.

The health pathway has two sub-pathways: “full-income pathway and instrumental value of improved health pathway. In the full-income pathway, health is seen as an essential part of what people value as individuals. Health is conceived of as an intrinsic benefit with intrinsic value (something good for its own sake), and not as an instrumental benefit (something good for the sake of something else, such as monetary income). This role of health, as a direct consumption good, justifies the central importance of this pathway in most health-related analyses: health is a fundamental part of what people value as a good life; it plays an integral part in theories of human well-being; and it features prominently in discussions of social welfare” (Lauer et al, 2016).

The second sub-pathway is important because “improved health implies that individuals can engage in increased levels of activity. If the activity resulting from an improvement in health takes place in the labour market, it constitutes a market-valued benefit and will be recorded in the national income as an increased level of economic productivity. In general, part of this increased economic productivity is attributable to an augmented quantity of labour supplied (through reduced absenteeism, disability and early retirement), but part is also attributable to reduced presenteeism (resulting in improved quality of labour) and increased labour productivity” (Lauer et al, 2016).

Economic output pathway reflects the fact that “the health sector produces direct economic value through its multiplier effects on the economy through the employment of staff; non-staff expenditures, such as the purchase of equipment, supplies and services; investments in manufactured capital, such as buildings and related facilities, the development of communications, logistics and supply networks, and investments in human capital, such as training and education. Through this pathway, the health system makes direct contribution to economic growth even if no health benefit is derived” (Lauer et al, 2016).

The economic output pathway comprises of two sub-pathways: “the services pathway, and the goods and capital assets pathway. The contribution of services to output can be measured either through the wages of health workers (through income accounting) or through the value of their billings to consumers of health services (through expenditure accounting). However, the health economy also produces a range of manufactured goods,

such as pharmaceuticals and medical devices and equipment, which form part of the goods and capital assets pathway" (Lauer et al, 2016).

The social protection pathway shows "the route by which the health system offers social protection benefits that are external to its defining purpose of improving health, which do not directly contribute to market-valued economic output, and which are spill-over effects of health employment. These include, for instance, social protection in case of sickness, disability, unemployment and old age, and financial protection against loss of income, out-of-pocket payments, and catastrophic health expenditures, whether through social insurance or through publicly funded systems" (Lauer et al, 2016). These social protection benefits are intended to provide "income or consumption transfers to the poor, protect the vulnerable against livelihood risks and enhance the social status and rights of the marginalized; with the overall objective of reducing the economic and social vulnerability of poor, vulnerable and marginalized groups. As a result of reducing impoverishment and economic vulnerability, social protection benefits offer opportunities for enhanced economic activities and growth" (WHO, 2010). In Amartya Sen's capability approach, "poverty is understood as deprivation of basic capabilities to live a good, long, healthy, and fulfilling life. People get deprived of such capabilities in a number of ways; for example, lack of financial resources, ill health, lack of proper education, inability to actively participate in social and political activities, ignorance and so on. Basic essentials like education and health directly improve the quality of life and capabilities, thus, improving the ability to earn more" (Amartya Sen, 1989).

The social cohesion pathway reflects the fact that "reducing inequality in societies contributes to greater political stability, which is an important condition for economic growth. The provision of health services to all is a vital element in delivering greater equity in society, together with decent jobs for women, young people and the poorest" (WHO, 2016).

The innovation and diversification pathway "illustrates how some countries have invested in their health sector specifically to promote economic growth. The health sector has been driving technological innovations in many areas, including genetics, biochemistry, engineering and information technology. Exports of pharmaceuticals, equipment and

medical services have also been an important driver of growth in many countries" (OECD, 2015).

Finally, the health security pathway shows that "investments in the health workforce can create the resilient health systems that are essential to protect a country's economy from epidemic threats and from instability due to conflicts. Increasing health worker numbers and improving their skills will ultimately support emerging economies by insulating them from health or socially generated shocks, which lead to disruptions in trade, commerce and food production and population movements" (World Bank, 2014).

2.1.3. Inclusive Healthcare System

Inclusion is an aspect which has gained recognition in society today and is gaining significant momentum in various areas, it essentially means including individuals coming from varying sectors**.** Strictly from economics perspective, inclusiveness connotes a broader and all-encompassing meaning for macroeconomic terms. In other words, it assumes a place for all strata or classes of samples or populations or phenomena. That is, it is used and perceived from a holistic point of view. Inclusiveness in health system or inclusive health system follows the same line.

However, what exist in a couple of health systems today shows a deviation from above. World health statistics (2020) shows that only "between one third and one half the world's population (33% to 49%) was covered by essential health services in 2017. Although, service coverage in low- and middle-income countries remains lower than coverage in wealthier ones. Globally, between 2000 and 2015, the total number of people pushed below the extreme poverty line by health spending decreased from 123.9 million people (2%) to 89.7 million people (1.2%). However, most of the people pushed into impoverished (surviving on less than 1.90USD per person per day) by out-of-pocket payments was concentrated in lower-middle-income countries and South-East Asia. A good health system must ensure that everyone, everywhere, can access quality health services without being forced into poverty" (WHO, 2020).

According to Kilishi and Obasa (2018), "inclusive health system is a concept that advances equitable opportunities for all economic groups in the delivery of responsive and high-quality health care services. It emphasizes on the inclusion of everyone in health

services, regardless of their economic class, gender, disability and religion. Inclusive health system provides high quality health care in sufficient quantity and ensures that broader sector of people have access to it".

An inclusive health system seeks to improve the quality of health services, to increase access to health care for all, especially vulnerable and marginalised populations, and to lower financial barriers to care (Audrey and Karagueuzian, 2016**).** The movement towards the attainment of inclusive health system is vehemently based on the WHO constitution of 1948 declaring health as a fundamental human right. A couple of agendas such as Health for all down to the most recent powerful concept- Universal Health Coverage (UHC)- have been set over the years to ensure the inclusiveness of health system globally.

2.2. A Review of Literature

2.2.1. Review of Literature on the Link between Health System and Economic Development

Several studies have been conducted to determine the role of health system in economic growth and development. However, it should be noted that given the vast numbers of literature that have proliferated the field of health economics, only a few have specifically investigated the link between inclusive health system and economic development. Therefore, the bulk of this literature review is basically on health system and economic growth or/and development.

Audrey and Karagueuzian (2016) after constructing an inclusive health system index for 178 countries using Totally Fuzzy Analysis and the Principal Components Analysis, following a simple regression model analysis, captured that there exists a high rank correlation (0.823) between inclusive health system index (proxy for inclusive health system) and GDP per capita (proxy for economic development).

Elvis (2014) analysed "the relative impacts of health and education on economic development in Southern Africa using a set of cross-country panel data from 11 countries over the period 2005 to 2011. Health index was used as a proxy for health; calculated based on life expectancy at birth. Education index was used as a proxy for education; calculated based on the mean years of schooling of adults and expected years of schooling

of children. Income index was used as a proxy for GNI (gross national income) per income growth and indicator of economic development; calculated as GNI per capita in purchasing power parity terms. Adopting the Breusch and Pagan Lagrangian Multiplier test and Hausman test techniques, the Fixed Effects model results revealed that health and education demonstrate significant positive effects on economic development in the region. In relative terms, health recorded a more pronounced effect on economic development than education. A 1% improvement in health status leads to approximately 0.28% increase in economic development. Similarly, a 1% increase in mean years of schooling leads to nearly 0.04% in economic development in the region".

Weil (2005) accounts for "the impact of health on economic performance by estimating the returns to a number of health indicators. The study found that a 10% increase in the adult survival rate would lead to an increase in labour input per worker of 6.7% and in GDP per worker of about 4.4%". Mayer (2001), "using life expectancy and mortality rates as health indicators found that health accounted for approximately one third of long-term economic growth in Mexico during the period 1970-1995. In the same vein, improved health captured by life expectancy and infant mortality demonstrates a significant positive impact on economic development". Bloom, Canning and Sevilla (2004) in their study focused on "the labour productivity effects of health on economic growth. Their main result shows that health has a positive and significant effect on economic development". However, contrary to similar findings by Arora (2001), Bloom and Canning (2005). Acemoglu and Johnson (2007) found is a significant negative effect of life expectancy on GDP per capita.

2.2.2. Review of Literature on the Index of Inclusive Health System

Economic literature that presents an index of inclusive health system are farfetched although a few literatures have attempted the inclusion of health indicators in inclusive growth indices.

Audrey and Karagueuzian (2016) "pushed beyond the restrictions of inclusive growth indices, which typically combine health indicators with a variety of other variables. They defined and quantified inclusive health independently, focusing on three critical elements of inclusiveness: quality, quantity, and accessibility. The study was conducted across 178 countries across Asia & Pacific, Europe (non-OECD), Latin America & Caribbean,

MENA (Middle East and North Africa), OECD (Organization for Economic Co-operation and Development) and SSA (sub-Saharan Africa)". The empirical results were based "on two different methodologies – the Totally Fuzzy Analysis and the Principal Components Analysis – which were also compared for robustness purpose. The researchers devised an inclusive health index based on nine worldwide health indicators that took into account three conceptual aspects of inclusive health. The findings of the study revealed that almost all countries (97.9%) in sub-Saharan Africa are deprived in terms of inclusive health, followed by Asian & Pacific (68.6%), Latin America & Caribbean (58.6%), MENA (44.4%) which were in contrast with Europe (5.3%) and the OECD (0%). Also, nine out of ten bottom countries are from sub-Saharan Africa" (Audrey and Karagueuzian, 2016).

Similarly, Kilishi and Obasa (2018) computed "an inclusive health index for 44 countries in sub-Saharan Africa for the period 2002 to 2013 using the Principal Component Analysis. Using zero as an average value, about 52% of countries are deprived of inclusive health system (countries with values below zero. About 16 countries are less deprived (countries with values between zero and one), while 5 countries have active inclusive health system (countries with values between one and above). Countries with positive values of IHI are likely to improve on inclusive health system more quickly than countries with negative values. Mauritius is recorded to have the most inclusive health system in the region".

Masaeli, Sadeghi, Ghanbari, Mahdavi, and Javadi (2013) "conducted a study to determine the standard and quality of health in the provinces of Iran. The study used fuzzy logic to calculate the indexes of standard and quality of health. This study used the following variables; public health expenditure of household, the number of physicians for 1000 people (%) and improved water source to all water access (%) for index of standard of health while the index of quality of health used the following variables; life expectancy at birth, number of health and medical institutions and centres to 10,000 people (%), the number of insured people to the population. The fuzzy logic gave the various indexes for 30 provinces and the critical point was determined to aid the identification of the provinces faced by some deprivations. Furthermore, the study regressed the indexes of standard of health and quality of health over per capita income and human development. It was observed that there is a meaningful relationship between standard of health index

and human development but there is no significant relationship between standard of health index and per capita income. Also observed for quality of health is that there is a significant relationship between this index and standard of health, however, this index does not have any significant relationship with human development and income per capita". This implies that the income and expenses on the area of health are less linked/directed to quality of health.

The World Economic Forum (2017 and 2018) used healthy life expectancy in its inclusive development index as one of the inclusive growth and development key performance indicators. Similarly, "8 out of 35 proposed indicators in the framework of inclusive growth indicators by the Asian Development Bank (2014) were health related; prevalence of under-weight children under-five years of age, under-five mortality rate per 1,000 live births, diphtheria, tetanus toxoid and pertussis (DTPB) immunization coverage among 1-year-olds, physicians, nurses and midwives per 10,000 population, government expenditure on health as a percentage of total expenditure, social security expenditure on health as a percentage of government expenditure on health, proportion of population using an improved sanitation facility and proportion of population using an improved drinking water source".

At the country level, McKinley (2010) sought to create "a composite inclusive growth indicator. The study found appropriate indicators in the areas of growth, productive employment, economic infrastructure, income poverty and equity, human capacities, and social protection to be useful for this goal. Within the framework of the Growth Composite Index, the researchers employed three health indicators (under-5 mortality, mortality under the age of 40, and underweight children). The study however failed to measure independently the index of inclusive health system". The Euro-Mediterranean Forum of Institutes of Economic Sciences (FEMISE, 2009) created "a health index as part of its inclusive growth index, which includes health outcomes (life expectancy, child mortality, tuberculosis rates) and public health expenditure".

2.3. Summary of Literature and the Identified Research Gap

It is generally acknowledged that the role of health as a form of human capital to economic growth and development cannot be over emphasized. While the impact of health system (using health indicators and outcomes) on economic growth and development has been

explored extensively in the field of health economics, there are very few available studies that have attempted to examine the significant effect of inclusive health system on economic development and especially in Africa.

This study intends to take up the challenge to fill this research gap. First, it computes a composite inclusive health system capturing three crucial aspects of inclusiveness in the health system: access, affordability and quality. Second, the relationship between inclusive health system on economic development is empirically investigated. Findings will help the government, health analysts and all other interested authorities to take necessary actions to improve health indicators to better stimulate health-led economic growth and development in the region.

CHAPTER TWO

This chapter discusses the method of analysis, the nature and scope of data, model specification, method of estimation as well as evaluation technique. This chapter is divided into five sections: method of analysis, model specification, nature and scope of data, estimation technique and evaluation criteria. These sections present method of constructing an inclusive health index, specification of empirical models, sources and range of data set, estimation techniques of specified models and criteria for evaluating statistical results.

3.1 Construction of Inclusive Healthcare System Index

The construction of index of inclusive healthcare systems is strongly influenced by Verdier-Chouchane and Karagueuzian's "Concept and Measure of Inclusive Health across Countries" (2016). This choice is largely due to a dearth of research studies relevant to this study. However, to ensure broader coverage and to eliminate any deficiencies caused by underrepresentation, indicators based on rural population statistics are replaced by total (urban and rural) population statistics, and indicators based on female population statistics are replaced by total (male and female) population statistics. As shown in Table 1, the study focuses on three important dimensions of inclusiveness, namely accessibility, quality and quantity. Table 1 summarises the indicators for each dimension.

In Africa, there exist disparities in access to healthcare services. This is largely due to the spatial and income inequalities between the less privileged and the rich class. The less privileged, mostly living in rural areas, have restricted access to quality healthcare services and fundamentals like sanitation facilities and water sources because access to public healthcare is limited, and they cannot simply afford to pay private insurance or direct out-of-pocket expenditures.

