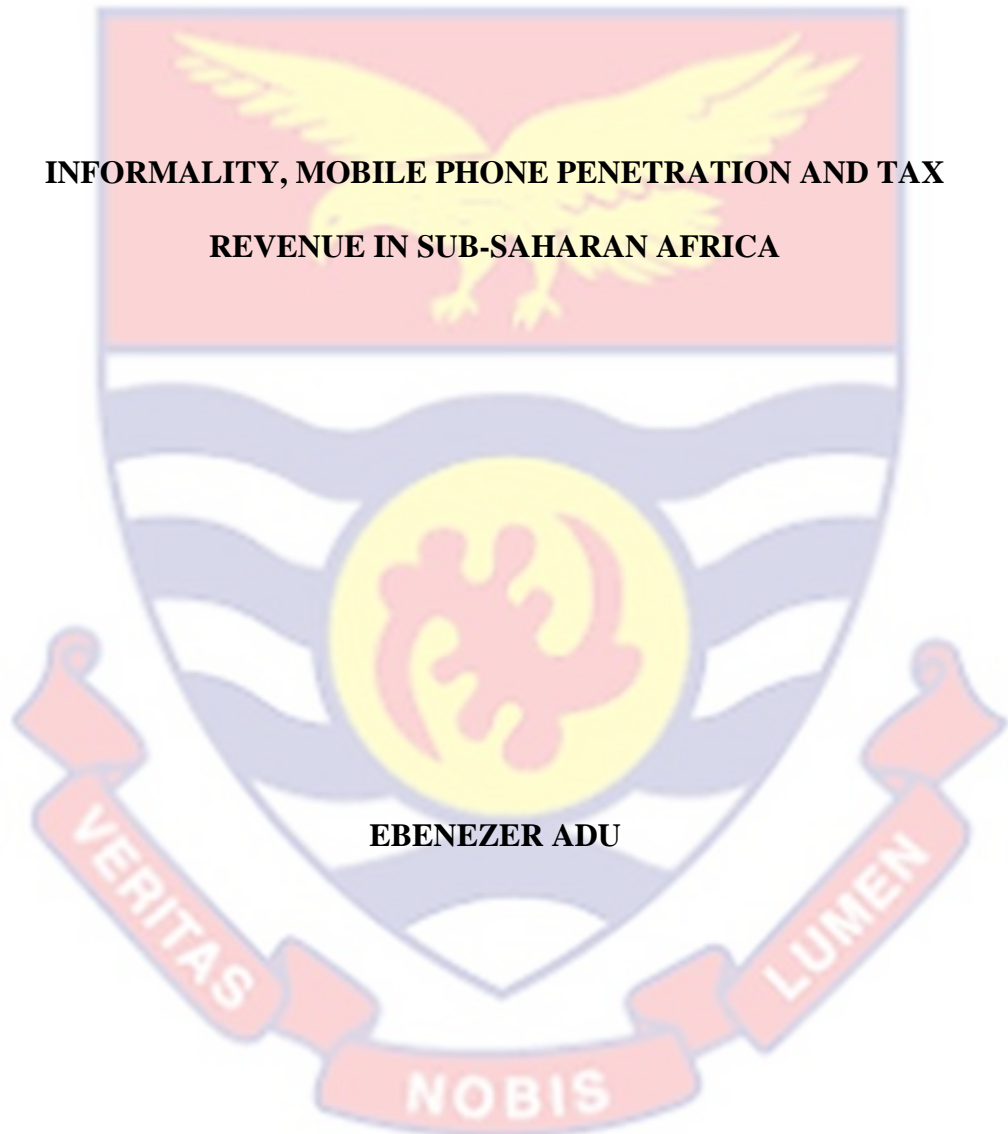**UNIVERSITY OF CAPE COAST**

INFORMALITY, MOBILE PHONE PENETRATION AND TAX

REVENUE IN SUB-SAHARAN AFRICA

EBENEZER ADU

2021

UNIVERSITY OF CAPE COAST

INFORMALITY, MOBILE PHONE PENETRATION AND TAX REVENUE

IN SUB-SAHARAN AFRICA

BY

EBENEZER ADU

Thesis submitted to the Department of Economic Studies of the School of

Economics, College of Humanities and Legal Studies, University of Cape

Coast, in partial fulfilment of the requirements for the award of Master of

Philosophy Degree in Economics

DECEMBER 2021

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been published or presented for another degree in this university or elsewhere.

Candidate's Signature……………………… Date…………………………

Name: Ebenezer Adu

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature…………………… Date……………………

Name: Dr. Isaac Bentum-Ennin

Co-Supervisor's Signature………………………….. Date……………………

Name: Dr. Benedict Afful Jr

ABSTRACT

As part of the Sustainable Development Goals (SDGs), emphasis is placed on the necessity to reinforce resource mobilisation domestically and expand revenue collection with respect to the first target of SDG 17. However, sub-Sharan Africa (SSA) is losing significant amount of its revenue as a result of the large size of the informal sector in the various economies. The study examines the effect of informality on tax revenue in SSA and the moderating role of mobile phone penetration. The system Generalised Methods of Moments (GMM) approach was used on 26 SSA countries over a 11-year period. Findings from the study showed that informality has a significant and negative impact on tax revenue in SSA, whereas mobile phone penetration has a significant and positive impact on tax revenue. Again, mobile phone penetration is effective in playing the moderating role on informality to affect tax revenue in SSA. Based on the findings, the study recommends that strengthening the special government agencies established and tasked with identifying, registering, educating, and advising all informal sector operators on how to keep accurate records, market their goods, access cheap financing, among others, will help them feel recognized and will encourage voluntary compliance with regard to paying taxes. Also, the study recommends that there should be some form of consumer education by governments together with telecommunications agencies in order to help improve awareness on the benefits of using mobile phone to transact businesses and the ease of payment of taxes through the usage of mobile phones.

KEY WORDS

Informality

Mobile phone penetration

Tax revenue

Sub-Saharan Africa

Generalised Method of Moment

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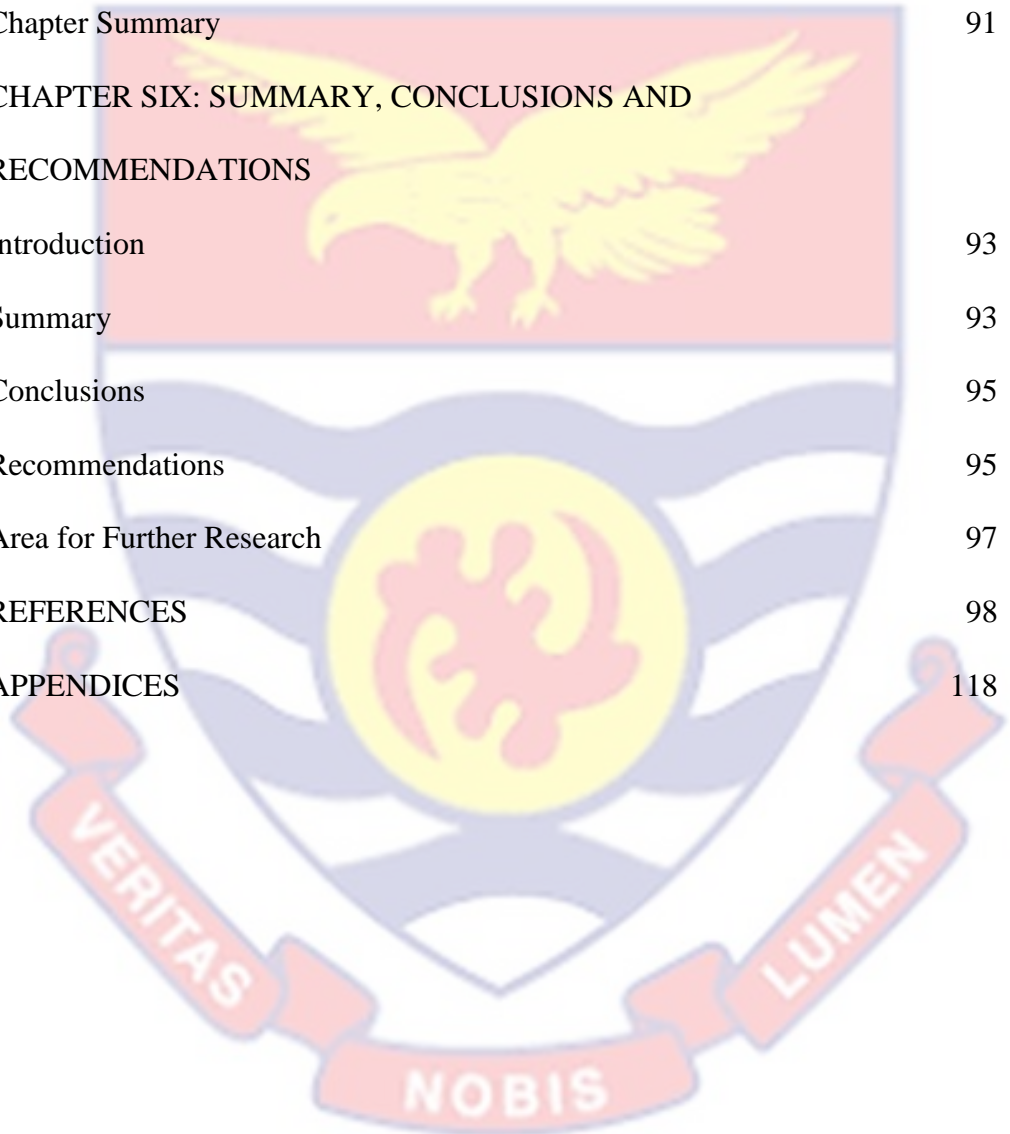
DEDICATION