TABLE 1: Inclusive health indicators by dimensions

Access to health	Quality of health	Quantity of health
Improved sanitation facilities, rural (% of rural population with access)	Maternal mortality ratio (per 100 000 live births)	Immunization for diphtheria, pertussis (or whooping cough), and tetanus (DPT) (percentage of children 12-23 months)
Improved water source, rural (% of total population with access)	Incidence of Tuberculosis (per 100 000 population)	Density of physicians (per 1000 population)
Out-of-pocket expenditures (% of total expenditure on health)	Life expectancy at birth (female)	Government expenditure on health (% of total government expenditure)

Source: Verdier-Chouchane and Karagueuzian (2016)

It is a fundamental need and a human right to have access to basic sanitation and drinking water, as these are essential for one's health. "The percentage of the rural population who has access to improved sanitation facilities is calculated by dividing the number of rural households who use flush or pour flush (to a piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet by the total number of rural households" (WHO, 2020). While coverage in rural areas continues to be unacceptably poor and much lower than in metropolitan areas, there is also the issue of coverage imbalance within urban areas. Coverage in urban slum regions is different and significantly lower than the national average. Sanitation in slums is a critical and complex issue, owing to high population density, inadequate urban infrastructure, limited access to space, and widespread poverty. Not only is excluding the percentage of people who have access in urban areas insufficient, it is outright deficient. For this reason, our index is based on the weighted average of the percentage of the total population (urban and rural) who has access to an improved sanitation facility in order to avoid this

deficiency. Improved sanitation facilities enable the hygienic isolation of human excreta from human contact; nevertheless, when shared with other households or made available to the general public, these facilities are not considered improved.

“The percentage of rural population with access to improved water source is calculated by dividing the number of rural households with access to improved drinking water source by the total number of rural households. Piped water on the premises, public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection are all examples of improved drinking water source. It is also a foundation of health since it serves as a proxy for having access to safe drinking water. Out-of-pocket expenditure as a percentage of total expenditure shows the level of out-of-pocket expenditure expressed as a percentage of total expenditure on health. Out-of-pocket expenditure as a percentage of total health expenditure indicates the level of out-of-pocket spending as a proportion of total health spending. It helps to understand the relative weight of household direct payments in relation to total health expenditure. As a key indicator of the health financing system, high out-of-pocket spending is associated with catastrophic and impoverishing spending” (WHO, 2020).

According to Sharan, Ahmed, Ghebrehiwet and Rogo (2011), “the quality of the health system is measured by health outcomes, as health outcome indicators are more dependable than health process indicators. The term "health outcomes" refers to a patient's response to the health system in terms of disease incidence, mortality and morbidity. Maternal mortality ratio (MMR) is expressed as the number of maternal deaths per 100,000 live births over a specified time period. It quantifies the risk of maternal death in relation to the number of live births and encapsulates the risk of death during a single pregnancy or live birth. Maternal mortality is highly dependent on the ability of the health system to prevent and treat complications associated with pregnancy and childbirth, excluding those resulting from accidental or incidental events. Tuberculosis is a severe infectious disease that can be transmitted from person to person and claims hundreds of lives every year, particularly in developing countries where treatment is difficult and expensive. The incidence of tuberculosis is the estimated number of new cases of tuberculosis and relapses in a given year. It is expressed as a rate per 100,000 population” (WHO, 2020).

Female life expectancy at birth is an estimate of the average number of years a female new-born would live if the mortality rates prevalent at the time of birth remained constant throughout her life. Women have a longer life expectancy than men. This disparity is partly explained by the female's innate biological advantage and the behavioural differences between men and women. Our index is based on life expectancy for both sexes, males and females. Variations in life expectancy can be related to a variety of factors, including socioeconomic status, lifestyle, education, and access to high-quality health care.

According to a substantial body of research, there is a causal relationship between the availability of human resources, material resources, medications and infrastructures and health outcomes. The competence of the health system in providing standard or essential health services, such as DPT immunization, adequate medical staff, as assessed by physician density, and government health financing are prerequisites for achieving acceptable health outcomes. Diphtheria, pertussis (or whooping cough) and tetanus (DPT) immunization is determined by the percentage of children aged 12 to 23 months who received the three required doses of the combined DPT vaccines prior to 12 months or at any point prior to the survey. After receiving three doses of vaccination against diphtheria, pertussis (or whooping cough) and tetanus, a child is considered adequately vaccinated (WHO, 2020).

The density of physicians refers to the number of physicians in a country in relation to the size of its population (per 1000 population). Having an adequate workforce is crucial to service delivery performance. Government expenditure on health measures the overall level of government spending on health as a percentage of total government expenditure. In addition to government-funded resources, it comprises of expenditures on health by parastatals, extrabudgetary institutions and health insurance. While adequate resourcing of the health system is necessary to provide quality health services to the population, it is not sufficient. To be effective and efficient, health system resources must be substantial, appropriately used and managed (WHO, 2020).

3.2 Method of Analysis

The construction of an inclusive health system index (IHI) in this study is based on Principal Component Analysis (PCA) and totally Fuzzy Analysis (TFA). "The variables were standardised by calculating the $\mu_j(i)$ for each indicator in order to carry out the two analyses with the same unit of measurement. Assuming that there are $i \in [1, n]$ countries, $j \in [1, p]$ health performance indicators and $X_j = \{x_j / j = 1 \ldots p\}$ the vectors of components. The variable x_j^i is the value taken by indicator j for the ith country. The higher the value of the indicator, the lesser the deprivation. The definition of the standardized indicator $\mu_j(i)$ is expressed as follows:

$$\mu_j(i) = \frac{x_j^i - x_j^{min}}{x_j^{max} - x_j^{min}}$$

with $x_j^{min} = Min_i(x_j^i)$ and $x_j^{max} = Max_i(x_j^i)$. Therefore, $\mu_j(i)=0$ if the value of the indicator is the minimum value while $\mu_j(i)=1$ if it is maximum value. However, for maternal mortality, incidence of tuberculosis and out-of-pocket expenditures, the form below applies:

$$\mu_j(i)' = \frac{x_j^{max} - x_j^i}{x_j^{max} - x_j^{min}}$$

$\mu_j(i)' = 0$ if the value of the indicator is the maximum value while $\mu_j(i)' = 1$ if it is the minimum value. According to the degree of deprivation, both functions decrease linearly between one and zero" (Audrey and Karagueuzian, 2016).

3.2.1 Principal Component Analysis

Originating from the work of Pearson (1901) and Hotelling (1933), "Principal Component Analysis (PCA) is a tool developed to find patterns of similarity and dissimilarity in a data collection. PCA facilitates in lowering the dimensionality of the data set after identifying the pattern with minimal loss of information. The computation of indexes is one of the numerous alternative applications of PCA. The objective of PCA is to find unit-length linear combinations of the variables with the greatest variance**.** Since the explanatory variables are measured in different units, in order to bring them in a

comparable range, this study uses the standardized variables $\mu_j(i)$ which range from 0 to 1. Normalization or standardization of variables prevents giving more emphasis to indicators that have higher variance than to those with low variances" (Audrey and Karagueuzian, 2016)..

"The first and the second principal components ($\hat{Y}_1$and $\hat{Y}_2$) respectively have the maximal overall variance and the greatest variance among all unit-length linear combinations that are uncorrelated to the first principal component. This constraint holds for all the principal components $\hat{Y}_j$:

$$\hat{Y}_1 = \hat{e}_{11}\,\mu_1(i) + \hat{e}_{12}\,\mu_2(i) + \hat{e}_{13}\,\mu_3(i) + \ldots + \hat{e}_{1p}\,\mu_p(i)$$

$$\hat{Y}_2 = \hat{e}_{21}\,\mu_1(i) + \hat{e}_{22}\,\mu_2(i) + \hat{e}_{23}\,\mu_3(i) + \ldots + \hat{e}_{2p}\,\mu_p(i)$$

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$$\hat{Y}_p = \hat{e}_{p1}\,\mu_1(i) + \hat{e}_{p2}\,\mu_2(i) + \hat{e}_{p3}\,\mu_3(i) + \ldots. + \hat{e}_{pp}\,\mu_p(i)$$

The coefficients maximize the variance subject to the constraints that the sums of square coefficients add up to one and the components are uncorrelated with one another: cov ($\hat{Y}_i$, $\hat{Y}_j$) = 0. The eigenvectors ($\hat{e}_1$, $\hat{e}_2$,..., $\hat{e}_p$) which are normalized and orthogonal (uncorrelated) describe the linear combinations of the variables with the greatest variance" (Audrey and Karagueuzian, 2016).

3.2.2. Totally Fuzzy Analysis

The totally fuzzy analysis is a suitable mathematical tool to analyze phenomena that are hard to place in a set and allows elements to have different degrees of membership in the unit interval (0, 1). It was invented by Zadeh (1965) and developed by Dubois and Prade (1980). In economics, the use of the methodology is quite new. The approach has been

extensively applied in multidimensional analyses of poverty and well-being (see Bérenger and Verdier-Chouchane 2007 and 2011; Chatterjee 2014; Lemmi and Betti 2006) and standard and quality of health care services (Masaeli *et al.*, 2013).

As defined by Cerioli and Zani (1990), "the normalized logarithm (In) of the inverse proportion of the mean deprivation level as the weight given to a specific indicator". The weight ω_j relative to the indicator *j* is as follows:

$$\omega_j = \frac{In\left(\frac{1}{\bar{\mu}_j}\right)}{\sum_{j=1}^{M} In\left(\frac{1}{\bar{\mu}_j}\right)} \; with \; \bar{\mu}_j = \frac{1}{N}\sum_{i=1}^{N} \mu_j(i)$$

With $\omega_j \geq 0$ and $\sum_{j=1}^{M} \omega_j = 1$

$\bar{\mu}_j$ is the average value of the indicator *j*.

Inclusive health system index is the weighted arithmetical mean of the $\mu_j(i)$:

$$IHI = \sum_{j=1}^{p} \omega_j \, \mu_j(i) \; with \; (0 < IHI < 1)$$

To allow for the classification of countries into "health care services are inclusive" and "health care services are not inclusive" categories, a critical value ($\mu_j crit$) is calculated.

$$F\left(\mu_j crit\right) = 1 - \bar{\mu}_j$$

F is a function of cumulative distribution and $\bar{\mu}_j$, which is the average of the value of indicator *j*.

3.3 Model Specification

As observed in section 2.2.1, health plays a significant role in economic growth and development. This study seeks to analyse the relationship between inclusive health system and economic development. Since there are a bunch of measures of economic development, the study uses alternative indicators to allow for comparison. For simplicity, the models are built based on the assumption that a linear relationship exists

between the dependent variable (level of economic development) and the explanatory variable (inclusive health system). The general form of the model is given as:

LED = f (IHS)

Where;

LED = Level of Economic Development

IHS = Inclusive Health System

The level of economic development is measured alternatively by Human Development Index and Gross Domestic Product per capita (current US$) while inclusive health system is measured by the inclusive health system index composed by the author. Although, the main aim of this study is to investigate the impact of inclusive health system on the level of economic development, it is highly imperative to examine the effects of various macroeconomic variables established in the literature such as population growth, capital formation, government expenditure on education, and government effectiveness. Thus, the empirical alternative models are specified as:

$$GDPPC_{it} = \beta_0 + \beta_1 IHI_{it} + \beta_2 PG_{it} + \beta_3 CAP_{it} + \beta_4 GEE_{it} + \beta_5 GEF_{it} + E_i + \mu_{it}$$

$$HDI_{it} = \alpha_0 + \alpha_1 IHI_{it} + \alpha_2 GEE_{it} + \alpha_3 GEF_{it} + E_i + \mu_{it}$$

Where;

i = cross-sectional unit (individual country)

t = time period (2002-2020)

GDPPC = GDP per Capita (current US$)

HDI = Human Development Index

IHI =Inclusive Health system Index

PG = Population Growth (annual %)

CAP = Capital Formation

GEE = Government Expenditure on Education, total (% of GDP)

GEF = Government Effectiveness Index

α_0 and β_0 = Intercept parameters of all countries

$\alpha_1 - \alpha_3$ and $\beta_1 - \beta_5$ = Coefficients of Regressors

E_i = Country/Cross-sectional error term

μ_{it} = Combined time and country/cross-sectional error term

"GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars. The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions. Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. Capital formation is a term used to describe the net capital accumulation during an accounting period for a particular country. The term refers to additions of capital goods, such as equipment, tools, transportation assets, and electricity. Countries need capital goods to replace the older ones that are used to produce goods and services. If a country cannot replace capital goods as they reach the end of their useful lives, production declines. Generally, the higher the capital formation of an economy, the faster an economy can grow its aggregate income" (WHO, 2020).

General government expenditure on education (current, capital, and transfers) is "expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government. General government usually refers to local, regional and central governments. Government expenditure on education, total (% of GDP) is

calculated by dividing total government expenditure for all levels of education by the GDP and multiplying by 100. Government effectiveness is the perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (WHO, 2020).

3.4 Nature and Scope of Data

This study utilizes a panel data set computed by the author. Data for the study was obtained from the United Nations human development data centre, World Bank world development indicators and worldwide governance indicators. The data covers 51 countries in Africa "(Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo Republic, Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe)" over 18 years (i.e., 2002-2020). The criterion for selecting the 51 countries is solely based on availability of data.

3.5 Estimation Technique

This study employs a one-way error component model. The individual effects component included in the model specified (E_i) captures all unobserved time invariant factors that affect economic development. E_i accounts for features peculiar to each country that does not change over time.

If the model is estimated using Ordinary Least Squares (OLS), E_i will be assumed to be zero and this is erroneous as each country is different from the other. Thus, OLS is not a good estimator for this model. The other alternatives are fixed effect and random effect models. The fixed effect and random effect models assume that E_i is not equal to zero. The fixed effect model assumes that E_i is a fixed parameter to be estimated while random effect model assumes that E_i is a random parameter to be estimated. The random effect

model and fixed effect model estimators shall be run using the Generalized Least Squares (GLS) estimators and Hausman test is used to choose between random effect model and fixed effect model for the models.

3.6 Evaluation Criteria

To evaluate the results, this study employs the economic or *a-priori* criteria and statistical criteria.

Economic or *a-priori* criteria: This depicts the expectation about the estimated parameters based on previous studies or on common sense (where previous studies are disunited). The *a-priori* expectation of this study based on previous studies is that:

$\alpha_1 - \alpha_3$ and $\beta_1 - \beta_5 > 0$

Statistical criteria: Statistical criteria tests are used to determine the statistical reliability of the estimates and are generally referred to as the First Order Tests. Major first order tests are T- test statistics, Standard error test, F- test statistics, probability value (p-value), R^2 etc. The criterion for the test of reliability of the parameters in this study is p-value. The decision rule is that the hypothesis would be rejected if the p-value is less than the significant value.

CHAPTER THREE

This chapter contains the data analysis and result of the specified models. The econometric analysis follows after carrying out the pooled regression model and Hausman test is be used to choose between fixed and random effects of panel estimation. The chapter concludes with the presentation of findings and discussions.

4.1 Results of the Methodologies

4.1.1 Summary of Descriptive Statistics (mean, standard deviation, range)

TABLE 2: Summary Statistics of Health Indicators

Variable	Mean	Std. Dev.	Min	Max
Public Health Expenditure	6.90	3.35	0.73	18.29
DPT Immunization	79.61	17.27	19.0	99.00
Tuberculosis incidence	259.33	244.64	7.60	1270.0
Life Expectancy	60.26	7.73	41.38	76.88
Maternal Mortality	475.04	315.94	37.0	2080.0
Out-of-Pocket Expenditure	40.69	19.70	2.99	84.16
Improved Water	65.83	17.72	21.84	99.87
Improved Sanitation	38.76	26.66	3.88	100.0
Density of Physicians	0.34	0.50	0.008	2.83

Source: Author's Computation, 2021

The results of summary statistics for the employed health indicators presented in table 2 revealed that public health expenditure averaged 6.9 percent of GDP for African countries over the period 2002-2020. This has a spread from this mean by about 3.35 percent, with the lowest health expenditure recorded as 0.73 percent of GDP by Cameroon and the highest health expenditure recorded as 18.29 percent of GDP by Sudan. The results also show that about 79.61 percent of children between ages 12 to 23 months were immunized against diphtheria, pertussis and tetanus, with a spread of 17.27 percent, the lowest recorded proportion of children immunized is 19 percent by Chad and highest recorded proportion of children immunized is 99 percent by Morocco and Seychelles. An average of 259.33 individuals per 100,000 people were discovered as incidence of tuberculosis. This has a spread of 244.64 persons per 100,000 individuals, the lowest recorded

incidence of tuberculosis is 7.6 individuals per 100,000 people by Seychelles and the highest recorded incidence of tuberculosis is 1,270 individuals per 100,000 people by South Africa.

Total life expectancy averaged 60.26 years in Africa over the period under investigation. This has a spread from this mean by about 7.73 percent, with the lowest life expectancy recorded as 41.38 years by Sierra Leone and the highest life expectancy recorded as 76.88 years by Algeria. Maternal mortality averaged 475.04 women per 100,000 live births in Africa over the period under investigation. This has a spread from this mean by about 315.9 women, the lowest recorded maternal mortality is 37 women in Egypt and the highest recorded maternal mortality is 2080 women per 100,000 live births in Sierra Leone. Out-of-pocket health expenditure averaged 40.69 percent of total health expenditure in Africa over the period under investigation. This has a spread from this mean by about 19.70 percent, the lowest out-of-pocket expenditure recorded is 2.99 percent in Botswana and the highest out-of-pocket health expenditure recorded is 84.16 percent of total health expenditure in Equatorial Guinea.

Improved water source averaged 65.83 percent of total population with access. This has a spread from this mean by about 17.72 percent, with the lowest improved water source recorded as 21.84 percent in Ethiopia and the highest improved water source recorded as 99.87 percent of total population with access in Mauritius. Improved sanitation facilities averaged 38.76 percent of total population with access. This has a spread from this mean by about 26.66 percent, with the lowest improved sanitation facilities recorded as 3.88 percent in Ethiopia and the highest improved sanitation facilities recorded as 100 percent of total population with access in Libya and Seychelles. Density of physicians averaged 0.34 physicians per 1,000 population in Africa over the period under investigation. This has a spread from this mean by about 0.50 physicians, with the lowest density of physicians recorded as 0.008 physicians per 1,000 population in Tanzania and the highest density of physicians recorded as 2.83 physicians per 1,000 population in Egypt.

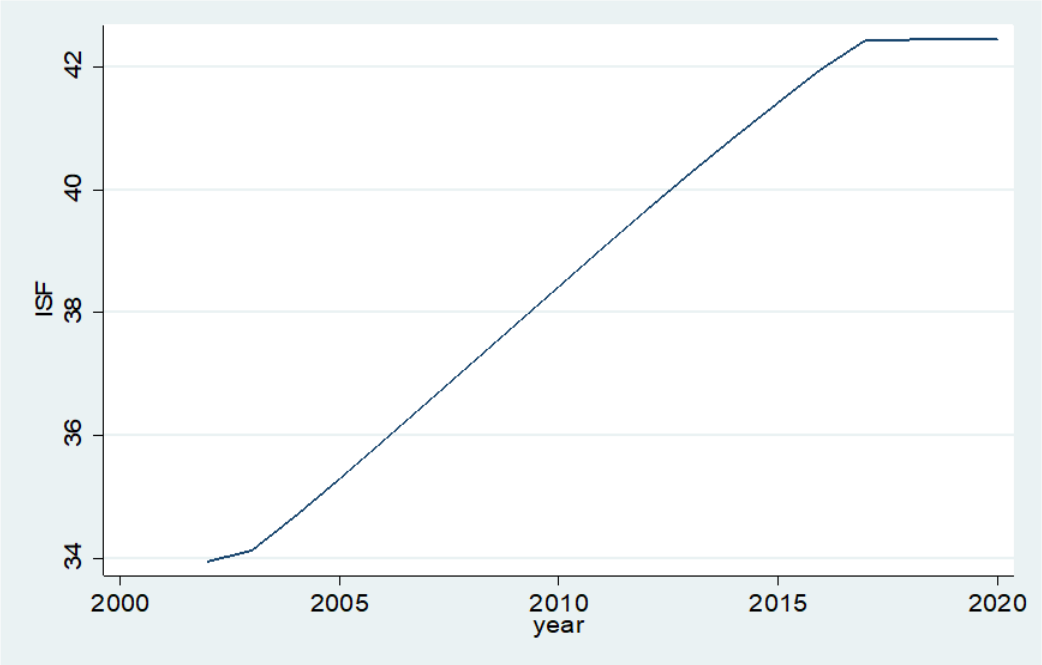
4.1.2 Trend Analysis of Health Indicators

Figure 3 presents the time plot of the average of each of the indicators measuring access to health care services in African countries. These indicators include improved sanitation facilities (% of total population with access), improved water source (% of total

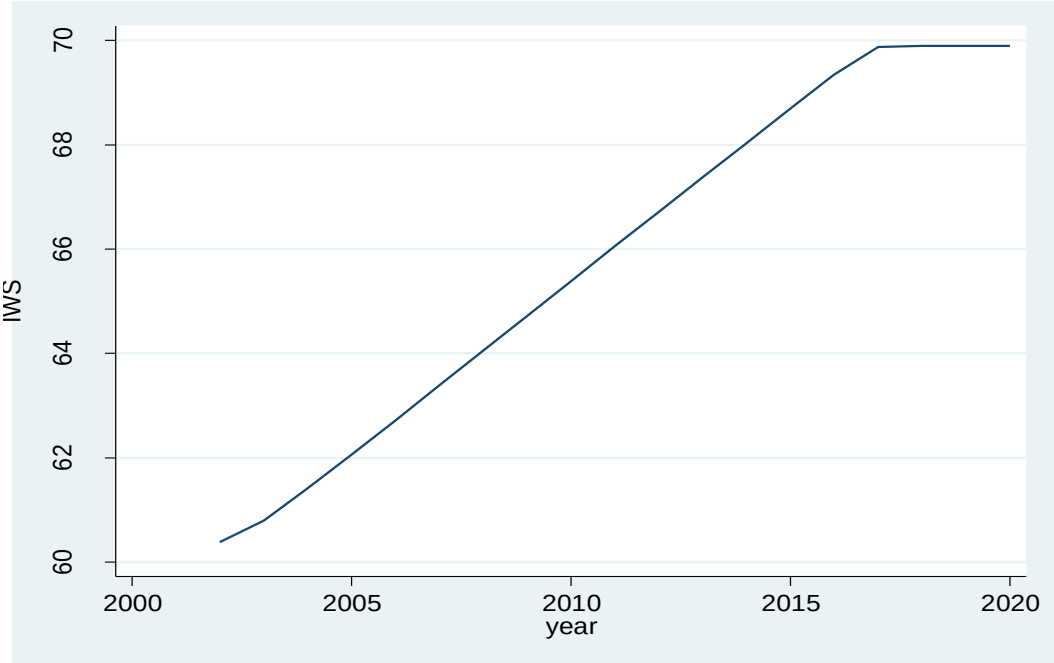
population with access) and out-of-pocket expenditures (% of total expenditure on health). The figure shows that improved sanitation facilities in African countries have been on an increase for most part of the period under investigation.

FIGURE 3: Time Plot of Access to Health Indicators

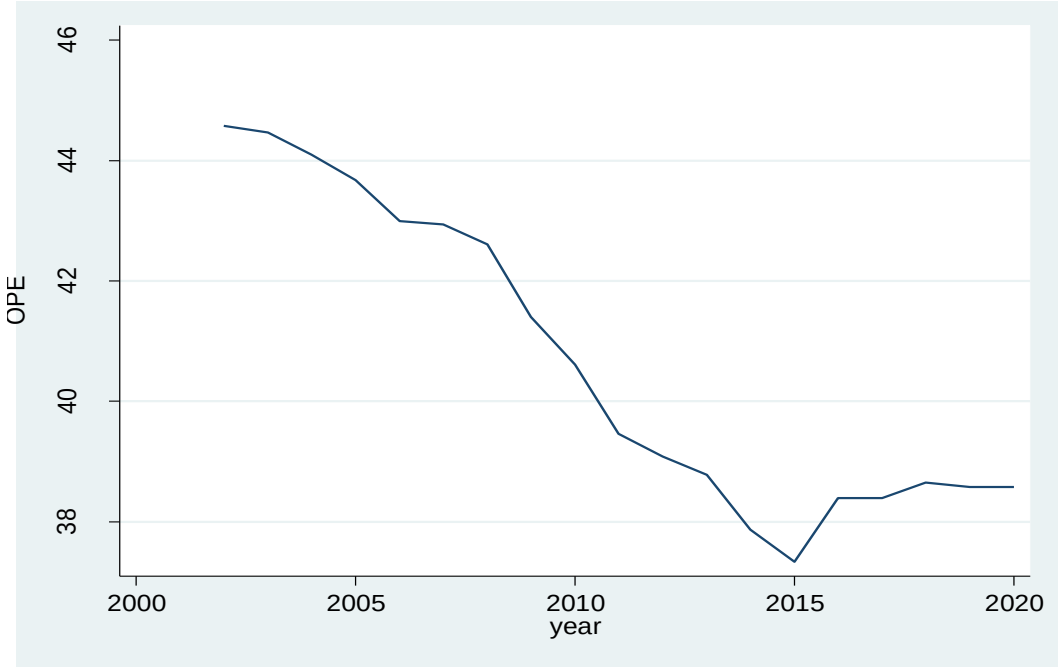
a) Improved Sanitation Facilities (% of total population with access)



b) Improved Water Source (% of total population with access)



c) Out-of-Pocket Expenditures (% of total expenditure on health)



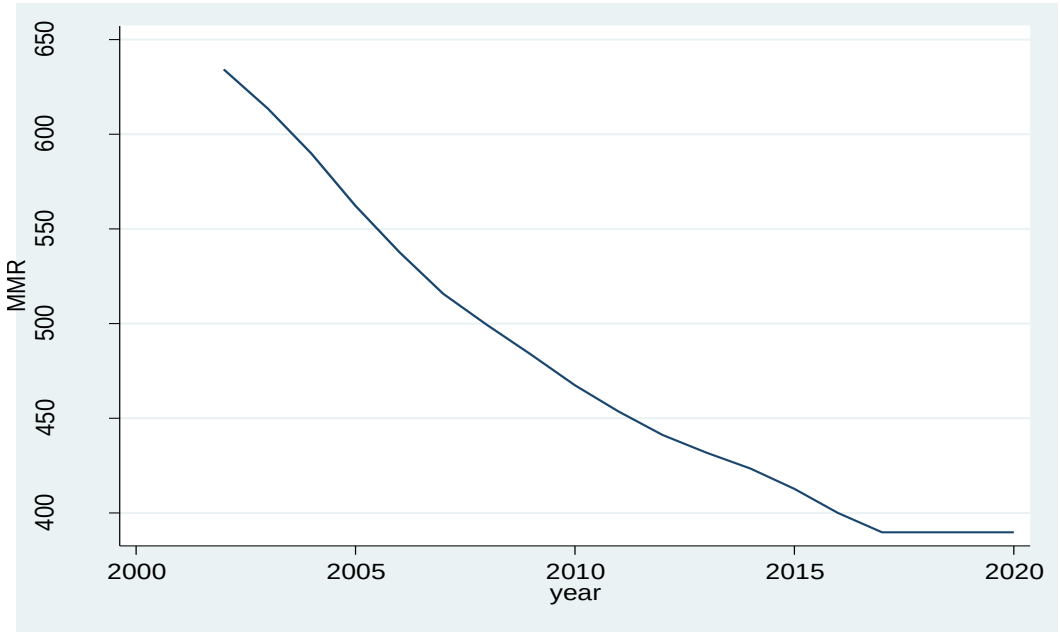
The figure 3(a) shows that the percentage of total population with access to improved sanitation facilities in African countries have been on an increase for most part of the period under investigation. Similarly, it can also be seen from the figure 3(b) that improved water source in African countries have been on an increase for most part of the period under investigation**.** As for out-of-pocket expenditures, the figure 3(c) shows that out-of-pocket expenditures has been declining consistently from the beginning of the period up until year 2015, which shows a good sign of government interventions in providing public-owned alternatives to private-owned healthcare services. However, beyond 2015, out-of-pocket expenditures started to increase steadily until the end of the period reflecting the ineffectiveness of government policies to provide public healthcare alternatives.