To my parents

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LIST OF ABBREVIATIONS

AERC	African Economic Research Consortium
OECD	Organization for Economic Co-operation and Development
GDP	Gross Domestic Product
ITU	International Telecommunications Union
ICT	Information and Communications Technology
UN	United Nations
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
WDI	World Development Indicators
WGI	World Government Indicators
ILO	International Labour Organisation
GSMA	Global System for Mobile Association
VAT	Value Added Tax
LTU	Large Taxpayer Units
SARA	Semi-Autonomous Revenue Authority
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
TPB	Theory of Planned Behaviour
OLS	Ordinary Least Squares
MIMIC	Multiple Indicator-Multiple Cause
ATM	Automated Teller Machine
POS	Point of Sale
CBN	Central Bank of Nigeria
MSE	Micro and Small Enterprise

GMM   Generalised Method of Moment

DRM   Domestic Resource Mobilisation

GNI   Gross National Income

CHAPTER ONE

INTRODUCTION

Background to the Study

Economic development is a macroeconomic goal that every country in the world strives for (Ayenew, 2016). The issue of economic development, in particular, remains unresolved in the majority of developing economies. While most developing countries have abundant natural resources, they face a fiscal deficit, forcing them to rely on foreign aid to fund their development programs. Therefore, increased domestic resource mobilisation might aid in reducing the fiscal deficit, as well as better control the process of economic development and reduction of poverty. In underdeveloped nations, resource efficiency has remained low, and governments in these economies have a stronger involvement in economic stabilisation through various policy measures such as fiscal policy (Ayenew, 2016). Due to the scarcity of resources in society, an increase in government spending often causes a fall in private spending. Implementing fiscal policy, such as raising tax revenue, is one way to transfer resources from the private to the public sector. Taxation is without a doubt the most significant source of government revenue. Governments usually raise finances by a variety of tactics, including borrowing, accepting aid, printing money, and taxation (Chaudhry & Munir, 2010).

Taxation is essential for countries that are developing to mobilise their own resources for long-term development. It underpins the fundamental tasks of a functioning state by aiding it to raise the resources necessary to perform important services and by providing a conducive environment for economic

growth. Simultaneously, it serves as a stimulus for governments that are more responsive and accountable to their citizens, as well as for state capacity expansion (OECD, 2008). Also, over the last few decades, many developing countries have worked on a wide range of reforms, such as putting in place a value-added tax (VAT), in order to increase their overall tax revenues (VAT). Even though the amount of taxes collected shows how well the economy can support government expenditure, most developing countries still have low levels of taxation (Haque, 2012).

Most SSA countries have a low tax-to-GDP ratio (Ayenew, 2016). Despite significant efforts, many nations are unable to generate adequate resources to finance the government deficit and meet their development needs. According to the United Nations Development Program (2013), half of SSA nations raised 16,8% of their GDP through taxation, which is below the UN benchmark of 20% for achieving the Sustainable Development Goals (SDGs). According to the United Nations, developing nations will need to raise at least 20% of their GDP in taxes in order to meet the Sustainable Development Goals (SDGs). Nonetheless, half of all sub-Saharan African countries collect less than 17% of their GDP in taxes, and numerous Asian and Latin American countries perform little better (De Paepe & Dickinson, 2014). Sub-Saharan Africa has a significant funding need for investment, estimated to be around $230 billion per year on average (Coulibaly & Gandhi, 2018). This gap is mostly caused by low domestic savings rates and the fact that tax collections are still not as good as they could be, despite recent improvements. Indeed, regional tax collections (excluding those from the natural resource sector) increased from 11% of GDP in the early 2000s to almost 15% in 2015

(Coulibaly, Gandhi & Senbet, 2019). Even though there has been an increase from 11% to almost 15%, the percentage falls short of the intended target, remaining lower than the OECD (24%) and developing countries.

Informality is also another key factor contributing to low tax revenue mobilisation in the sub-Saharan region over the years (Keen & Mansour, 2010). According to Kalyani (2016), the informal sector is considered as a vital resource in most developed economies because it contributes significantly to the reduction of unemployment problems, and it is estimated that the informal sector employs roughly one-third of the population in developing countries. In terms of job opportunities and poverty alleviation, the informal sector plays a major role in the economy. This industry provides employment opportunities for a number of people. According to Allard (2017), the informal sector is a critical component of most economies in sub-Saharan Africa, accounting for between 30 and 90 percent of total non-agricultural jobs and contributing between 25 and 65 percent of GDP. Though international experience shows that the informal economy shrinks as development progresses, most economies in sub-Saharan Africa are likely to have large informal economies for several years to come as a result of weak governance as well as greater poverty and income inequality in the region, providing policymakers with both opportunities and challenges. The informal sector, according to the World Bank (2011), is important in both developing and developed countries because it employs thousands of unemployed workers and is often referred to as "social safety net" for the poor. Despite the importance of the informal sector in providing employment opportunities and contributing to GDP to promote growth and development, it contributes to the

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low tax revenue in the SSA region. This is due to the fact that the informal sector invades tax since it is difficult to identify and tax them.

Excessive taxes, inflation, poor implementation of tax laws, low wages, some government measures aiming at formalising the informal sector, and a high unemployment rate are the key factors leading to informality (DiJohn: 2010; Marcia & Cazzavillan, 2010; Zhou & Madhikeni: 2013). Politicians are using this part of the economy to get elected by not taxing it and relaxing some important laws on the sector (Bairagya, 2011). As a result of such actions by the politicians, informality becomes more attractive and formalisation becomes less attractive (Bairagya, 2011; Karki & Xheneti 2016). According to Mpapale (2014), the informal sector arose as a result of the following characteristics: ease of entry, lack of formal education, scarcity of formal jobs, and people's inability to obtain adequate initial funds or capital to start formal businesses.

Russel (2010) outlines the primary factors that affect a firm's decision to operate informally and why the sector is still challenging to tax. These include: the complication of the tax system, the overall tax and social security contribution burden, the state of social welfare at the time, the efficiency of tax administration, the costs associated with formalising a firm, and attitudes toward government spending and authority. However, new trend of high adoption of mobile phones in the daily activities and its related service has been observed by actors of the informal sector and this is serving as a new way of mobilising tax revenue (Larson & Svensson, 2018).

Molony (2006) in Tanzania, Overa (2006) in Ghana, Jagun et al. (2008) in Nigeria, Aker (2008) in Niger, and Sife et al. (2010) in Tanzania

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have all found that micro-traders' adoption of mobile phone technology has resulted in less wasted time, resources, uncertainty, and risks, as well as easier access to information. Larsson and Svensson (2018) also conducted research in Kampala, Uganda, on mobile phones in the transformation of the informal economy: stories from market people, and discovered that 143 of the 149 women sampled owned a mobile phone. The use of a mobile phone was stated by all 149 respondents as being beneficial to their businesses. While the income of 124 of the women had increased after they began using the mobile phone, the expenditure of 114 of them had increased as well. The majority of the women used their phones to communicate with vendors and other business women. According to their research, 126 women used the phone to communicate with authorities and middlemen. Similarly, all of the women in the study used mobile money to pay bills, collect money from clients, pay taxes and rental fees, and communicate with storage owners.

In addition, studies by Souter et al. (2005) in Gujarat, Mozambique, and Tanzania show how mobile phones have impacted the competitiveness of traders, intermediaries, and customers by allowing them to access more information about the availability and price of goods, reducing travel time and thus improving market efficiency. Such effects on trading activities demonstrate the importance of cell phones in increasing consumer access and trade efficiency. These kinds of results, according to Boateng (2010, 2011), are strategic benefits that arise when mobile phones are used for micro-trade in the informal sector. In as much as mobile phone is aiding in the activities of actors in the informal sector, it is also contributing significantly to GDP and revenue generated through taxation (GSMA, 2020).

According to the Global System for Mobile Association (GSMA) 2020 report, in sub-Saharan Africa, mobile technology and services contributed 9 percent of GDP in 2019, amounting to more than $155 billion in economic value added. In addition, the mobile economy created nearly 3.8 million jobs (directly and indirectly) and contributed significantly to public sector revenue, with nearly $17 billion generated by taxation (GSMA, 2020). Per the report, it is projected that mobile contribution will hit about $184 billion by 2024, as countries benefit from improved productivity and quality brought about by increased use of mobile services by individuals found in both the formal and informal sectors. As part of the Sustainable Development Goals (SDGs), great emphasis is placed on the need of strengthening domestic resource mobilisation and revenue collection in order to achieve SDG 17's first target. The use of mobile phone serving as a new medium for mobilising revenue from the informal sector cannot be overlooked in achieving the first target of SDG 17.

Statement of the Problem

A significant source of funding for development in Africa, which is the official development assistance (ODA), has over the years been declining. This suggests that finding means to enhance domestic resource mobilisation is essential if the continent is to achieve the sustainable development goals (SDGs). The first SDG 17 target underlines the need for countries to develop domestic capacity for tax and other revenue collection and to strengthen domestic resource mobilisation. Tax revenue generation is key for a nation's economic development (OECD, 2014). Increased revenue will particularly strengthen the continent's fiscal capacity, enabling it to support public goods

and services that will lower vulnerability, poverty, and inequality. However, the average tax-to-GDP ratio for Africa is 17.1%, which is below the 18.5 percent mark required to promote growth and provide essential services like health care, public safety and improved road infrastructure in nations that are developing (Aydin & Esen, 2019). This is significantly different from the OECD's 34 percent and the Caribbean's and Latin America 22 percent, respectively (OECD, 2019). If this issue is not resolved, it would not only make it difficult to accomplish SDG 17 but also the other 16 SDGs. Over the years, low tax revenue mobilisation in SSA has been caused by a number of factors, including the slow rate of economic growth; the large proportion of agriculture activities in the economy; and the size and scope of the informal sector (Coulibaly & Ghandi, 2018). Governments of various states within the SSA region have put in place some mechanism to decrease the large scale of the informal sector since it contributes less to tax revenue.

Over time, the size of the informal sector in SSA has shrunk, but not to the extent that is expected (Medina & Schneider, 2018). In SSA, the informal sector accounts for 34 percent of GDP (Coulibaly & Ghandi, 2018). In as much as the informal sector is seen as a cause to low tax revenue, it provides some employment opportunities within the region. According to (ILO, 2018), the informal sector employs about 70 to 80 percent of non-agricultural workers, with the majority of self-employed individuals and micro-businesses. According to Larsson and Svensson (2018), majority of these individuals who are self-employed and in the micro-businesses have adopted the use of mobile phones in their day-to-day activities and also running of their businesses. This growing usage of mobile phones in the informal sector is a sign of the

informal economy's current transformation and also an avenue through which tax revenue is mobilised from the sector (Larsson & Svensson, 2018).