Figure 4 presents the time plot of the average of each of the indicators measuring the quality of health care services in African countries. These indicators include maternal mortality ratio (per 100,000 live births), incidence of tuberculosis (per 100,000 population) and life expectancy at birth (total). The figure 4(a) shows that maternal mortality ratio has been on the decline over the period under investigation. It also shows

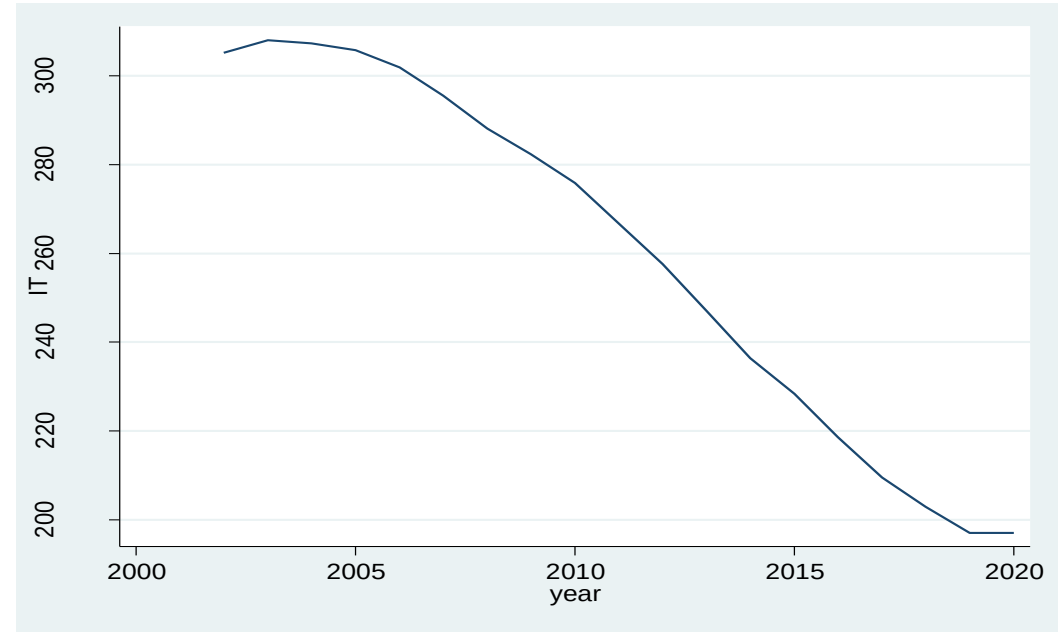
that the highest level of maternal mortality rate witnessed by an average Africa country was at the beginning of the period (year 2002) while the lowest level of maternal mortality rate witnessed by an average African country was at the end of the period (year 2020).

FIGURE 4: Time Plot of Quality of Health Indicators

a) Maternal Mortality Rate (per 100,000 live births)



b) Incidence of Tuberculosis (per 100,000 population)



A similar pattern of movement is shown also for incidence of tuberculosis among African countries. The figure 4(b) shows that incidence of tuberculosis has also been on the decline over the period under investigation. The highest incidence of tuberculosis reported for an average African country was at the beginning of the period while the lowest incidence of tuberculosis reported for an average African country was at the end of the period. Contrary to the pattern of movement seen for maternal mortality rate and incidence of tuberculosis, the figure 4(c) shows that the total life expectancy at birth has been on the rise throughout the period under investigation. It also shows that the lowest life expectancy at birth for an average African country was at the beginning of the period while the highest life expectancy at birth for an average African country was at the end of the period. These three indicators indicate that there has been improvement in the quality of health in an average African country.

c) Life Expectancy at Birth (total)

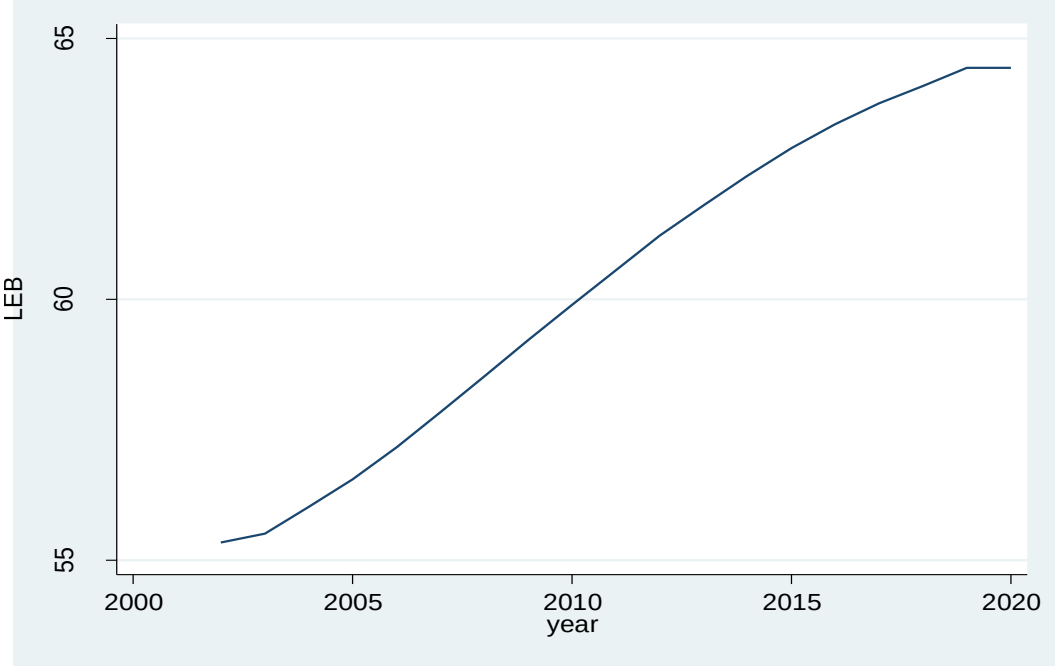
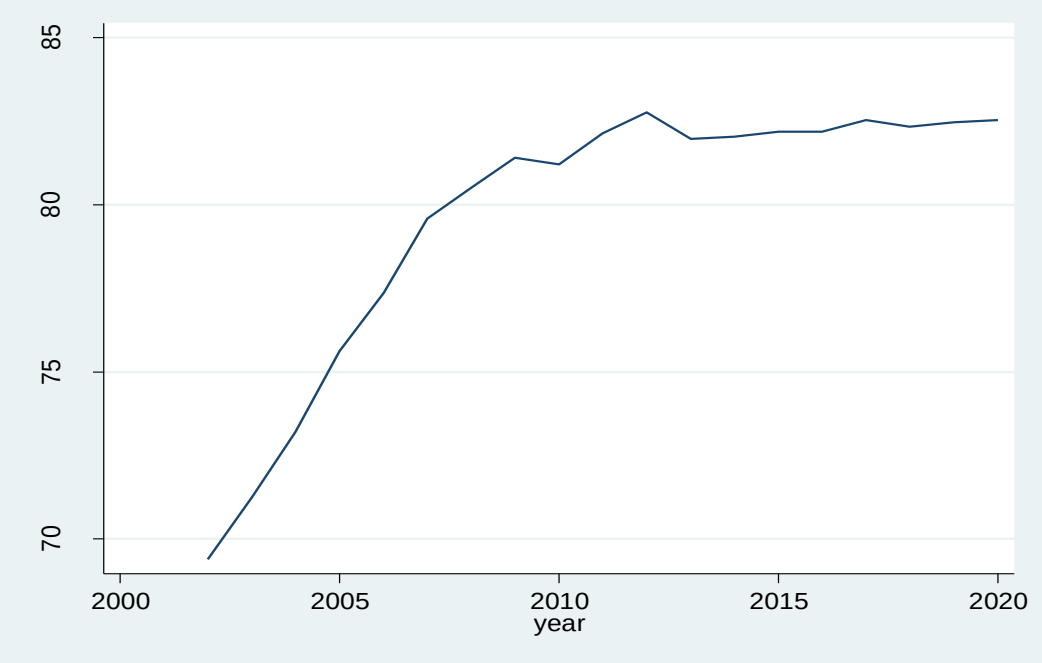


Figure 5 presents the time plot of the average of each of the indicators measuring the quantity of health care services in African countries. These indicators include immunization against Diphtheria, Pertussis and Tetanus (% of children aged 12-23 months), density of physician (per 1000 population) and government expenditure on health (% of total government expenditure). Figure 5(a) shows that immunization coverage for diphtheria, pertussis and tetanus has largely increased over the period under

investigation. Although, the most significant increase was seen at the beginning of the period up until around 2013, the increase afterwards was relatively mild and steady. The density of physician as seen in figure 5(b) also shows upward movement over the period of investigation. Although, there are some years in which the region witnessed a fall in the density of physician.

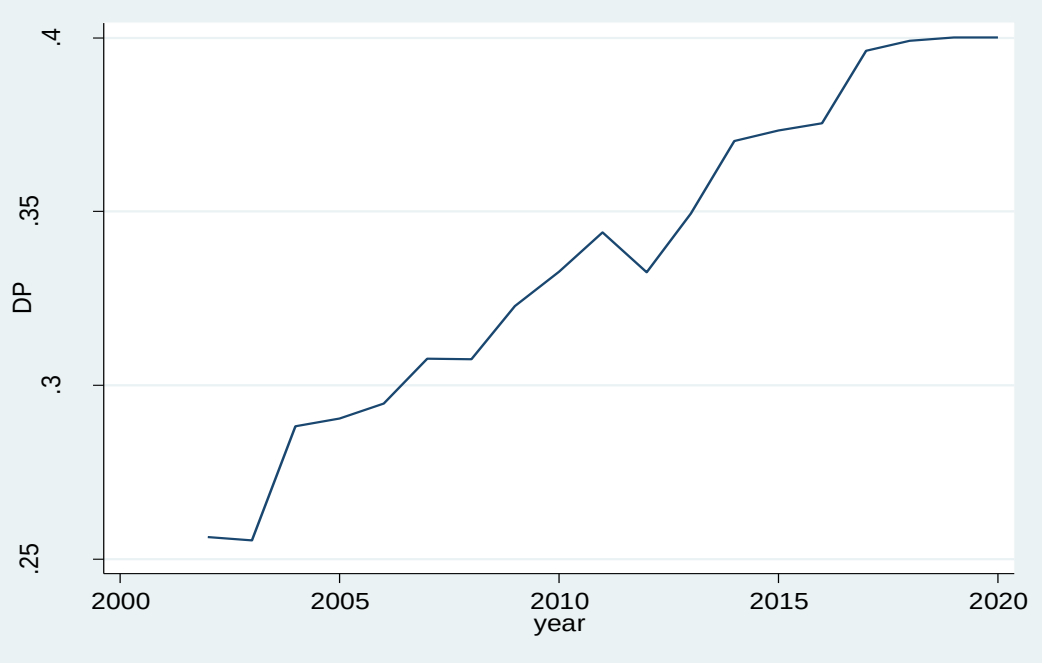
FIGURE 5: Time Plot of Quantity of Health Indicators

a) Immunization for Diphtheria, Pertussis & Tetanus (% of children 12-23 months)

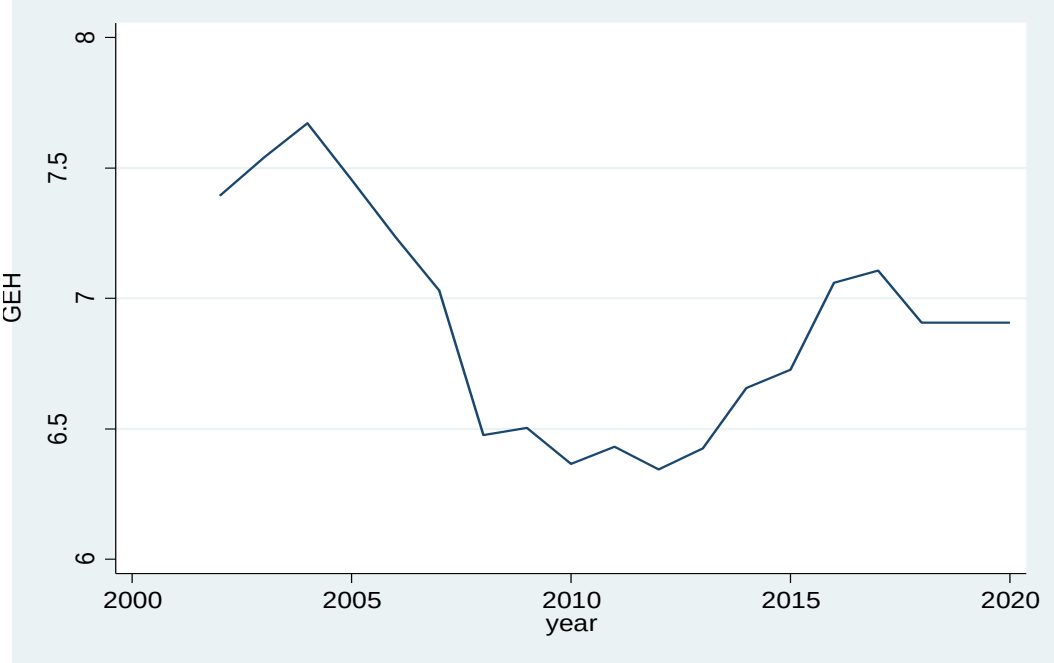


Contrary to the pattern of movement seen for immunization against diphtheria, pertussis and tetanus and density of physician, the figure 5(c) shows that government health expenditure declined for most part of the period under investigation. It also shows that government health expenditure was initially at a higher level at the beginning of the period, which dropped afterwards in 2005 and further dropped continuously until it reached its lowest in 2012. It eventually started to move upward afterwards but this upward movement was short-lived as government health expenditure declined in 2018 and continues to fall until the end of the period.

b) Density of Physicians (per 1000 population)



c) Government Expenditure on Health (% of total government expenditure)



4.1.3 Robustness of the Results (correlation between TFA and PCA)

The pairwise correlation analysis results are presented in the table 3 below to examine the relationships that exist among variables and in particular, to examine the relationship between the two indices computed from the Principal Component Analysis (PCA) and Totally Fuzzy Analysis (TFA) and verify the robustness of both indices. The results show that most of the variables have significant relationship at 5% significance level. Specifically, the relationship between IHI index from PCA and the IHI index from TFA has a correlation coefficient of approximately 0.76 which signifies a high positive relationship. This suggests that the two methodologies provide similar outcomes as regards to the index of inclusive health system.