The mobile revolution has changed many lives by offering not only connectivity but also basic financial access in the form of phone-based money transfer and storage (Jonathan & Camilo, 2008; Demombynes & Thegeya, 2012). Given the potential of mobile technology to drive inclusive growth and sustainable development, mobile phones are critical to achieving some of the SDGs within the SSA region. Theoretically, growth and development are primarily observed when a country's tax revenue improves. The tax revenue is used for projects such as construction of roads, social amenities, creating of jobs for employment which translate into growth and development (OECD, 2014).

The effect of mobile phone on economic growth and development has been studied by some researchers (Lum, 2011; Aker & Mbiti, 2010). Also, the effect of mobile phone penetration on inequality was studied by (Asongu, 2015; Carabregu Vokshi, Dedaj, Youssef & Toçi, 2019). Moreover, the majority of research on mobile phones have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). Studies that looked at the relationship between mobile phones and taxes looked at the effect of particular taxes and how they influence the mobile market (Exelby, 2011; GSMA, 2010). Also, studies that looked at the effect of the informal sector on tax revenue have been country specific (Guillermo & Deyve, 2019; Mawejje & Francis-Munyambonera, 2016).

Given the preceding literature, and to the best of my knowledge, there is currently no study that has examined the effect of mobile phone penetration

on tax revenue, as well as the moderating role of mobile phone penetration in the informal sector on tax revenue in the SSA region. The few existing empirical works hinge on country-specific and micro-level data mostly collected from surveys (Demombynes & Thegeya, 2012). In SSA, an examination of the moderating role of mobile phone penetration in the informal sector on tax revenue is needed since evidence from literature proves that over the years actors in the informal sector have resorted to the use of mobile phones to run their businesses and also use it as a medium to pay their taxes, which in the long-run increases the overall tax revenue (Larsson & Svensson, 2018). Hence, this missing gap in the literature provides a unique opportunity to complement existing literature with a macroeconomic assessment of informality, mobile phone penetration and tax revenue.

Purpose of the Study

The purpose of this study is to examine the effect of the informal sector on tax revenue and explore how mobile phone penetration moderates the effect of the informal sector on tax revenue in sub-Saharan Africa over the period 2009 to 2019.

Objectives of the Study

In achieving the principal objective, the study sought to:

1. Examine the effect of the informal sector on tax revenue in sub-Saharan Africa.

2. Investigate the effect of mobile phone penetration on tax revenue in sub-Saharan Africa.

3. Determine the moderating role of mobile phone penetration in the informal sector on tax revenue in sub-Saharan Africa.

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Hypotheses

1. H_0: The informal sector does not have any effect on tax revenue in sub-Saharan Africa.

   H_1: The informal sector has an effect on tax revenue in sub-Saharan Africa.

2. H_0: Mobile phone penetration does not have any effect on tax revenue in sub-Saharan Africa.

   H_1: Mobile phone penetration has an effect on tax revenue in sub-Saharan Africa.

3. H_0: There is no moderating role of mobile phone penetration in the relationship between the informal sector and tax revenue in sub-Saharan Africa.

   H_1: There is a moderating role of mobile phone penetration in the relationship between the informal sector and tax revenue in sub-Saharan Africa.

Significance of the Study

In spite of the number of research works on informality and mobile phone penetration in the SSA region, an attempt to look at how mobile phone penetration moderates the effect of informality on tax revenue has not yet been done, to the best of my knowledge. Results and findings from this study highlight the effect of informality on tax revenue and the moderating role of mobile phone penetration in the informal sector to influence tax revenue in the SSA region. The results also inform government and other stakeholders in the region as to track the usage of mobile phones by the informal sector in their various activities and how revenue can be mobilised in the sector since it is

difficult to tax the sector. Thus, close attention needs to be paid to the usage of mobile phones by the informal sector in their activities so as to help generate more revenue if the results are seen to be positive. The findings from the study also contribute to existing theory and academic discourse on the informal sector and tax revenue.

Delimitation of the Study

The study examined the effect of informality on tax revenue and how mobile phone penetration moderates' the effect of informality on tax revenue in 26 sub-Saharan African countries. The study was conducted for a 11-year period due to data unavailability.

Limitation of the Study

Sub-Saharan Africa has different demographic, social, and economic characteristics. Categorising the region as a block implies overlooking some of these individual heterogeneities among these nations.

Organisation of the Study

The study is organised into six chapters. The first chapter constitutes the introduction to the study, the background to the study, statement of the problem, purpose of the study, objectives, study hypotheses, significance of the study, delimitation, limitation and organisation of the study. The second chapter covers the overview of tax revenue, mobile phone penetration and tax revenue. A review of related literature is discussed and presented in Chapter Three. The fourth chapter discusses the methods employed in the research. It focuses on the study area, the study design, research approach, data collection techniques, analysis of data, and appropriate estimation techniques applied in the study. Research results are analysed in Chapter Five. Chapter Six

summarizes the study and draws conclusions and recommendations based on the results. It also suggests areas for further studies.

CHAPTER TWO

INFORMALITY, MOBILE PHONE PENETRATION AND TAX REVENUE

IN SUB-SAHARAN AFRICA

Introduction

This chapter presents an overview of informality, mobile phone penetration, and tax revenue in the sub-Saharan Africa region. The chapter first looked at the issue of informality, followed by that of mobile phone penetration and tax revenue.

Informality in sub-Saharan Africa

William and Round (2007) considers the informal sector as "non-structured, unpaid, non-official, non-organised, abnormal, hidden, an illegal, black, submerged, non-visible, shadow, a-typical or irregular, and Cash-on-Hand". According to the International Labour Organization (ILO, 2018), the informal sector employs roughly 2 billion people, or 60% of the global workforce aged 15 and up. Informal employment accounts for more than 90% of total employment in several SSA economies, while informal output accounts for up to 62 percent of official GDP in the region (ILO 2018). Workers may choose informal employment for a variety of reasons, depending on the country's circumstances and worker characteristics. Thus, informal workers include everyone from agricultural day laborers to small-business owners with a few employees.

In contrast to high-income markets, where the informal sector is sometimes referred to as the "hidden economy," informality in SSA is probably the norm, accounting for over 70% of non-agricultural employment and around 90% of all economic units (ILO, 2018). Informal activity is also

significant economically, accounting for between 30% and 65% of GDP (Charmes, 2016). The majority of enterprises in SSA operate in an informal manner; significant and vital economic activities such as public transportation, market centers, and food processing are controlled by informal businesses (Adams, Silva & Razmara, 2013; Osei-Boateng & Ampratwum, 2011). The informal sector in SSA is not limited to certain sectors or components of the economy; it is extensive, encompassing all genders, age groups, sectors, and the majority of economic activity, as shown in Figure 1. Informality manifests itself in a variety of forms, and it is often difficult to distinguish from the formal economy. Self-employed people (who account for 52 percent of all non-farm workers in SSA), people employed by legitimate businesses that operate informally (11 percent), people employed or engaged on an informal basis by businesses that operate in the formal sector (10 percent), and people employed as domestic workers in households (4 percent) are all examples of informal workers in SSA (ILO, 2018). Self-employed people include street traders and petty traders who are in charge of micro businesses, as well as self-employed people who run SMEs and employ a large number of people. These informal firms are frequently linked to the formal sector.

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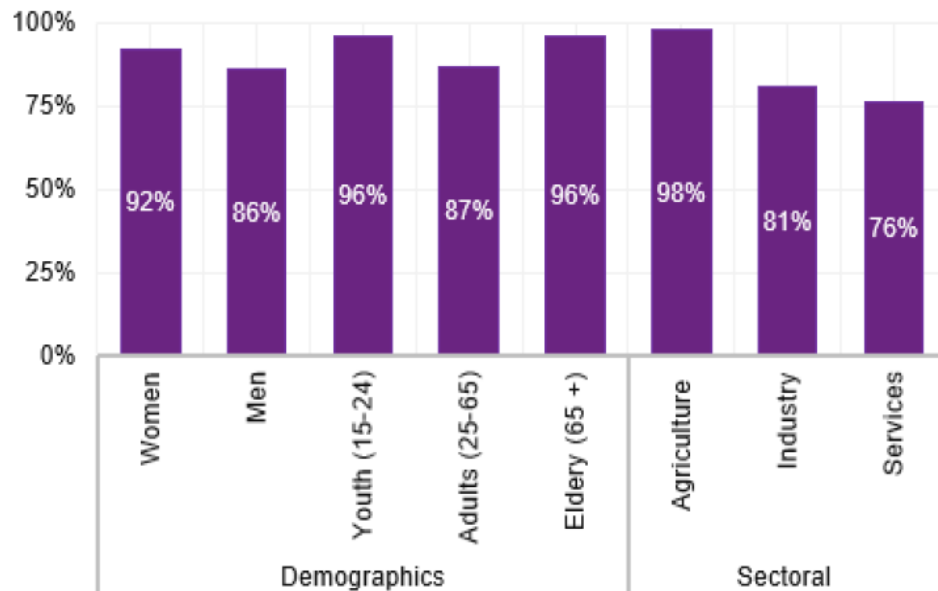
Figure 1*: Informality in SSA in terms of demographics and by sector*

Source: ILO (2018)

From Figure 1, in terms of demographic characteristics, the youth (15-24 years) and the elderly (65+ years) accounts for the highest level of informality (96 percent), followed by adults (25-65 years) who accounts for 87 percent of the informal sector in the SSA region. In terms of gender, women account for the highest level of informality (92 percent) followed by the men (86 percent). Under the sectoral categorisation, agriculture account for the highest level of informality with 98 percent, followed by the industrial and services sector with 81 and 76 percent respectively in the SSA region. Having looked at the informal sector in the SSA region in terms of demographics and by sector, the study proceeds to look at how informality varies across SSA, Latin America, South Asia among others.

Figure 2 shows the size of the informal economy according to region categorised into three different year interval (1991-99, 2000-09 and 2010-17). From the figure, sub-Saharan Africa and Latin America stand out as the two

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regions of the world with the most informality for all the three years interval. In the last decade, informality in these two regions stand at 34 percent as a percentage of GDP, next is South Asia, Middle East and North Africa, East Africa and Europe with an informality size of 28 percent, 22 percent, 21 percent and 19 percent as a percentage of GDP respectively. Lastly, the Organisation for Economic Co-operation and Development (OECD) countries have the least size of informality for the three years interval with 15 percent in the last decade.
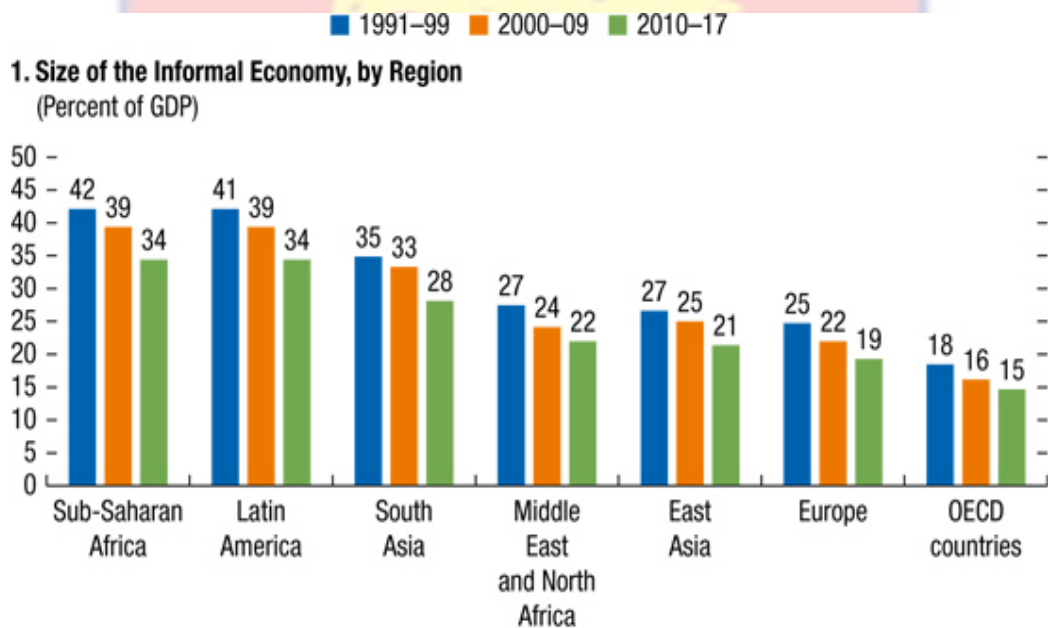
Figure 2: *Size of the informal economy by region*
Source: Medina and Schneider (2018)

Mobile Phone Penetration in sub-Saharan Africa

In the year 2000, less than 3% of Africans had access to fixed telephone land lines (Bailard, 2009). In view of this, mobile phone providers initially ignored the African continent. Assuming that, whether due to financial constraints or a lack of interest, the apparent scarcity of demand for land lines among Africans extends to mobile phones as well. "We all misread

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the market," admits the chief executive officer of a Kenyan mobile service provider (Ngowi, 2005). Despite the fact that the number of land-line telephone subscribers has remained stable at less than 4%, the number of mobile phone subscribers has increased from less than 2% in 2000 to about 30% in 2007 (International Telecommunications Union [ITU], 2008). Over the decades, the mobile economy in the sub-Saharan African region is experiencing a rapid growth. According to the GSMA's "Mobile Economy Sub-Saharan Africa in 2019," there was a 20 million rise in mobile subscribers by the end of 2018. The total number of mobile subscribers in sub-Saharan Africa is projected to reach 600 million by 2025. Figure 3 depicts the number of mobile subscribers and the level of penetration from 2012. From Figure 3, the total number of unique mobile subscribers in the sub-Saharan Africa region was 287 million with a penetration rate of 32%. In 2018, the total number of unique subscribers increased to 456 million with a penetration rate of 44%. Enhancing 4G connectivity will accelerate this growth in mobile subscribers by 23 percent by 2025. The number of unique subscribers in the region is projected to increase to 623 million by the year 2025 with an increase in the penetration rate to 50%.

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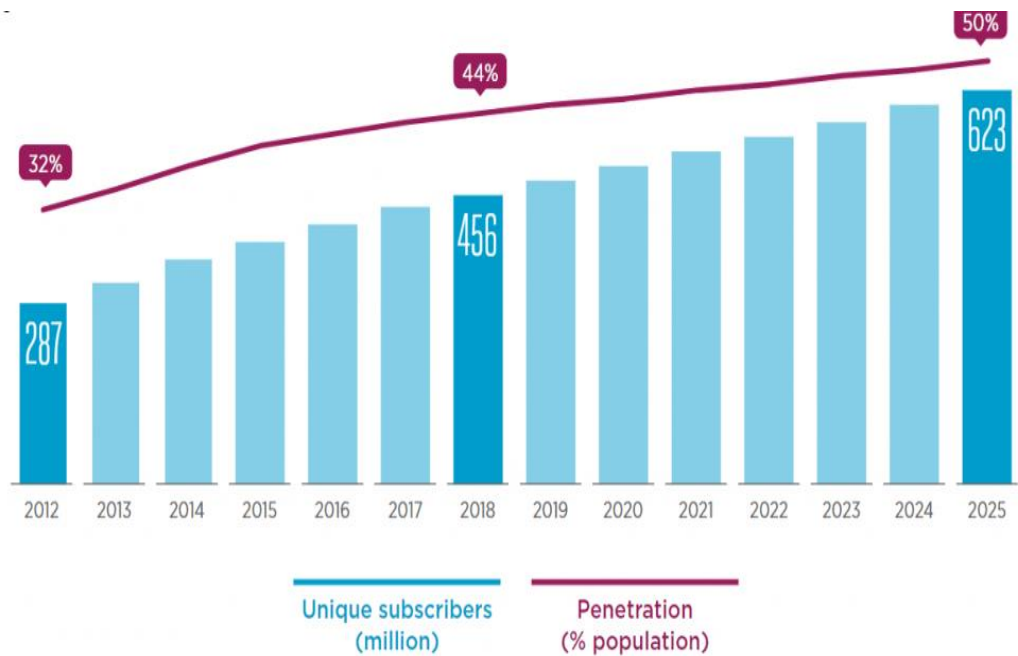
Figure 3: *Mobile subscribers and the level of penetration in sub-Saharan Africa*

Source: GSMA (2019)

Geopoll which is considered as the world's largest survey platform conducted a study on Africa's youth and e-commerce (purchases made online with the use of mobile technology) for six African countries in 2019. Findings from their study revealed that, "58% of Nigerian respondents indicated making an online purchase in the past month", with a variety of buyer characteristics ranging from "alcoholic beverages, non-alcoholic beverages, home decor, hygiene, and automotive parts". The study also revealed that Kenya and Uganda reported a smaller, but still considerable number of internet shoppers in East Africa. Uganda had the lowest number of online shoppers, with 57% of respondents saying that they had never made any online purchases before. All six nations surveyed (Ghana, Côte D'Ivoire, Kenya, Nigeria, Tanzania and Uganda) revealed that electronics were the most popular commodity purchased by consumers, with Kenyan's accounting for about 64% of all purchases. Clothing came in second place, with Tanzania and

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Ghana reporting the highest number of transactions. Figure 4 gives an overview of the six countries used in the study and the level of items purchased by each country online.

Figure 4: *A survey on online purchases for six African countries by Geopoll*
Source: Geopoll (2019)

Tax Revenue in sub-Saharan Africa

The Evolution of Tax Revenue in sub-Saharan Africa

Since 1995, tax revenues have accelerated, increasing from 17.5% of GDP in 1980 to 22.3% in 2010. While there was no change in the proportional contributions of non-resource and resource taxes (total taxes) between 1980 and 2010, substantial shifts did occur over that time period (Mansour, 2014). At the beginning of the 1980s, most of Nigeria's tax revenues came from oil. This was because of the oil shock at the end of the 1970s. It was responsible for more than three-quarters of the revenues that the extractive industries in SSA brought in. A large portion of the remaining quarter was made up of

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mining revenues in South Africa. Back then, only eight SSA nations declared their resource revenues. Although 18 nations reported resource revenues in 2010, these profits were still highly concentrated by country, with over 75% of oil revenues coming from Nigeria and Angola and over 15% from Francophone Central Africa (Cameroon, Congo, Equatorial Guinea, and Gabon).

During the 1980s and the majority of the 1990s, resource revenues decreased despite a rise in the number of nations reporting such sources. Despite the fact that much of this was attributable to negative world energy prices, SSA nations failed to adequately tax the mining industry. Compared to oil and gas, where production is concentrated and frequently offshore, making it impossible to engage in without major capital outlays, this sector is normally more difficult to tax. In the 1980s and 1990s, when commodity prices were extremely low, many nations endorsed lenient tax systems for the mining industry, only to regret it when prices began to rise in the early 2000s. The IMF has given significant technical help in this area since 2008, and nearly all SSA nations have recently altered or are currently reviewing their mining tax regimes. SSA can anticipate higher revenues from the mining sector in the future, provided that the new taxation regimes are more successful at taxing mining rent. However, oil revenue will dominate for years. The 1980s saw a minor improvement in non-resource taxes, but since the early 1990s, they have remained unchanged (slightly over 15 percent of GDP). The connection between the yearly growth rates of resource and non-resource taxes over the period is -0.42, so some of this may be related to changes in resource

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revenues, but ineffective tax administration and policy continue to be significant contributors (Mansour, 2014).