TABLE 3: Pairwise Correlation Analysis Results

Variable	PCA	TFA	GEH	IDPT	IT	LEB	MMR	OPE	IWS	ISF	DP
PCA	1										
TFA	0.7565*	1									
GEH	0.7014*	0.4673*	1								
IDPT	0.7176*	0.5726*	0.2815*	1							
IT	0.0172	0.169*	-0.244*	0.1579*	1						
LEB	0.6126*	0.799*	0.195*	0.542*	0.4722*	1					
MMR	0.6731*	0.7669*	0.2726*	0.5169*	0.1098*	0.735*	1				
OPE	0.6829*	0.3514*	0.4927*	0.3924*	-0.3994*	0.1116*	0.3548*	1			
IWS	0.4607*	0.7995*	0.2271*	0.4527*	0.0602	0.6044*	0.6041*	0.1192*	1		
ISF	0.4984*	0.8744*	0.2246*	0.4*	0.172*	0.6798*	0.645*	0.1528*	0.7768*	1	
DP	0.4462*	0.8723*	0.221*	0.318*	0.2126*	0.6781*	0.5774*	0.0677*	0.6924*	0.7943*	1

Source: Author's computation, 2021.

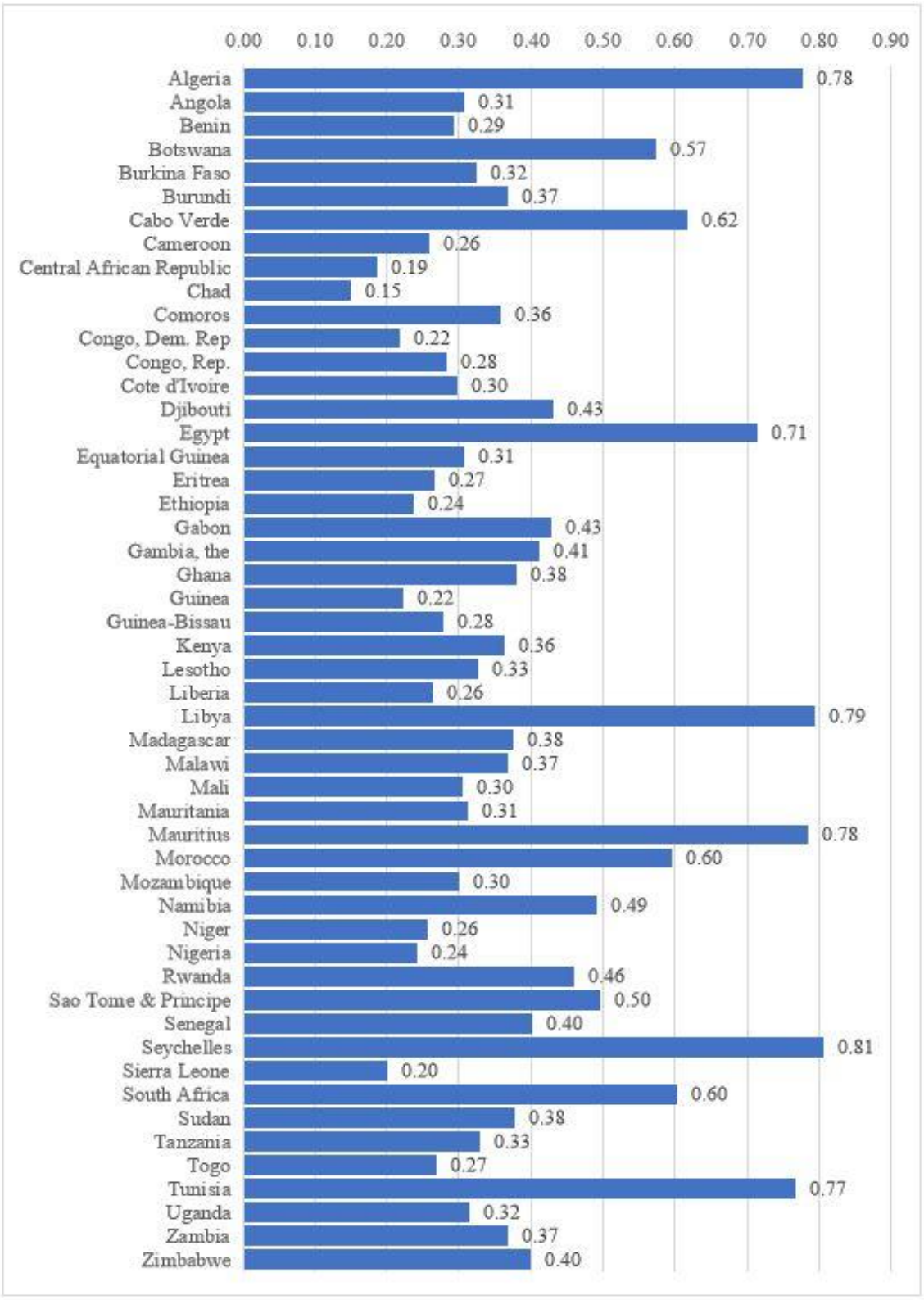
Note: *indicates significance at 5%

4.1.4 The State of Inclusive Health System in Africa (Ranking of countries according to the index)

The state of inclusive health system in Africa is depicted in figures 6 and 7 below. Figure 6 shows that countries like Algeria, Botswana, Cabo Verde, Egypt, Libya, Mauritius, Morocco, Seychelles, South Africa and Tunisia have relatively greater inclusive health systems than other countries in the continent. Given the calculated critical value of 0.4, which serves as a cut-off to classify countries as deprived or not deprived using the TFA, the figure 6 shows that 33 countries are deprived of an inclusive health system from the TFA perspective. This is because these 33 countries have inclusive health index that fall below the 0.4 critical value. This leaves 18 African countries to be classified as not deprived of inclusive health system.

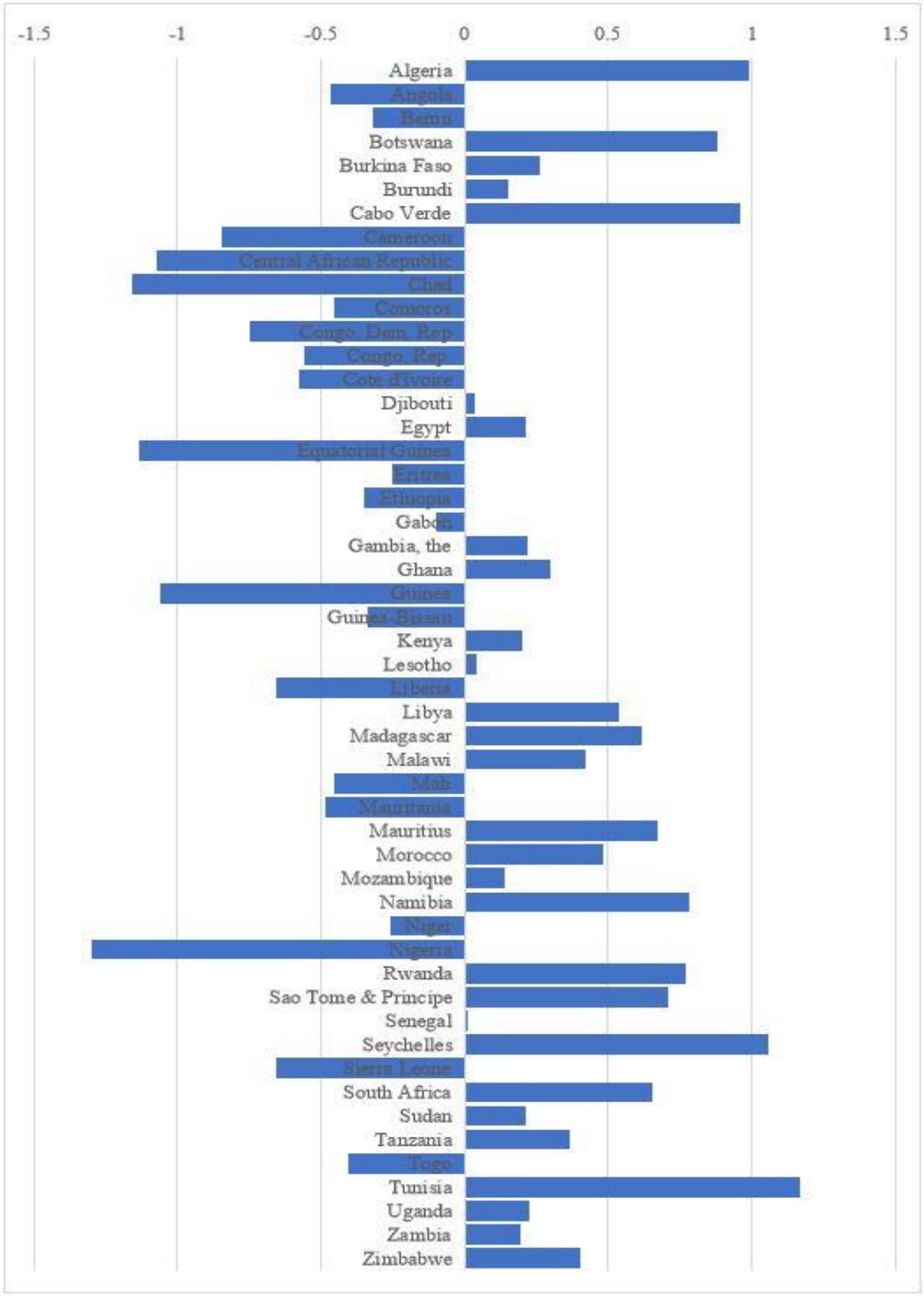
With an average of zero, figure 7 clearly shows the countries that are deprived in terms of inclusive health system from the PCA perspective and those that are not. Out of the 51 African countries employed in this study, the figure shows that 22 countries are severely deprived in terms of inclusive health system. These are countries with values less than zero. On the other hand, 29 countries are not severely deprived since they have values above zero. Among the 22 countries that are deprived of inclusive health system are Nigeria, Cameroon, Cote d'Ivoire and Equatorial Guinea. 27 of the countries that are not severely deprived have values between zero and one, making them to be classified as less deprived while only 2 countries (Seychelles and Tunisia) have active inclusive health system since they have values above 1.

FIGURE 6: The State of Inclusive Health System in Africa (TFA)



Source: Author's computation

FIGURE 7: The State of Inclusive Health System in Africa (PCA)



Source: Author's computation

Table 4 presented below identifies the top ten and bottom ten countries according to the totally fuzzy analysis estimated inclusive healthcare system index. The table revealed that all bottom ten countries except one are from the Western and Central Africa region. These includes five countries from Western Africa and four countries from Central Africa. Ethiopia is the only country from Eastern Africa in this category.

TABLE 4: Africa Top Ten and Bottom Ten Inclusive Health Index (TFA Estimate)

Top 10 Countries		
Country	Score	Region
Seychelles	0.81	Eastern Africa
Libya	0.79	Northern Africa
Mauritius	0.78	Eastern Africa
Algeria	0.78	Northern Africa
Tunisia	0.77	Northern Africa
Egypt	0.71	Northern Africa
Cabo Verde	0.62	Western Africa
South Africa	0.60	Southern Africa
Morocco	0.60	Northern Africa
Botswana	0.57	Southern Africa
Bottom 10 Countries		
Country	Score	Region
Liberia	0.26	Western Africa
Cameroon	0.26	Central Africa
Niger	0.26	Western Africa
Nigeria	0.24	Western Africa
Ethiopia	0.24	Eastern Africa
Guinea	0.22	Western Africa
Congo, Democratic Republic	0.22	Central Africa
Sierra Leone	0.20	Western Africa
Central African Republic	0.19	Central Africa
Chad	0.15	Central Africa

Source: Author's computation, 2021

The table also shows that all five Northern African countries made it to the top ten most inclusive health system in Africa, with the remaining five consisting of one Western African country (Cabo Verde), two Eastern African country (Seychelles and Mauritius) and two Southern African country (South Africa and Botswana).

TABLE 5: Africa Top Ten and Bottom Ten Inclusive Health Index (PCA Estimate)

Top 10 Countries		
Country	Score	Region
Tunisia	1.16	Northern Africa
Seychelles	1.06	Eastern Africa
Algeria	0.99	Northern Africa
Cabo Verde	0.96	Western Africa
Botswana	0.88	Southern Africa
Namibia	0.78	Southern Africa
Rwanda	0.77	Eastern Africa
Sao Tome & Principe	0.71	Central Africa
Mauritius	0.67	Southern Africa
South Africa	0.65	Southern Africa
Bottom 10 Countries		
Country	Score	Region
Cote d'Ivoire	-0.58	Western Africa
Liberia	-0.65	Western Africa
Sierra Leone	-0.66	Western Africa
Congo, Democratic Republic	-0.75	Central Africa
Cameroon	-0.85	Central Africa
Guinea	-1.06	Western Africa
Central Republic of Africa	-1.07	Central Africa
Equatorial Guinea	-1.14	Central Africa
Chad	-1.16	Central Africa
Nigeria	-1.30	Western Africa

Source: Author's computation, 2021

Table 5 presented above identifies the top ten and bottom ten countries according to the principal component analysis estimated inclusive healthcare system index. The table reveals that all bottom ten countries are from the Western and Central Africa region. These includes five countries from Western Africa (Cote d'Ivoire, Liberia, Sierra Leone, Guinea and Nigeria) and five countries from Central Africa (Democratic Republic of Congo, Cameroon, Central African Republic, Equatorial Guinea and Chad).

The table also shows that the top ten countries comprise of four countries from Southern Africa (Botswana, Namibia, Mauritius and South Africa), two countries each from Northern Africa (Tunisia and Algeria) and Eastern Africa (Seychelles and Rwanda), one country each from Western Africa (Cabo Verde) and Central Africa (Sao Tome & Principe) respectively.