Real taxes per capita in SSA have decreased, with the exception of the 1980s, which, as was said before, were driven by oil revenue from Nigeria. To the extent that these taxes fund the social safety net of government employment, this would simply indicate a reduction in real public salaries (Mansour, 2014). However, SSA's budget resources per capita were lower in 2010 than they were in the 1980s and a large portion of the 1990s to the degree that they finance infrastructure, health, education, and other pro-poor spending. The impact of the resource sector's inflationary effects (coupled with population expansion) was greater than the effect of the sector's increased tax revenue. The standard deviations for resource taxes as a percentage of GDP and as a percentage of total taxes during the full period were 7.3 and 22.6, respectively (Mansour, 2014).

The Current State of Tax Revenue in sub-Saharan Africa

Over the past two decades, Africa has made some headway in increasing non-resource tax revenues (Coulibaly & Gandhi, 2018). From about 11 percent in the early 2000s to almost 15 percent in 2015, the ratio of tax collections excluding natural resource taxes and social contributions increased steadily (Coulibaly & Gandhi, 2018). The 1990s and 2000s saw significant administrative and legislative reforms that improved tax revenues (Fossat & Bua, 2013; Kloeden, 2011). Among the reforms were the rollout of electronic filing systems, projects to improve taxpayer services, and the adoption of value-added tax in a number of nations (OECD, 2017). The establishment of semiautonomous revenue agencies in a number of nations has also enhanced

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the collection of non-resource taxes (Ebeke, Mansour & Rota-Graziosi, 2016). Countries have withdrawn tax breaks, updated investment regulations, and adopted tax reforms for small firms based on domestic situations (IMF, 2018b). Despite these efforts, the tax-to-GDP ratio remains low. Sub-Saharan Africa has one of the lowest rates in the world, at roughly 15%, much lower than the OECD average of 24 percent.

The trend of Africa's tax revenue-to-GDP ratio between 2007 and 2017 is shown in Figure 5. In as much as there has been some tax reforms in the continent over the past decades to ensure effective revenue mobilisation, tax revenue mobilisation is still on the low due to some challenges.
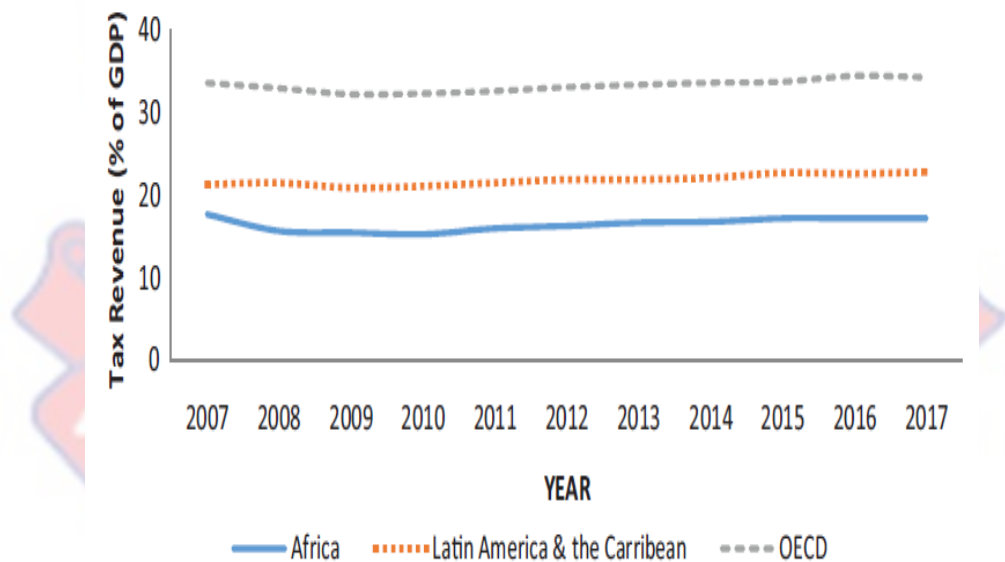
Figure 5: *The trend of Africa's tax revenue-to-GDP ratio between 2007 and 2017*
Source: Asmah et al. (2020)

In Africa, the average tax-to-GDP ratio increased from 15.1 percent to 16.5 percent between 2010 and 2018, primarily as a result of increases in value-added taxes (VAT, which increased by 1 percent) and individual income taxes (which increased by 0.7 percent), while corporate income taxes

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decreased (by 0.5 percent) (OECD, AUC & ATAF, 2020). Since 2014, the average ratio has stabilised at 16.4–16.5 percent as growth in certain nations offsets declines in others.

Taxes on goods and services accounted for 51.9% of overall tax receipts in African countries in 2018, according to the OECD, AUC, and ATAF (2020). The Value-Added Tax (VAT) accounted for an average of 29.7 percent, making it the most significant tax on goods and services. On average, corporate taxes made up 19.2 percent of total tax collections, with personal income taxes making up 17.5 percent. Taxes on social insurance and property had smaller impacts, at 7.2% and 1.6%, respectively.

Challenges of Mobilizing Tax Revenue in sub-Saharan Africa

A number of the tax challenges faced by sub-Saharan Africa are particularly attributed to:

Weak tax administrations: Mobilising domestic resources in developing countries is impossible without a well-functioning tax administration. Nonetheless, many administrations are staffed by inexperienced and low-paid personnel, lack an integrated strategy to all taxes, and fail to balance enforcement with taxpayer services. Tax systems must consequently be designed with the tax administration's competence to administer them.

Low taxpayer morale, corruption and poor governance: Public tax compliance and tax morale have been shown to be closely linked in studies (Torgler, 2011). Low state revenue is closely linked to high levels of corruption and other indicators of poor governance (political instability, weak rule of law). Because tax collection is important as an exercise of state

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authority, concerns of governance in tax collection are given a significant deal of attention.

Prevalence of "hard-to-tax" sectors, consisting of micro enterprises, professionals and small farms. This is particularly important in regions with little administrative capability and little motivation for compliance. Even though the informal sector in developing countries accounts for up to 60% of GDP in some countries, it is debatably not a problem in and of itself: because even though small business owners and professionals may be deemed "informal," their earnings and sales are probably well below any conceivable tax threshold. Qualified professionals are responsible for most significant tax evasion. Although estimates of the extent of non-compliance are inadequate, it has been estimated that VAT "gaps" in some developing nations are between 50 and 60 percent, whereas in developed nations, these gaps are between 7 and 13 percent.

Dealing with natural resource wealth: The design and implementation of fiscal regimes that are not only transparent, but also capable of generating a sufficient amount of public revenue from natural and mineral resources is a major challenge for many resource-rich countries in SSA. Recent discoveries of natural resource in underdeveloped countries have brought this topic to the forefront of public discussion.

Geographical and historical factors: Many geographical or historical factors can impact a country's tax collection. Small islands, for example, can tax more effectively than landlocked nations. It is difficult for post-conflict countries with broken tax bases and administration to mobilise domestic revenue, while the successor states are typically keen to develop a favorable

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reputation for investors. In addition, history has a role, as seen by the heritage of legal traditions that represent varied colonial pasts with a variety of revenue systems and performances.

Tax Reforms in sub-Saharan Africa

The efficiency and fairness with which the government can collect taxes depends on how well its tax systems are designed. Countries have employed a number of tax reforms since the 1990s to increase the effectiveness of revenue collection, fight corruption in tax administration, and lower administrative and compliance expenses. The World Bank and the International Monetary Fund (IMF) have been ardent supporters of these actions. The three most important of these initiatives were the Value Added Tax (VAT), Large Tax Units (LTU), and Semi-Autonomous Revenue Authority (SARA).

Value-Added Tax (VAT)

The Value Added Tax (VAT) is a modern tax. Prior to its implementation, domestic indirect taxes were usually limited to certain products (such alcohol and tobacco) and sales and turnover taxes. Alternatively, fewer distorting taxes were sought after in response to the distortions generated by the last type of tax (such as encouraging vertical integration of an industry simply to lower tax payments). The core notion of the VAT believed to have come from a German industrialist named von Siemens in the 1920s. Due to its benefits, the value-added tax (VAT) is of great relevance. The absence of cascading connected with the turnover tax is the first and most significant economic benefit. So, if there are no exceptions, the effective VAT tax rate is the same as the legal rate, which is very

important from an efficiency point of view. Second, the VAT offers "self-enforcement" advantages due to the credit-invoice technique, which is the most widely utilised worldwide. This feature should have a favorable impact on the total amount of revenue that the government is able to collect. In fact, in order to receive credit for taxes already paid to businesses operating above them in the chain, taxed businesses must produce their invoices. The VAT in this sense: (i) reduces the incentive to evade in order to obtain credit, (ii) helps in the discovery of fraud by allowing tax inspectors to take advantage of conflicts between businesses that are attempting to avoid paying taxes. The introduction of VAT is also perceived as "the central element in a program of modernising tax administration, developing the use of methods of self-assessment, the generalization of which is expected to ease administration and compliance in relation to other taxes as well" in developing countries (Keen & Lockwood, 2007).

Several studies have been undertaken on the efficiency of VAT in sub-Saharan African countries, however, the majority of them have concentrated on a particular nation. Using stepwise regression analysis, Onaolapo, Aworemi and Ajala (2013) assessed the VAT's contribution to Nigeria's revenue creation. He found VAT to be significant in affecting the generation of Nigeria's tax revenue.

Large Taxpayer Units (LTUs)

Large taxpayer units (LTUs) were first recommended as a replacement for revenue authorities, but they were later proposed as a supplement to RAs or the implementation of VAT. LTUs are intended to monitor large taxpayers "via audits, registration, tax accounting, collection, and taxpayer service

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provision encompassing many types of tax" (McCarten, 2004). The following are the key reasons for LTUs: improved compliance among major taxpayers and "pilot to test administrative reforms later expanded to the rest of the taxpayers"; support for tax reforms such as VAT in nations where tax officials have limited enforcement authority, improvements in the business environment communicate transparency and confidence in fair assessment and auditing to foreign investors (McCarten, 2004). According to McCarten, LTU fulfills these tasks in the following ways: "(i) reorganising from a tax to a functional structure, (ii) reducing the potential for corruption by automating and restructuring control systems, (iii) strengthening the audit function, (iv) changing attitudes of officials toward taxpayers; and (v) simplifying and reducing paper handling through appropriate use of information technology" (McCarten, 2004). Kidd (2010) claims that a function-based organization for tax collection has some benefits, including "enhanced compliance results, the ease of tax collection and compliance, improved resource management, and an increase in tax officers' integrity."

McCarten cites 1994 Dos Santos research in which it stated that in the short to medium term, the LTU system can boost tax collection. The primary issues that may occur and result in inefficiency are those that result in enterprises downsizing or preventing expansion above the threshold that would qualify them for LTU. The caution generated by this problem is summarized in Juan Toro, Katherine and Olivier (2002), who underline the importance of integrating LTU methods into an extra general tax administration, which includes small and medium taxpayers, avoiding the perception of LTU as a "parallel tax administration" (Juan Toro et al., 2002).

Semi-Autonomous Revenue Authority (SARA)

Many countries have established revenue agencies in an effort to improve the efficiency of their tax administrations or authorities. The term "unified semi-autonomous body" or "semi-autonomous revenue authority" or simply "revenue authority"(RA) has been used in literature to describe these authorities. Crandall and Kidd (2006) define RA as "a governance model for revenue administration where the traditional ministry of finance departments (tax and usually customs administrations) is established as an organisation or agency with a degree of autonomy from government and independence from standard public service policies". Apart from the objective of raising government revenue, the establishment of RA was motivated by the following: "(i) signaling political autonomy; (ii) creating managerial autonomy; and (iii) facilitating reform of tax administration generally" (Kidd & Crandall, 2006). The benefits of RA could accrue after it is implemented by Ministries of Finance, particularly in the fields of employment, salary, and procurement, hence facilitating tax administration in general (Kidd & Crandall, 2006). Taxpayers' willingness to show their financial information to taxation officials rather than finance ministers to avoid political capture and pressure is another advantage cited by Moore (2014).

Several research have been conducted to determine the efficacy and performance of RA on a global scale. Taliercio (2004) used a comparative analytical approach to investigate disparities in the design, performance, and sustainability of various RA in six case studies across Latin America and sub-Saharan Africa countries. A more autonomous RA increases agency performance, allows for organizational reform, and is "more adept at boosting

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performance than the less autonomous ones," depending on the quality of employees and proper design, as postulated (Taliercio, 2004). The main limitation of this study is that it relies on descriptive analysis rather than robust econometric tools to establish causality, and it is confined to just six nations. Kidd and Crandall reference a number of studies (Delay, Devas & Hubbard, 1999; Di John & Putzel, 2005; Gray & Chapman, 2001; Mann, 2004, to name a few) that show that having more autonomy leads to better performance. They further show that these studies lack analytical models that can be used to separate the effect of RA on tax collection. In conclusion, Kidd and Crandall criticize previous studies on RA efficiency for their methods of measuring autonomy (proposed using a scoring system rather than a quantitative one), data limitations in the scope of pre and post RA establishment, and, as previously stated, establishing and isolating causality (Crandall & Kidd, 2006).

Chapter Summary

This section in summary considered an overview of informality, mobile phone penetration and tax revenue within the SSA region. In terms of informality, the chapter looked at how the informal sector is categorised with respect to demographics and sectors (agriculture, industry and service) as well as comparing the informal sector of SSA with other regions. With respect to mobile phone penetration, the overview focused on the number of subscribers and level of penetration within the region. The overview on tax revenue focused on the evolution of tax revenue, the current state, some challenges of mobilising tax revenue within the region, and finally ended with tax reforms.

CHAPTER THREE

LITERATURE REVIEW

Introduction

This chapter reviews related literature. It is composed of two sections. Section One discusses some theoretical foundations on informality, mobile phone penetration and tax revenue. The second section highlights some empirical studies relating to informality, mobile phone penetration and tax revenue. The chapter concludes with a synthesis of the reviewed literature and a summary of the entire chapter.

Theoretical Review

The theoretical literature review, an assessment of linked theories that serve as the study's foundation, is presented in this section. The review consists of these sections: Theories of the informal sector (the dualists', the structuralists' and legalists' theory of the economy), theories on mobile technology (Technology Acceptance Model, Diffusion of Innovation Theory, Unified Theory of Acceptance and Use of Technology and Theory of Planned Behavior) as well as some theories on taxation such as Benefit Theory, Optimal Taxation Theory, Voluntary Exchange Theory and the Heller model of public fiscal behaviour.

Theories of the informal sector

The dualists' view of the informal economy

According to the dualist perspective, the informal sector develops as a result of exclusion from formal sector economic prospects. This is due to disparities in employment in the industrial sector and population growth, as well as the skills of people relative to the opportunities in the economy

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provided by that growth. According to dualists, the informal sector is a distinct, marginal sector unrelated to the formal sector that offers the poor with a safety net or income (ILO, 1972). The idea of the informal economy came from research on problems in developing countries (Gerxhani, 2007). It was thought that the informal sector existed alongside the formal sector to take in people who would otherwise be unemployed and without a way to survive. Scholars who agree with this viewpoint, referring to the informal sector as "informal," "secret," or "illegal" is unsuitable because it merely shows a different technique or strategy for meeting survival needs (Elijah & Uffort, 2007; Schneider, 2005). According to this view, studying the informal sector is of less significant because it exists only to meet basic needs without regard for profit, and hence operators have just one fundamental objective - subsistence. Nonetheless, a major flaw in this reasoning is that informality is not limited to developing or poor nations; it appears in sophisticated economies as well, where subsistence cannot be the primary motive as these nations have social security (benefits) systems that offer basic necessities.

Regarding the nature of the informal sector, the ILO has traditionally taken a dualist stance. All of its research on the informal sector, most particularly (2002) and most recently (2010), focus on alleviating poverty in order to lower the size of the informal sector in developing nations. Also, in favor of this dualist theory, studies by Elijah and Uffort (2007) and Schneider (2012) suggest that nations' increases in the informal sector are consistent with their poverty levels. From the dualists' point of view, it's understandable why the compliance of tax is a major difficulty in this industry - after all, survival, not profit, is the key motive for doing business in this industry.

The structuralists' view of the informal economy

People who adopt this viewpoint believe that the informal sector arose as a result of capitalism's rise and firms' need to cut costs and/or obtain a competitive advantage (WIEGO, 2016). Those who believe in structuralist thinking, such as Castells and Portes (1989), feel that the informal sector is subject to the formal economy. Small producers and traders are being subordinated by privileged capitalists in order to minimize cost (Moser, 1978). Furthermore, the dominance of powerful labor unions, as well as strict governmental laws which includes taxation, other social regulations and, health and safety, push formal businesses to involve in informal activities (Chen, 2012). The government's 'weak' regulation of the informal sector in comparison to that of the formal sector is seen by these formal firms as an opportunity to enhance income and cut tax responsibilities.

The informal sector is impacted and intricately tied to the operations of formal sector operators, according to structuralists. With regards to this theory, the informal sector exists to give 'cheap' services and goods to the formal sector. Casual employment and subcontracting to "informal businesses and people" by formal local firms or off-shore industries are common examples of these arrangements. Large firms that operate in the informal sector, according to structuralists, do so not merely to get around the government's strict regulations, but also to enrich themselves by aggressively dominating and mistreating the labor force there (Chen, 2012).

In some cases, the reasons why people and businesses in the informal sector don't pay their taxes can be found in their motivations. According to structuralists, excessive regulation in the formal sector, notably tax laws, and

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restrictions in the informal sector have a substantial impact on operators in the sector. This shows that sector operators' initial decisions to engage in activities that are regarded as informal in the economy are influenced by tax avoidance and evasion.

The Legalists' theory of the economy

The argument put out by legalists is that an aggressive legal system promotes illegal economic activity. Some firms choose to operate on a less formal basis because of the expenses associated with registering and licensing, as well as the ongoing expenses associated with maintaining a formal status, such as tax compliance and other formal arrangements. According to legal experts, informal employment measures are a reasonable reply by microentrepreneurs to the excessive regulation of state agencies (De Soto, 1989). According to this point of view, a high tax burden, ineffective economic rules, and excessive and needless administration all contribute to the development of the informal economy in most countries.

Rao and Walton (2004) added an extra twist to the informality argument by saying that some indigenous cultures don't work well in a current market system. They claim that the reason some nations have large informal sectors is because such nations' cultures have changed to make the informal economy a natural component of their way of life. As a result, their people try to stay away from the formal economy. Hence, indigenous institutions may be incompatible with a current market system in these economies, which means that a cultural shift is needed to get people to change their ways.

Rogers (2009) disproves the cultural argument by comparing the informal economies of Peru, Egypt, and Tanzania. He argues that while

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culture and history do have an impact on how people adapt to the market, this does not always mean that they are unable to engage in modern market economies (i.e., formal sector setting). According to Rogers (2009), "the majority of people are constrained to involvement in the informal sector because the formal market's regulations do not allow them to readily carry out all of the activities required to carry out every day economic transactions." Similarly, to the structuralists, the legalists argue that laws, particularly taxation, could account for the informal economy's size.