4.2 Panel Data Regression Analysis

4.2.1 Summary of Descriptive Statistics (mean, standard deviation, minimum, maximum)

The summary statistics results are presented in the table 6 below. GDP per capita has a mean value of 2342.2, indicating that average per capita income obtainable among African countries for the period under investigation was US$2,342.2. This average has an overall standard deviation of US$3,216.9, between (i.e., across countries) standard deviation of US$3,000.4 and within (i.e., over periods) standard deviation of US$1,230.1. It also has an overall minimum of US$111.9, between minimum of US$221.5 and within minimum of US$-8,013.1 and overall maximum of US$22,942.6, between maximum of US$13,099.5 and within maximum of US$12,185.3.

The results also shows that human development index has a mean value of 0.519, indicating that average human development index obtainable among African countries for the period under investigation was 0.519 points. This average has an overall standard deviation of 0.116 points, between standard deviation of 0.111 points and within standard deviation of 0.038 points. It also has an overall minimum of 0.273 points, between minimum of 0.338 points and within minimum of 0.404 points and overall maximum of 0.804 points, between minimum of 0.762 points and within minimum of 0.598 points.

TABLE 6: Panel Summary Statistics of Variables employed in the Estimation

Variable		Mean	Std. Dev.	Min	Max
GDPPC	Overall	2342.2	3216.9	111.9	22,942.6
	Between		3000.4	221.5	13,099.5
	Within		1230.1	-8013.1	12,185.3
HDI	Overall	0.519	0.116	0.273	0.804
	Between		0.111	0.338	0.762
	Within		0.038	0.404	0.598
IHI (PCA)	Overall	-0.000000022	0.689	-1.787	1.543
	Between		0.639	-1.298	1.164
	Within		0.272	-0.885	1.143
IHI (TFA)	Overall	0.397	0.177	0.106	0.965
	Between		0.173	0.151	0.806
	Within		0.043	0.255	0.580
PG	Overall	2.370	0.916	-2.628	4.719
	Between		0.845	0.268	4.200
	Within		0.373	-1.272	4.852
CAP	Overall	22.86	9.242	2.000	81.05
	Between		7.208	8.420	39.81
	Within		5.868	-1.265	64.10
GEE	Overall	4.054	2.050	0.622	13.21
	Between		1.862	1.252	9.993
	Within		0.897	1.046	9.254
GEF	Overall	-0.725	0.606	-1.922	1.056
	Between		0.586	-1.613	0.817
	Within		0.175	-1.479	0.056

Source: Author's Computation, 2021

Inclusive health index computed from PCA has a mean value of -0.000000022, indicating that average health inclusiveness obtainable among African countries for the period under investigation was very low. This average has an overall standard deviation of 0.689 points, between standard deviation of 0.639 points and within standard deviation of 0.272 points. It also has an overall minimum of -1.787 points, between minimum of -1.298

points and within minimum of -0.885 points and overall maximum of 1.543 points, between minimum of 1.164 points and within minimum of 1.143 points.

The results also show that inclusive health index computed from TFA has a mean value of 0.397, indicating that average health inclusiveness obtainable among African countries for the period under investigation was 0.397 points. This average has an overall standard deviation of 0.177 points, between standard deviation of 0.173 points and within standard deviation of 0.043 points. It also has an overall minimum of 0.106 points, between minimum of 0.151 points and within minimum of 0.255 points and overall maximum of 0.965 points, between minimum of 0.806 points and within minimum of 0.580 points.

Population growth has a mean value of 2.370, indicating that average African population for the period under investigation grows by more than two percent every year. This average has an overall standard deviation of 0.916 percent, between standard deviation of 0.845 percent and within standard deviation of 0.373 percent. It also has an overall minimum of -2.628 percent, between minimum of 0.268 percent and within minimum of -1.272 percent and overall maximum of 4.719 percent, between maximum of 4.200 percent and within maximum of 4.852 percent.

Capital formation has a mean value of 22.86, indicating that capital formation in an average African country for the period under investigation was 22.86 percent of its GDP. This average has an overall standard deviation of 9.242 percent of GDP, between standard deviation of 7.208 percent of GDP and within standard deviation of 5.868 percent of GDP. It also has an overall minimum of 2.0 percent of GDP, between minimum of 8.420 percent and within minimum of -1.265 percent and overall maximum of 81.05 percent of GDP, between maximum of 39.81 percent and within maximum of 64.10 percent.

Government expenditure on education has a mean value of 4.054, indicating that government expenditure on education in an average African country for the period under investigation was 4.054 percent of its GDP. This average has an overall standard deviation of 2.050 percent of GDP, between standard deviation of 1.862 percent of GDP and within standard deviation of 0.897 percent of GDP. It also has an overall minimum of 0.622 percent of GDP, between minimum of 1.252 percent and within minimum of 1.046 percent and overall maximum of 13.21 percent of GDP, between maximum of 9.993 percent and within maximum of 9.254 percent.

Government effectiveness on education has a mean value of -0.725, indicating that government effectiveness in an average African country for the period under investigation had a negative estimate of -0.725 points, which is low. This average has an overall standard deviation of 0.606 points, between standard deviation of 0.586 points and within standard deviation of 0.175 points. It also has an overall minimum of -1.922 points, between minimum of -1.613 points and within minimum of -1.479 points and overall maximum of 1.056 points, between maximum of 0.817 percent and within maximum of 0.056 percent.

4.2.2 Panel Data Econometric Analysis (Regression result of the models)

A regression analysis was carried out to examine the impact of inclusive health system on the level of economic development in Africa, employing the pooled ordinary least squares (OLS), fixed effects and random effects methods. The impacts of inclusive health system is therefore examined on each of GDP per capita and human development index, which are the dependent variables of this study.

TABLE 7: Panel Regression Results for GDP per Capita Using PCA

Dependent Variable =	OLS			Fixed Effects			Random Effects		
GDPPC	Coefficient	t	p-value	Coefficient	t	p-value	Coefficient	z	p-value
IHI (PCA)	-615.2	-3.52	0.000	233.8	2.36	0.019	235.6	2.4	0.017
PG	-332.7	-3.08	0.002	-146.1	-2.03	0.043	-160.8	-2.27	0.023
CAP	-14.82	-1.54	0.124	16.18	3.3	0.001	15.80	3.24	0.001
GEE	73.83	1.45	0.146	131.0	4.18	0.000	133.2	4.28	0.000
GEF	1494.5	7.23	0.000	-294.3	-1.86	0.063	-223.1	-1.45	0.148
Constant	3891.4	8.72	0.000	1263.3	4.74	0.000	1346.9	3.04	0.002
R-squared	0.120			0.044			0.043		
F-statistic	24.28		0.000	7.74		0.000			
Wald Chi-squared							40.0		0.000
F-test of Homogeneity	167.6		0.000						
Hausman test				6.81		0.235			

Author's Computation, 2021

The OLS method assumes homogeneity of panel individuals while both the fixed and random effects models are alternative heterogeneous panel regression methods. While the F-test of homogeneity is used to check the appropriateness of the pooled OLS method against the heterogeneous panel methods of fixed and random effects, the Hausman specification test is used to choose the most appropriate method between the fixed and random effects methods.

TABLE 8: Panel Regression Results for GDP per capita using TFA

Dependent Variable =	OLS			Fixed Effects			Random Effects		
GDPPC	Coefficient	t	p-value	Coefficient	t	p-value	Coefficient	z	p-value
IHI (TFA)	2574.5	3.46	0.001	2629.8	4.32	0.000	2741.6	4.65	0.000
PG	-114.2	-0.96	0.335	-146.7	-2.06	0.040	-153.8	-2.19	0.028
CAP	-12.73	-1.33	0.184	16.35	3.37	0.001	15.98	3.31	0.001
GEE	76.11	1.5	0.135	126.6	4.06	0.000	127.7	4.15	0.000
GEF	665.9	3.09	0.002	-330.4	-2.1	0.036	-286.1	-1.87	0.062
Constant	1725.1	2.55	0.011	228.6	0.64	0.524	236.3	0.47	0.642
R-squared	0.120			0.058			0.091		
F-statistic	24.19		0.000	10.47		0.000			
Wald Chi-squared							56.54		0.000
F-test of Homogeneity	170.5		0.000						
Hausman test				2.51		0.774			

Source: Author's Computation, 2021.

Considering the results for the GDP per capita model, examining the choice of the most appropriate result among OLS, fixed effects and random effects models, the study employed the F-test of homogeneity and the Hausman test. The F-test of homogeneity shows statistic values of 167.6 and 170.5 for the model with PCA- and TFA-generated index of health inclusiveness respectively, with p-value of 0.000 each. This test's result indicates that the statistic is significant. With the test's null hypothesis being that there is no heterogeneity among panel members, the significant test statistic suggests rejection of such hypothesis in favour of the alternative that panel members are heterogeneous. This implies that the pooled OLS method that assumes homogeneity among panel members is

not appropriate for these models and hence, heterogeneous panel methods such as the fixed and random effects methods are preferred.

The result of the Hausman test shows a statistic value of 6.81 and 2.51 for the model with PCA and TFA respectively, with p-values of 0.235 and 0.774 respectively, which are not statistically significant. With the Hausman test's null hypothesis being that 'the difference in the coefficient of the fixed and random effects results are not systematic' (i.e., the random effects result is preferred) the test result indicates that this null hypothesis could not be rejected since the Hausman test's statistic is not significant. Therefore, the most appropriate result is that of the random effects method for both models.

In the random effects result where the PCA index of health inclusiveness was employed, the inclusive health index has a statistically significant positive coefficient (235.6 with p-value of 0.017). This indicate that inclusive health index has a significant positive impact on GDP per capita and a point increase in health inclusiveness will lead to a rise in GDP per capita by 235.6 US dollars. The result also indicates that capital formation and government expenditure on education have statistically significant positive coefficients (15.80 and 133.2 with p-values of 0.001 and 0.000 respectively) while population growth has a statistically significant negative coefficient (-160.8 with p-values of 0.023).

On one hand, this indicates that capital formation and government expenditure on education have significant positive impact on GDP per capita. A percent point increase in the share of capital formation in GDP will lead to a rise in GDP per capita by 15.80 US dollars and a percent point increase in the share of government expenditure on education will lead to a rise in GDP per capita by 133.2 US dollars. On the other hand, the result indicates that population growth has a significant negative impact on GDP per capita. A percent point increase in the growth of African population will lead to a fall in GDP per capita by 160.8 US dollars.

In the random effects result where the TFA index of health inclusiveness was employed, the inclusive health index has a statistically significant positive coefficient (2741.6 with p-value of 0.000). This indicates that inclusive health index has a significant positive impact on GDP per capita and a point increase in health inclusiveness will lead to a rise in GDP per capita by 2,741.8 US dollars. The result also indicates that capital formation and government expenditure on education have statistically significant positive

coefficients (15.98 and 127.7 with p-values of 0.001 and 0.000 respectively) while population growth and government effectiveness have statistically significant negative coefficients (-153.8 and -286.1 with p-values of 0.028 and 0.062 respectively).

On one hand, this indicates that capital formation and government expenditure on education have significant positive impact on GDP per capita. A percent point increase in the share of capital formation in GDP will lead to a rise in GDP per capita by 15.98 US dollars and a percent point increase in the share of government expenditure in GDP will lead to a rise in GDP per capita by 127.7 US dollars. On the other hand, the result indicates that population growth and government effectiveness have significant negative impact on GDP per capita. A percent point increase in the growth of African population will lead to a fall in GDP per capita by 153.8 US dollars and a point increase in the government effectiveness will lead to a fall in GDP per capita by 286.1 US dollars.

TABLE 9: Panel Regression Results for HDI using PCA

Dependent Variable =	OLS			Fixed Effects			Random Effects		
HDI	Coefficient	t	p-value	Coefficient	t	p-value	Coefficient	z	p-value
IHI (PCA)	0.054	9.25	0.000	0.011	2.39	0.017	0.016	3.47	0.001
GEE	-0.001	-0.57	0.568	0.006	4.54	0.000	0.007	4.9	0.000
GEF	0.080	11.88	0.000	-0.014	-1.95	0.051	-0.0001	-0.01	0.989
Constant	0.570	57.26	0.000	0.476	57.19	0.000	0.484	34.75	0.000
R-squared	0.437			0.031			0.333		
F-statistic	235.27		0.000	9.27		0.000			
Wald Chi-squared							37.88		0.000
F-test of Homogeneity	75.57		0.000						
Hausman test				38.18		0.000			

Source: Author's Computation, 2021.

For the HDI model, examining the choice of the most appropriate result among these three results, the study employed the F-test of homogeneity and the Hausman test. The F-

test of homogeneity shows statistic values of 75.57 and 34.93 for the model with PCA- and TFA-generated index of health inclusiveness respectively, with p-value of 0.000 each. This test's result indicates that the statistic is significant. With the test's null hypothesis being that there is no heterogeneity among panel members, the significant test statistic suggests rejection of such hypothesis in favour of the alternative that panel members are heterogeneous. This implies that the pooled OLS method that assumes homogeneity among panel members is not appropriate for these models and hence, heterogeneous panel methods such as the fixed and random effects methods are preferred.

The result of the Hausman test shows a statistic value of 38.18 and 58.03 for the model with PCA and TFA respectively, with p-value of 0.000 each, which are statistically significant. With the Hausman test's null hypothesis being that 'the difference in the coefficient of the fixed and random effects results are not systematic' (i.e., the random effects result is preferred) the test result indicates that this null hypothesis is rejected since the Hausman test's statistic is significant. Therefore, the most appropriate result is that of the fixed effects method for both models.

In the fixed effects result where the PCA index of health inclusiveness was employed, the inclusive health index has a statistically significant positive coefficient (0.011 with p-value of 0.017). This indicates that inclusive health index has a significant positive impact on HDI and a point increase in health inclusiveness will lead to a rise in HDI by 0.011 points. The result also indicates that government expenditure on education has a statistically significant positive coefficient (0.006 with p-value of 0.000 respectively) while government effectiveness has a statistically significant negative coefficient (-0.014 with p-value of 0.051).

On one hand, this indicates that government expenditure on education has a significant positive impact on HDI. A percent point increase in the share of government expenditure in GDP will lead to a rise in HDI by 0.006 points. On the other hand, the result indicates that government effectiveness has a significant negative impact on HDI. A point increase in government effectiveness index will lead to a fall in HDI by 0.014 points.