Theories on Mobile Technology

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is an information systems paradigm that simulates consumer adoption and use of technology. TAM asserts that perceptions of the technology's utility and ease of use have an impact on how well it is received (Davis, 1989). The term "perceived usefulness" relates to an individual's trust in a certain system's ability to improve work performance in an organisational context. While the degree to which a user believes that using a given system would be straightforward indicates the system's ease of use. According to the concept, perceived usefulness and perceived ease of use, two important factors in how people adopt new ideas, have an indirect effect on innovation use (Hong, Lin, & Hsieh, 2017).
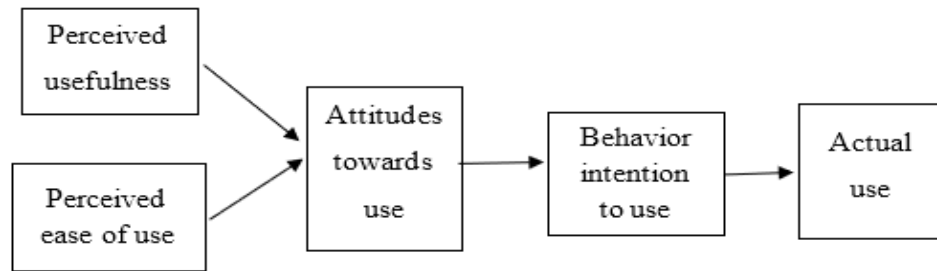
Figure 6: *Technology Acceptance Model (TAM) Adapted from Davis (1989)*

Source: Adu (2021)

Diffusion of Innovation Theory

The Innovation Diffusion Theory is one of the most popular ways to look at how people use IT and how new IT ideas spread across and within communities. The Diffusion of Innovation theory, according to Rogers (2003), is the process through which innovation is conveyed over time amongst members of the social system through certain channels. According to the theory, innovation is considered as a new or unfamiliar idea, procedure, or technology to individuals or organisations in a certain field or social context. The means of sending information from one person or organisation to another is known as a communication channel. Lastly, a social system is made up of several components that cooperate to address issues in order to achieve a common goal.

Rogers (1962) asserts that the goal of diffusion innovation theory is to understand how technologies are used, to explain how they are adopted, and to predict how quickly things will change. The theory says that scientific progress is shared among members of a social network over time and across different networks. This theory concerns the sub-Saharan region in that with the invention of mobile phones over the decades, it has served as a medium through which tax revenue can be mobilised.

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In addition, Rogers (2003) argued that the phases of technological advancement consist of five sequential stages that occur simultaneously. These are "knowledge: a person learns about the nature of innovation, understands how it operates and finds information on how to use it correctly. The second is the knowledge phase at which the innovation-decision process is evaluated. The third is the resolution stage where the user decides to adopt or reject the innovation. In Rogers' view, adoption is the full use of innovation as the most favourable course of action available, whereas rejection is not the use of innovation". The confirmation stage is the "final stage", in which "the fortification is linked to the positive outcomes of the innovation and the user(s) seeks validation for their decision."

Unified Theory of Acceptance and Use of Technology (UTAUT)

This paradigm, which was developed by Venkatesh and others, tries to make the consumer's desire to utilize the information system and the system's subsequent usage behavior clear. The "TRA, TAM, Motivational Paradigm, Planned Behaviour Theory (TPB), Technology Diffusion Theory, PC Usage Model, Social Cognitive Theory, and the TAM and TPB Combination Model" are the eight theoretical models that make up the UTAUT model. UTAUT's primary objective is to distinguish the gap between "planning to use" and "actually using" an information system (IS) (Venkatesh, Morris, Davis & Davis, 2003). According to theory, intentional usage and behavior are directly influenced by four major constructs: "performance expectations", "effort expectations", "social influence", and "facilitating factors". Experience, age, gender and willingness to use are designed to facilitate the effect of the four main constructs on the intent and behaviour of use (Venkatesh et al, 2003).

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Theory of Planned Behaviour

Because people do not have complete control over their online payment activities, with respect to the theory of planned behavior, perceived behavioral control should become a significant component of m-payment acceptance. Self-efficacy and enabling situations are two components of perceived behavioral control (Mathieson, 1991; Taylor & Todd, 1995).

Bandura (1982) defined self-efficacy as a person's confidence in his or her capability to do an activity, whereas enabling conditions are the resources required to engage in that conduct (Triandis, 1971). The theory of planned behavior captures the internal psychological elements that influence user acceptance through several external variables investigated in Information Systems (IS) research, and it may give a unifying framework for integrating disparate avenues of investigation (Li, 2008).

Theories on Taxation

Benefit Theory

The benefit theory holds that taxes ought to be distributed to people in accordance with the advantages they derive from public spending. The benefit hypothesis states that tax should be computed as payment for the services rendered by the government to individuals who are state members (Pigou, 1960). Identifying the recipients of various government expenditures can be challenging, and determining how much benefit a single person receives from a government expenditure is extremely tough. These two issues make it difficult to put the benefit theory into practice. Benefit-based taxation will not create a substantial amount of revenue for the government since, as previously mentioned, many individuals who can afford to pay high taxes may end up

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paying less because they do not gain a significant amount of benefit from government spending (Pigou, 1960).

The theory also has four other implications: "taxation is voluntary", "tax is seen as a payment for benefits from the government", "it doesn't take into account how hard it is to price both public goods and goods that are harder to price", and "some people won't pay tax voluntarily unless taxation is made mandatory and tax enforcement is backed by punishments."

Optimal Taxation Theory

The theory of optimal taxation examines how taxes can be extended to provide the greatest social welfare outcomes (Hellerstein, 1997). Two of the models covered in optimum taxation theory are the Ramsey rule and the Laffer curve model. The Ramsey rule states that the taxation ratio should be inversely related to the "price elasticity of demand for tangible and intangible electronic goods" in order to avoid the excessive burden of taxation (Ramsey, 1927). This idea holds that in order to meet a specific revenue objective, governments make an effort to reduce the additional burden (effectively lost) of taxation. The Ramsey rule takes into account the "optimal" taxation approach, which seeks to reduce the overall tax burden while still generating the necessary revenue from "tangible and intangible" electronic companies.

Arthur Laffer invented the optimal taxation Laffer curve. The model suggests the government will attempt to raise as much revenue as possible, despite tax efficiency losses. Constitutional limitations and other laws are the only constraints on the government's thirst for greater money. The Laffer curve considers how taxes affect both "tangible and intangible" electronic products in a negative way, as well as how this affects tax revenues. An

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empirical investigation has revealed that in transactions involving electronic commerce, a higher tax rate is not always the one that will maximize revenue; in some cases, a lower tax rate may even result in higher revenue (Effiong & Attah, 2016).

Voluntary Exchange Theory

According to this hypothesis, people trade voluntary payments for government services based on how the taxpayer perceives those services. The voluntary exchange idea is based on the reality that public service entails taking resources from the private sector and putting them to use in the public sector. The public sector must return value for the private resources it takes and utilizes, which is usually in the form of public services and goods (Lindahl, 1919). Garg (2000) cites further guidelines for the taxation of technology as follows: Neutrality: The taxation system ought to be fair and impartial. The type of technology shouldn't change how much tax is paid, and it shouldn't lead to double taxation or no taxation at all; Efficiency: The system of taxation should be cost-effective for both the government and the private sector. Increased compliance costs may encourage tax avoidance or stifle technological advancement; Simplicity: Simple laws elicit voluntary compliance and reduce litigation, which should be self-evident; Flexibility and effectiveness: The legal frameworks must be capable to generate the appropriate sum of tax at the appropriate time. It should be sufficiently discouraging to tax evaders while also having the least possibilities for tax evasion.

Despite the fact that it is hard to pass a law that addresses all future technological and economic advances, it should be flexible enough to apply to

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fresh conditions without causing harm to its wording.; In the case of a cash jurisdiction, revenue should be split.: while developed countries would like to keep focusing on residence-based taxation, the goal is to prevent dual taxation and avoid conflicts and lawsuits.

The Heller model of public fiscal behaviour

The Heller (1975) model is based on the observation that one of the most basic tasks that public sector decision-makers in all countries face is allocating money among various spending categories while adhering to budget limits. As a way of simplifying the discussion, he distinguished between two types of public expenditure: recurrent expenditure, which refers to government consumption, and capital expenditure, which refers to public sector investment. Taxation and other recurrent revenue, as well as borrowing, are the main sources of government revenue. Several approaches to analysing the fiscal behavior of the public sector have been proposed by Heller (1975), one of which is to assume that the behavior is a reflection of the acts of a group of public decision makers (i.e., a Council of Ministers, etc.). He made the assumption that they optimise their utility by taking all relevant factors into account: "(i) alternative uses of public resources such as expenditures for economic growth, for provision of current social and economic services, and for the maintenance of political order and stability; (ii) the distribution of total output between the private and public sector; (iii) alternative modes of domestic financing such as borrowing and taxation; and (iv) alternative types of external assistance, such as grants and loans".

The tax theory selected for the study

The Heller model of public fiscal behaviour serves as the theoretical basis for this study. According to the Heller model, fiscal decisions made in developing nations represent the actions of a public decision-maker who maximizes a welfare function while working within a budgetary limit. The welfare function is then maximized to determine the desired tax level (tax revenue-GDP ratio). The model captures some determinants of tax revenue which are per capita income, tax base handles, macroeconomic policies and the external environment. In this study, the informal sector falls under the tax base handles.

The informal sector is seen to impact on tax revenue negatively since it's difficult to identify and tax actors in this sector. Since the informal sector forms a greater portion of the economy, and also provides employment opportunity in the economy, when measures are put in place to identify the various actors in the sector and tax them accordingly, it will help improve the tax revenue.

Empirical Review

A study by Guillermo and Deyve (2019) looked at the scale of Peru's informal economy in comparison to other nations in Latin America and the Organisation for Economic Cooperation and Development (OECD). The Multiple Indicator-Multiple Cause (MIMIC) model was used in the research. According to the findings, the estimated average size of the informal economy on tax revenue as a percentage of GDP in Peru was 37.4 percent, 34 percent in Latin America, and 19.89 percent in OECD nations, which is less than half of the average in Latin America. Findings from the study showed that the

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informal sector impacted tax revenue negatively. The study recommended that factors such as trust in the government and politicians, transparency and efficiency in government spending, the elimination of corruption, are likely more important and effective variables to consider in reducing informality than tax reduction programs.

Obara and Nangih (2017) investigated the impact of taxing the informal sector in Nigeria, focusing on Rivers State. The researchers used a descriptive research design, as well as a judgmental and convenience sampling technique. The Kruskal Wallis and Chi-square test were used to examine the formulated hypotheses, and also used to analyse the data collected. The results indicated that taxing the informal sector increased revenue collection and had a positive effect on Nigeria's economic development in most developing states.