In the fixed effects result where the TFA index of health inclusiveness was employed, the inclusive health index has a statistically significant positive coefficient (0.172 with p-value of 0.000). This indicate that inclusive health index has a significant positive impact

on HDI and a point increase in health inclusiveness will lead to a rise in HDI by 0.172 points. The result also indicates that government expenditure on education has a statistically significant positive coefficient (0.006 with p-value of 0.000 respectively) while government effectiveness has a statistically significant negative coefficient (-0.018 with p-value of 0.016).

On one hand, this indicates that government expenditure on education has a significant positive impact on HDI. A percent point increase in the share of government expenditure in GDP will lead to a rise in HDI by 0.006 points. On the other hand, the result indicates that government effectiveness has a significant negative impact on HDI. A point increase in government effectiveness index will lead to a fall in HDI by 0.018 points.

TABLE 10: Panel Regression Results for HDI using TFA

Dependent Variable =	OLS			Fixed Effects			Random Effects		
HDI	Coefficient	t	p-value	Coefficient	t	p-value	Coefficient	z	p-value
IHI (TFA)	0.514	30.05	0.000	0.172	5.93	0.000	0.281	10.82	0.000
GEE	0.001	1.23	0.219	0.006	4.56	0.000	0.006	4.87	0.000
GEF	0.012	2.42	0.016	-0.018	-2.41	0.016	-0.001	-0.25	0.802
Constant	0.313	26.91	0.000	0.406	28	0.000	0.373	23.7	0.000
R-squared	0.691			0.690			0.764		
F-statistic	677.95		0.000	19.32		0.000			
Wald Chi-squared							160.95		0.000
F-test of Homogeneity	34.93		0.000						
Hausman test				58.03		0.000			

Source: Author's Computation, 2021.

4.3 Overall Significance of the Model (R^2 and F-statistics)

The reported R-squared values for the GDP per capita random effects model in which PCA and TFA were employed respectively indicate that only about 4.3 percent and 9.1 percent of variations in GDP per capita are explained by the models respectively. The

reported Wald Chi-squared statistics of 40.0 and 56.54 for the model with PCA and TFA respectively, with p-values of 0.000 each indicate that the statistics are significant and hence, the overall models are statistically significant and in good fit.

As for the HDI models, the reported R-squared values for the fixed effects model in which PCA and TFA were employed respectively indicate that only about 3.1 percent and 69.0 percent of variations in human development are explained by the models respectively. The reported F-statistic values of 9.27 and 19.32 for the model with PCA and TFA respectively, with p-value of 0.000 each indicate that the statistics are significant and hence, the overall models are statistically significant and in good fit.

4.4 Findings and Discussions

From both the descriptive and inferential analysis presented in this study, the findings and discussions that emerged are presented here. The findings of this study from the descriptive analysis revealed that the most inclusive health systems are found in Northern African countries while the most deprived countries in terms of health system inclusiveness are found in the Western and Central African regions. This is not surprising as most of the Northern African countries were consistent in terms of the immunization against diphtheria, pertussis and tetanus while their counterparts in other regions, particularly those in the Western and Central African regions lagged behind.

The findings also revealed that inclusive health system led to greater improvement in economic wellbeing, specifically, increase in income per capita, using both the PCA and the TFA methodologies. This implies that an inclusive health system provides the required quality of health services for a reasonable proportion of the population thereby improving their health status and in turn, their productivity which consequently leads to an improvement in economic wellbeing through increase in income. This finding conforms to the a priori expectation of this study and is strongly corroborated by the findings of Weil (2005), Bloom *et al.* (2004) and Audrey and Karagueuzian (2016).

The findings of this study also revealed that inclusive health system led to greater improvement in human development, using both the PCA and the TFA methodologies. This implies that an inclusive health system guarantees quality health services required to promote a healthy society and improve human development. This finding conforms to

the a priori expectation of this study and is strongly corroborated by the findings of Elvis (2014) and Masaeli *et al.* (2013).

CONCLUSION

This study examines the nexus between inclusive healthcare system and economic development in Africa. The data set includes a total of 51 African countries from the period 2002 to 2020. The specific objectives of this study are: to compute an index of inclusive healthcare system, to empirically investigate the state of inclusive healthcare system across countries in Africa and to find the relationship between inclusive healthcare system, and economic development in Africa.

In order to achieve the objectives of the study, an inclusive health system index is computed using principal component analysis and totally fuzzy analysis. This index comprises of nine health indicators measuring the access to health system, quantity and quality of health system. Based on totally fuzzy analysis, about 65% of countries in Africa are deprived in terms of inclusive health system (countries with values below the critical value of 0.4). According to the inclusive health system index by principal component analysis, it is observed that 22 countries in Africa are deprived in terms of inclusive health system (countries with values below zero), 27 countries are less deprived (countries with values between zero and one) while just 2 countries (Seychelles and Tunisia) have active inclusive health system (countries with values above one).

To investigate the relationship between inclusive healthcare system and economic development in Africa, two models were specified with GDP per capita and human development index alternatively measuring the level of economic development. Independent variables include inclusive health system index and control variables (population growth, capital formation, government expenditure on health and government expenditure).

For the GDP per capita model using IHI index from PCA and TFA respectively, in order to choose between fixed effects and random effects method of estimation, the Hausman test is utilized. The Hausman test was statistically insignificant. This statistically implies that the most appropriate result is that of the random effects method. In the random effects model result for the model where the PCA index was employed, inclusive health index has a statistically significant positive coefficient (235.6 with p-value of 0.017). This indicate that inclusive health index has significant impact on GDP per capita in the random effects result. Its significance indicates that a point increase in health

inclusiveness will lead to a rise in the GDP per capita of African countries by 235.6 US dollars. The result also indicates that capital formation and government expenditure on education have statistically significant positive coefficients (15.80 and 133.2 with p-values of 0.001 and 0.000 respectively) while population growth has a statistically significant negative coefficient (160.8 with p-values of 0.023).

Similarly, in the random effects model result for the model where the TFA index was employed, inclusive health index has a statistically significant positive coefficient (2741.6 with p-value of 0.000). This indicate that inclusive health index has significant impact on GDP per capita in the random effects result. Its significance indicates that a point increase in health inclusiveness will lead to a rise in the GDP per capita of African countries by 2741.6 US dollars. The result also indicates that capital formation and government expenditure on education have statistically significant positive coefficients (15.98 and 127.7 with p-values of 0.001 and 0.000 respectively) while population growth and government effectiveness have statistically significant negative coefficients (153.8 and 286.1 with p-values of 0.028 and 0.062 respectively).

For the human development index model using IHI index from PCA and TFA respectively, the Hausman test is statistically significant. This statistically implies that the most appropriate result is that of the fixed effects method. In the fixed effects model result for the model where the PCA index was employed, inclusive health index has a statistically significant positive coefficient (0.011 with p-value of 0.017). This indicates that inclusive health index has significant impact on human development in the fixed effects result. Its significance indicates that a point increase in health inclusiveness will lead to a rise in the human development index of African countries by 0.011 points. The result also indicates that government expenditure on education has a statistically significant positive coefficient (0.006 with p-value of 0.000 respectively) while government effectiveness has a statistically significant negative coefficient (-0.014 with p-value of 0.051).

In the same vein, in the fixed effects model result for the model where the TFA index was employed, inclusive health index has a statistically significant positive coefficient (0.172 with p-value of 0.000). This indicates that inclusive health index has significant impact on human development in the fixed effects result. Its significance indicates that a

point increase in health inclusiveness will lead to a rise in the human development index of African countries by 0.172 points. The result also indicates that government expenditure on education has a statistically significant positive coefficient (0.172 with p-value of 0.000 respectively) while government effectiveness has a statistically significant negative coefficient (-0.018 with p-value of 0.016).

The reported R-squared values for the GDP per capita random effects model in which PCA and TFA were employed respectively indicate that only about 4.4 percent and 9.1 percent of variations in GDP per capita are explained by the models respectively. As for the HDI models, the reported R-squared values for the fixed effects model in which PCA and TFA were employed respectively indicate that only about 3.1 percent and 69.0 percent of variations in human development are explained by the models respectively. The overall significance of the models as measured by F-Statistics and Wald Chi-squared statistics indicate that the overall models are statistically significant and in good fit.

From the findings of this study, it can be concluded that lack of consistent attention given to immunization against diphtheria, pertussis and tetanus in children is one of the factors responsible for the poor performance of countries in terms of their health system inclusiveness. It can also be concluded that the neglect of basic facilities to ensure that children are well immunized is mostly responsible for the deprived state of most Western and Central African countries in terms of inclusive health system. This study also concludes that an inclusive health system is important to boost the economic wellbeing of African countries as much as it is vital to human development. In addition, capital formation and government expenditure are vital to improving economic wellbeing while population growth and government effectiveness are factors hindering economic wellbeing. Also, government expenditure on education is vital to improving human development.

From the findings and conclusion of this study, the following recommendations are considered relevant in order to improve the state of African countries in terms of inclusive health care, income per capita and human development.

i. It is recommended that African leaders should pay continuous attention to ensuring children are adequately immunized against diseases that may pose threat to their lives and distort the flow of economic activities of their families. This can

be effectively carried out by setting targets for regional and local governments to meet in terms of the proportion of children to be covered with immunization.

ii. Government of African countries, particularly those in Western and Central Africa should be more vigilant to the factors that might be responsible for their poor performance in achieving inclusive health system which may include the lack of monitoring in ensuring the public health expenditure are effectively and judiciously utilized at the appropriate space and time in order to guarantee improved level of health inclusiveness which is necessary for improved economic wellbeing and human development.

iii. African leaders should pay more attention to the prevailing health sector-related policies in order to ensure that they are not anti-inclusive by being available to a top few in the society and unavailable to the bottom majority. This is necessary to remove the roadblocks in the way to achieving a more inclusive health system which is a requirement for improved economic wellbeing and human development.

iv. Government should invest in health-related infrastructures. This is highly hinged on the presumption that the development of health infrastructures, most particularly in rural areas is crucial to enable better access to health services for the lower income class. Government can partner with the private sector to meet the financial requirement of health infrastructural development.

Based on the fore going, for any effort in improving the level of economic development in Africa to yield reasonable effect, conscious, deliberate and consistent effort must be made towards improving the quantity, quality and accessibility of healthcare in the continent.

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APPENDICES

APPENDIX 1

Eigen Value of The Correlation Matrix

Principal components/correlation — Number of obs = 969
Number of comp. = 9
Trace = 9
Rotation: (unrotated = principal) — Rho = 1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.28154	2.45996	0.4757	0.4757
Comp2	1.82158	.900618	0.2024	0.6781
Comp3	.920959	.299054	0.1023	0.7805
Comp4	.621906	.155386	0.0691	0.8496
Comp5	.46652	.134805	0.0518	0.9014
Comp6	.331715	.0980616	0.0369	0.9382
Comp7	.233653	.0597645	0.0260	0.9642
Comp8	.173889	.0256484	0.0193	0.9835
Comp9	.14824	.	0.0165	1.0000

Corresponding Eigenvectors

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Unexplained
geh	0.1831	0.4804	0.0201	0.8084	-0.1622	-0.2144	0.0387	-0.0764	0.0461	0
idpt	0.3166	0.1402	0.5626	-0.2822	-0.5961	0.0369	-0.3133	-0.1609	0.0569	0
it	0.1118	-0.5660	0.4891	0.3418	0.0745	0.2390	0.3700	0.0136	0.3338	0
leb	0.4174	-0.1925	0.2262	0.0979	0.2367	-0.1512	-0.1067	0.3085	-0.7365	0
mmr	0.4045	0.0657	0.0920	-0.2195	0.5029	-0.5585	-0.0486	-0.1898	0.4150	0
ope	0.1519	0.5996	0.2303	-0.1818	0.3495	0.5270	0.2908	0.2149	0.0281	0
iws	0.3985	-0.0370	-0.3383	-0.1806	-0.4195	-0.1823	0.5056	0.4595	0.1294	0
isf	0.4204	-0.0857	-0.3121	-0.0308	-0.0174	0.2840	0.2464	-0.7198	-0.2404	0
dp	0.3966	-0.1403	-0.3456	0.1602	0.0737	0.4113	-0.5906	0.2477	0.3052	0

Model 1: GDPPC

Estimate 1: PCA

Pooled Regression

Source	SS	df	MS		
				Number of obs	= 893
				F(5, 887)	= 24.28
Model	744463792	5	148892758	Prob > F	= 0.0000
Residual	5.4387e+09	887	6131612.83	R-squared	= 0.1204
				Adj R-squared	= 0.1154
Total	6.1832e+09	892	6931843.46	Root MSE	= 2476.2

gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ihi	-615.2664	174.6422	-3.52	0.000	-958.0266	-272.5063
pg	-332.7265	108.0193	-3.08	0.002	-544.7296	-120.7233
cap	-14.82041	9.617079	-1.54	0.124	-33.69529	4.054477
gee	73.838	50.79559	1.45	0.146	-25.85556	173.5316
gef	1494.558	206.7061	7.23	0.000	1088.868	1900.248
_cons	3891.477	446.1161	8.72	0.000	3015.911	4767.043

Fixed Effect

Fixed-effects (within) regression — Number of obs = 893
Group variable: contryid — Number of groups = 47

R-sq:
within = 0.0440
between = 0.0223
overall = 0.0242

Obs per group:
min = 19
avg = 19.0
max = 19

F(5,841) = 7.74
corr(u_i, Xb) = 0.0116 — Prob > F = 0.0000

gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ihi	233.8902	99.26117	2.36	0.019	39.06148	428.7189
pg	-146.1187	71.93584	-2.03	0.043	-287.3136	-4.923881
cap	16.18152	4.897733	3.30	0.001	6.568309	25.79474
gee	131.046	31.38767	4.18	0.000	69.4386	192.6533
gef	-294.3391	158.3694	-1.86	0.063	-605.1848	16.50662
_cons	1263.341	266.5569	4.74	0.000	740.1466	1786.536
sigma_u	2508.4027					
sigma_e	797.48759					
rho	.9082015	(fraction of variance due to u_i)				

F test that all u_i=0: F(46, 841) = 167.62 — Prob > F = 0.0000

Random Effect

```
Random-effects GLS regression                   Number of obs     =         893
Group variable: contryid                        Number of groups  =          47

R-sq:                                           Obs per group:
     within  = 0.0437                                         min =          19
     between = 0.0336                                         avg =        19.0
     overall = 0.0344                                         max =          19

                                                Wald chi2(5)      =       40.00
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000
```

gdppc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ihi	235.6992	98.32684	2.40	0.017	42.98213	428.4162
pg	-160.8888	70.89094	-2.27	0.023	-299.8325	-21.94512
cap	15.80703	4.882223	3.24	0.001	6.238049	25.37601
gee	133.213	31.09014	4.28	0.000	72.27746	194.1486
gef	-223.0766	154.294	-1.45	0.148	-525.4873	79.33407
_cons	1346.969	443.7912	3.04	0.002	477.1541	2216.783
sigma_u	2446.4886					
sigma_e	797.48759					
rho	.9039483	(fraction of variance due to u_i)				

Hausman Effect

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
ihi	233.8902	235.6992	-1.809003	14.31259
pg	-146.1187	-160.8888	14.77007	12.64392
cap	16.18152	15.80703	.374493	.4482802
gee	131.046	133.213	-2.167045	4.540128
gef	-294.3391	-223.0766	-71.2625	36.4109

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

  Test:  Ho:  difference in coefficients not systematic

              chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =         6.81
            Prob>chi2 =       0.2353
```

Estimate 2: TFA

Pooled Regression

Source	SS	df	MS		
				Number of obs	= 893
				F(5, 887)	= 24.19
Model	741865536	5	148373107	Prob > F	= 0.0000
Residual	5.4413e+09	887	6134542.09	R-squared	= 0.1200
				Adj R-squared	= 0.1150
Total	6.1832e+09	892	6931843.46	Root MSE	= 2476.8

gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
tfa	2574.57	743.7681	3.46	0.001	1114.819	4034.32
pg	-114.2974	118.5358	-0.96	0.335	-346.9407	118.346
cap	-12.73888	9.588238	-1.33	0.184	-31.55716	6.079395
gee	76.11737	50.90079	1.50	0.135	-23.78266	176.0174
gef	665.9872	215.7289	3.09	0.002	242.5885	1089.386
_cons	1725.116	676.3749	2.55	0.011	397.6343	3052.598

Fixed Effect

Fixed-effects (within) regression — Number of obs = 893
Group variable: contryid — Number of groups = 47

R-sq:
within = 0.0586
between = 0.0865
overall = 0.0835

Obs per group:
min = 19
avg = 19.0
max = 19

F(5,841) = 10.47
corr(u_i, Xb) = 0.0705 — Prob > F = 0.0000

gdppc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
tfa	2629.837	608.6406	4.32	0.000	1435.204	3824.47
pg	-146.7187	71.34488	-2.06	0.040	-286.7536	-6.683732
cap	16.35971	4.86047	3.37	0.001	6.819635	25.89979
gee	126.6618	31.16938	4.06	0.000	65.4829	187.8407
gef	-330.4305	157.2743	-2.10	0.036	-639.1267	-21.73419
_cons	228.6859	358.8837	0.64	0.524	-475.727	933.0988
sigma_u	2431.1413					
sigma_e	791.37989					
rho	.90419031	(fraction of variance due to u_i)				

F test that all u_i=0: F(46, 841) = 170.59 — Prob > F = 0.0000

Random Effect

```
Random-effects GLS regression                   Number of obs     =         893
Group variable: contryid                        Number of groups  =          47

R-sq:                                           Obs per group:
     within  = 0.0585                                         min =          19
     between = 0.0917                                         avg =        19.0
     overall = 0.0883                                         max =          19

                                                Wald chi2(5)      =       56.54
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000
```

gdppc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
tfa	2741.684	589.1242	4.65	0.000	1587.022	3896.346
pg	-153.8866	70.19856	-2.19	0.028	-291.4733	-16.29994
cap	15.98474	4.834167	3.31	0.001	6.509943	25.45953
gee	127.7596	30.82153	4.15	0.000	67.35052	188.1687
gef	-286.14	153.422	-1.87	0.062	-586.8417	14.56162
_cons	236.3496	508.1739	0.47	0.642	-759.653	1232.352
sigma_u	2488.8555					
sigma_e	791.37989					
rho	.90817898	(fraction of variance due to u_i)				

Hausman Effect

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
tfa	2629.837	2741.684	-111.847	149.4475
pg	-146.7187	-153.8866	7.167943	12.16313
cap	16.35971	15.98474	.3749735	.4342456
gee	126.6618	127.7596	-1.097796	4.339574
gef	-330.4305	-286.14	-44.29041	33.57594

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

  Test:  Ho:  difference in coefficients not systematic

              chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =        2.51
            Prob>chi2 =      0.7745
```

Model 2: HDI

Estimate 1: PCA

Pooled Regression

Source	SS	df	MS		
				Number of obs	= 912
				F(3, 908)	= 235.27
Model	5.21412323	3	1.73804108	Prob > F	= 0.0000
Residual	6.70791231	908	.007387569	R-squared	= 0.4374
				Adj R-squared	= 0.4355
Total	11.9220355	911	.013086757	Root MSE	= .08595

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ihi	.0541949	.0058586	9.25	0.000	.042697	.0656928
gee	-.0009554	.0016717	-0.57	0.568	-.0042363	.0023255
gef	.0802935	.0067599	11.88	0.000	.0670267	.0935603
_cons	.5704313	.0099621	57.26	0.000	.5508798	.5899828

Fixed Effect

Fixed-effects (within) regression — Number of obs = 912
Group variable: contryid — Number of groups = 48

R-sq:
within = 0.0313
between = 0.0802
overall = 0.0683

Obs per group:
min = 19
avg = 19.0
max = 19

F(3,861) = 9.27
corr(u_i, Xb) = 0.1533 — Prob > F = 0.0000

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ihi	.0114607	.0047908	2.39	0.017	.0020578	.0208636
gee	.0065677	.0014455	4.54	0.000	.0037306	.0094049
gef	-.0148347	.0075961	-1.95	0.051	-.0297437	.0000743
_cons	.4760778	.0083247	57.19	0.000	.4597388	.4924169
sigma_u	.10600581					
sigma_e	.03898953					
rho	.88083925	(fraction of variance due to u_i)				

F test that all u_i=0: F(47, 861) = 75.57 — Prob > F = 0.0000

Random Effect

```
Random-effects GLS regression                   Number of obs     =         912
Group variable: contryid                        Number of groups  =          48

R-sq:                                           Obs per group:
     within  = 0.0264                                         min =          19
     between = 0.3333                                         avg =        19.0
     overall = 0.2778                                         max =          19

                                                Wald chi2(3)      =       37.88
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000
```

hdi	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ihi	.0165355	.0047704	3.47	0.001	.0071857	.0258854
gee	.0070578	.0014408	4.90	0.000	.0042339	.0098816
gef	-.000098	.0073017	-0.01	0.989	-.0144091	.0142131
_cons	.4840429	.0139278	34.75	0.000	.456745	.5113408
sigma_u	.07586563					
sigma_e	.03898953					
rho	.79106245	(fraction of variance due to u_i)				

Hausman Effect

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
ihi	.0114607	.0165355	-.0050748	.0010597
gee	.0065677	.0070578	-.00049	.0003134
gef	-.0148347	-.000098	-.0147367	.0025922

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

Test:  Ho:  difference in coefficients not systematic

          chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =       38.18
        Prob>chi2 =      0.0000
```

Estimate 2: TFA

Pooled Effect

Source	SS	df	MS	Number of obs	=	912
				F(3, 908)	=	677.95
Model	8.24229755	3	2.74743252	Prob > F	=	0.0000
Residual	3.67973799	908	.004052575	R-squared	=	0.6913
				Adj R-squared	=	0.6903
Total	11.9220355	911	.013086757	Root MSE	=	.06366

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
tfa	.5147849	.0171289	30.05	0.000	.481168	.5484017
gee	.0015059	.0012236	1.23	0.219	-.0008955	.0039073
gef	.0129958	.0053721	2.42	0.016	.0024525	.023539
_cons	.313344	.0116429	26.91	0.000	.2904938	.3361942

Fixed Effect

Fixed-effects (within) regression — Number of obs = 912
Group variable: contryid — Number of groups = 48

R-sq:
within = 0.0631
between = 0.6901
overall = 0.5873

Obs per group:
min = 19
avg = 19.0
max = 19

F(3,861) = 19.32
corr(u_i, Xb) = 0.6776 — Prob > F = 0.0000

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
tfa	.1723931	.0290893	5.93	0.000	.1152989	.2294874
gee	.0064756	.0014216	4.56	0.000	.0036855	.0092658
gef	-.0180068	.0074753	-2.41	0.016	-.0326788	-.0033348
_cons	.4067759	.0145303	28.00	0.000	.378257	.4352948
sigma_u	.08698407					
sigma_e	.03834464					
rho	.8372927	(fraction of variance due to u_i)				

F test that all u_i=0: F(47, 861) = 34.93 — Prob > F = 0.0000

Random Effect

```
Random-effects GLS regression                   Number of obs     =         912
Group variable: contryid                        Number of groups  =          48

R-sq:                                           Obs per group:
     within  = 0.0554                                         min =          19
     between = 0.7646                                         avg =        19.0
     overall = 0.6663                                         max =          19

                                                Wald chi2(3)      =      160.95
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000
```

hdi	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
tfa	.2818346	.026058	10.82	0.000	.230762	.3329073
gee	.0068142	.0013988	4.87	0.000	.0040725	.0095558
gef	-.0017451	.0069671	-0.25	0.802	-.0154003	.0119101
_cons	.3734737	.015756	23.70	0.000	.3425924	.404355
sigma_u	.0496039					
sigma_e	.03834464					
rho	.62595674	(fraction of variance due to u_i)				

Hausman Effect

	Coefficients			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
tfa	.1723931	.2818346	-.1094415	.0148982
gee	.0064756	.0068142	-.0003385	.0004415
gef	-.0180068	-.0017451	-.0162617	.0033104

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

Test:  Ho:  difference in coefficients not systematic

          chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =       58.03
        Prob>chi2 =      0.0000
```

APPENDIX 2

List of Countries

S/N	COUNTRY
1	Algeria
2	Angola
3	Benin
4	Botswana
5	Burkina Faso
6	Burundi
7	Cabo Verde
8	Cameroon
9	Central African Republic
10	Chad
11	Comoros
12	Congo, Dem. Rep
13	Congo, Rep.
14	Cote d'Ivoire
15	Djibouti
16	Egypt
17	Equatorial Guinea
18	Eritrea
19	Ethiopia
20	Gabon
21	Gambia, the
22	Ghana
23	Guinea
24	Guinea-Bissau
25	Kenya

26	Lesotho
27	Liberia
28	Libya
29	Madagascar
30	Malawi
31	Mali
32	Mauritania
33	Mauritius
34	Morocco
35	Mozambique
36	Namibia
37	Niger
38	Nigeria
39	Rwanda
40	Sao Tome & Principe
41	Senegal
42	Seychelles
43	Sierra Leone
44	South Africa
45	Sudan
46	Tanzania
47	Togo
48	Tunisia
49	Uganda
50	Zambia
51	Zimbabwe

Inclusive Health System in Africa (PCA Estimate)

COUNTRY	SCORE	RANK
Tunisia	1.164423	1
Seychelles	1.05609	2
Algeria	0.987241	3
Cabo Verde	0.958531	4
Botswana	0.882609	5
Namibia	0.778954	6
Rwanda	0.769822	7
Sao Tome & Principe	0.710993	8
Mauritius	0.672103	9
South Africa	0.654429	10
Madagascar	0.617514	11
Libya	0.53737	12
Morocco	0.483168	13
Malawi	0.419883	14
Zimbabwe	0.400046	15
Tanzania	0.366129	16
Ghana	0.297604	17
Burkina Faso	0.259078	18
Uganda	0.225917	19
Gambia, the	0.215763	20
Sudan	0.215589	21
Egypt	0.212914	22
Kenya	0.201929	23
Zambia	0.196554	24
Burundi	0.151875	25
Mozambique	0.136396	26

Lesotho	0.044014	27
Djibouti	0.03336	28
Senegal	0.011557	29
Gabon	-0.10006	30
Eritrea	-0.25451	31
Niger	-0.25564	32
Benin	-0.3173	33
Guinea-Bissau	-0.33997	34
Ethiopia	-0.34921	35
Togo	-0.40761	36
Mali	-0.45611	37
Comoros	-0.45721	38
Angola	-0.46938	39
Mauritania	-0.48641	40
Congo, Rep.	-0.55695	41
Cote d'Ivoire	-0.57517	42
Liberia	-0.65495	43
Sierra Leone	-0.65636	44
Congo, Dem. Rep	-0.75018	45
Cameroon	-0.84663	46
Guinea	-1.06191	47
Central African Republic	-1.07095	48
Equatorial Guinea	-1.13675	49
Chad	-1.16023	50
Nigeria	-1.29838	51

Inclusive Health System in Africa (TFA Estimate)

COUNTRY	SCORE	RANK
Seychelles	0.81	1
Libya	0.79	2
Mauritius	0.78	3
Algeria	0.78	4
Tunisia	0.77	5
Egypt	0.71	6
Cabo Verde	0.62	7
South Africa	0.60	8
Morocco	0.60	9
Botswana	0.57	10
Sao Tome & Principe	0.50	11
Namibia	0.49	12
Rwanda	0.46	13
Djibouti	0.43	14
Gabon	0.43	15
Gambia, the	0.41	16
Senegal	0.40	17
Zimbabwe	0.40	18
Ghana	0.38	19
Sudan	0.38	20
Madagascar	0.38	21
Zambia	0.37	22
Malawi	0.37	23
Burundi	0.37	24
Kenya	0.36	25
Comoros	0.36	26

Tanzania	0.33	27
Lesotho	0.33	28
Burkina Faso	0.32	29
Uganda	0.32	30
Mauritania	0.31	31
Angola	0.31	32
Equatorial Guinea	0.31	33
Mali	0.30	34
Mozambique	0.30	35
Cote d'Ivoire	0.30	36
Benin	0.29	37
Congo, Rep.	0.28	38
Guinea-Bissau	0.28	39
Togo	0.27	40
Eritrea	0.27	41
Liberia	0.26	42
Cameroon	0.26	43
Niger	0.26	44
Nigeria	0.24	45
Ethiopia	0.24	46
Guinea	0.22	47
Congo, Dem. Rep	0.22	48
Sierra Leone	0.20	49
Central African Republic	0.19	50
Chad	0.15	51