In Uganda, Mawejje and Francis-Munyambonera (2016) investigated the effect of sectoral growth and public expenditure on tax revenue. First and foremost, they developed an analytical model for tax revenue performance that took into consideration key structural characteristics that are common in most developing nations with dominant informal economies. Secondly, they used ARDL bounds testing techniques to validate the model predictions on Ugandan time series data. Their findings suggested that agriculture and informal sectors' domination are the primary barriers to tax revenue performance. Additionally, tax revenue performance is positively correlated with development expenditures, trade openness, and industrial sector growth. They advocated strategies to foster value-added links between agricultural and

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industrial sectors, while highlighting the importance of unlocking the informal sector's potentially enormous contributions in order to broaden the tax base.

Koyunco, Yilmaz, and Unver (2016) used an unbalanced panel data set from 1990 to 2013 to examine the impact of ICT penetration on tax revenue for 153 countries, using four ICT penetration indicators and three tax revenue indicators. They discovered a very statistically significant positive link between ICT penetration and tax income using univariate and multivariate time effect models. The four ICT penetration measures (internet, cellphone, computer, and fixed broadband) and the three tax revenue indicators [tax revenue (as percentage of GDP), taxes on goods and services (value added of industry and services in percentages), revenue value-added taxes] were all statistically significant and valid. Additionally, they suggested that between 1990 and 2013, ICT penetration increased tax revenue across countries, and that controlling for other factors that may contribute to tax revenue growth is recommended.

Joe Duke, Kankpang, Emenyi, and Efiok (2013) examined the constraints to electronic commerce serving as a facilitator of tax revenue in Nigeria. The research was based on data from 2008 to 2011. The statistical significance of indirect taxes sourced from four e-commerce proxies, namely Automatic Teller Machines (ATM), Point-of-Sale (POS), On-line Purchasing (Internet Purchasing), and Mobile Phone Payment (GSM) was assessed using a model which was developed by the authors. The findings reveal that e-commerce transactions contribute very little to Nigeria's overall tax revenue. Furthermore, the study discovered that while ATM and POS tax revenue

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contributions are significant and large, those from Internet Purchasing and GSM are negligible.

Bristol (2001) examined the influence of electronic commerce on the Caribbean community's tax revenue. The study determined the impact of electronic commerce on the tax revenue using a static microeconomic technique. The analysis was predicated on the assumption that the region's current foreign trade trends and increase in electronic commerce would continue. Tax revenues would rise as a result of expanded export markets, tax and tariff revenues would rise as a result of higher traditional services and goods tax imports, and tariff revenues would drop as a result of digital items, based on the assumption of the analysis in the study. It was also projected that the displacement of intermediate-level businesses would result in a reduction in tax revenue.

Effiong and Nwangu (2020) used data from the CBN annual report, CBN economic evaluations, and the Federal Internal Review Service to analyze the influence of electronic transactions on tax collection in Nigeria, using the Ordinary Least Square (OLS) regression approach. The study found that e-commerce transactions and ATM transactions had a significant impact on tax revenue, whereas POS and mobile phone transactions have a significant impact on tax revenue but not as much as ATM and web payments. They claimed that the minimal impact of mobile phone and POS transactions was due to a lack of client knowledge. They discovered an interdependent connection between tax revenue and e-commerce transactions. Thus, e-commerce transactions make a major contribution to the total amount of tax revenue collected in a present-day market system that has risen in concurrence

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with the use of worldwide payment systems. Additionally, they recommended that revenue agencies make particular improvements to guarantee that all taxable electronic transactions are correctly recorded, collected, taxed, remitted, and reconciled.

Using panel data from 1980 to 2014, Nnyanzi, Babyenda, and Bbale (2016) investigated regional economic integration and tax revenue in the East African community. They used the GMM technique as their valuation technique, and the findings of their study demonstrated that East African regional integration has a major influence on tax revenue as a result of the presence of strong institutions. They advocate for any policy program that aims to improve manufacturing, and trade, macroeconomic stability, financial sector, the institutional environment and a well-coordinated strategy to reducing the informal sector. Lastly, they argue that, given the detrimental effects of capital account liberalisation, carefully constructed capital control regulations are likely to boost tax receipts in East Africa.

Using an unbalanced panel dataset of 39 nations from 1980 to 2005, Addison and Levin (2012) examined the predictors of tax revenue in sub-Saharan Africa. The study's estimating technique was a two-step GMM. The econometric analysis took into account some factors that could influence tax revenues, including the tax base, structural factors, foreign aid, and conflict. Apart from examining the determinants of overall tax revenue, they also examined how these determinants affect the tax structure, focusing on three major tax types: domestic direct taxes, domestic indirect taxes and international trade taxes. To begin with, their findings strongly suggest that the overall tax to GDP ratio is higher in economies that are more open and less

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agriculturally based, as well as in countries that are less populated and peaceful. The implementation of VAT had a positive and significant influence on the tax-GDP ratio as a whole. Evidence of links among the effect of per-capita GDP and openness on the trade-tax GDP ratio was discovered by them. The direct tax to GDP ratio was negatively impacted by the size of the agricultural industry and foreign aid, while positively impacted by a stable environment and VAT.

Coulibaly and Gandhi (2018) investigated the mobilisation of tax revenues in Africa considering the role of state play and policy options. They created an analytical framework to help them understand the factors that are still impeding the region's revenue collection. They discovered that the still-lower tax collections in the region are related to both decreased taxing capacities and revenue collection inefficiencies using the Stochastic Frontier Analysis (SFA) method. According to their findings, boosting governance, including eliminating corruption and enhancing accountability, can dramatically reduce inadequacies and contribute up to $110 billion revenue yearly in the next five years, on average.

Ayenew (2016) examined the main drivers of tax income in Ethiopia from 1975 to 2013 using the Johansen maximum likelihood co-integration method. His analysis revealed that over time, foreign aid, the industrial value-added share of GDP and real GDP per capita income all had a significant and positive effect in the long-run on tax revenue. On the other hand, inflation significantly and negatively affected tax revenue. In the short run, inflation and GDP per capita income had a negative impact on Ethiopian tax revenue, whereas the industrial value-added share of GDP had a positive impact. The

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expected sign of the real gross domestic product per capita income was not met. Finally, the study suggested that actions such as structural reforms, increased per capita income growth, introducing new tax bases, and the efficient use of foreign aid inflows be considered by the relevant bodies in order to improve tax administration and revenue growth.

Zarra-Nezhad, Ansari, and Moradi (2016) examined the factors that influence tax revenue: does liberalisation increase or decrease it? They used Generalised Method of Moment regression on a panel of 83 countries from 1990 to 2012 to test the hypothesis of whether trade liberalisation increases tax revenue. Additionally, the study evaluated the statistical significance of other determinants of tax revenue as a percentage of GDP. Increased trade liberalisation is associated with more tax revenue according to the results of dynamic panel estimation. The following variables had a statistically significant impact on tax revenue: democracy, official exchange rate, urbanisation, agricultural share of GDP and GDP growth rate. As a result, the study indicated that adequate macroeconomic policy is required to boost trade liberalisation and thereby increase government revenue.

Trade liberalisation, exchange rate changes, and tax revenue in sub-Saharan Africa were examined by Agbeyegbe, Stotsky, and WoldeMariam (2004). They used the Generalised Method of Moment technique to investigate the link between these factors using a panel of 22 nations in Sub-Saharan Africa from 1980 to 1996. The study's findings indicated that while the relationship between trade liberalisation and tax revenue is sensitive to the proxy for trade liberalisation used, trade liberalisation is not strongly associated with aggregate tax revenue or its components in general, though it

is associated with higher income tax revenue in one measure. Lower tax revenues or its components are linked to currency appreciation and greater inflation. These results partially supported earlier findings and the idea that trade liberalisation can be implemented while maintaining total revenue yield with the help of suitable macroeconomic policies.

Davoodi and Grigorian (2007) conducted a cross-country investigation of Armenia's persistently low tax revenue considering tax potential vs. tax effort. By benchmarking Armenia's tax-to-GDP ratio against some comparator countries and conducting a comprehensive econometric investigation of the primary determinants of tax revenue, the study considered a variety of reasons that may account for Armenia's chronically poor tax collection. The study discovered empirical support for the notion that Armenia's low tax-to-GDP ratio persists as a result of weak institutions and a significant shadow economy. In Armenia, the difference between potential and actual tax collection might be as much as six and half percent of GDP.

Chapter summary and synthesis of literature

This chapter covered some theoretical literature and empirical studies relating to informality, mobile phone penetration and tax revenue. The researcher searched for relevant related materials, including articles, journals, reports, and working papers on the subject matter. All references in related studies were assessed to verify that most of the literature for this study was captured. Nevertheless, it must be pointed out that the literature list presented in this study is non-exhaustive. Although the focus of the study was in Africa, literature on European and other non-African nations were also considered to capture other relevant variables within the context of the study.

Among the studies that were reviewed, majority of them focused on multiple countries from different continents. The remaining studies were conducted in either specific countries or regions worldwide. The Autoregressive Distributive Lag technique, random and fixed effects models as well as the Generalised Method of Moment were the most dominantly used methods. With regards to the link between the variables that were used in these studies, the relationship between the informal sector and tax revenue was negative. In almost all the countries and regional blocks studied, evidence of negative relationship between the informal sector and tax revenue has been documented. Also, the relationship between mobile phone penetration and tax revenue in the countries studied was found to be positive.

In summary, it should be said that although empirical studies on the informal sector and issues relating to tax revenue are extensive, a significant number of works examining the relationship between the informal sector and tax revenue have ignored the moderating role of mobile phone in influencing tax revenue through the informal sector (Deyve, 2019; Obara & Nangih 2017; Mawejje & Francis-Munyambonera (2016). It is the argument of this study that mobile phone penetration has a decisive role to play in enhancing tax revenue.

Despite sometimes acknowledging this inevitable, causal connection, most researchers fail to account for mobile phone penetration in their explanatory models. When assessing tax revenue, mobile phone penetration is key to consider, and as such, failure to incorporate it might lead to inconsistent results. The present study sought to fill this gap in the existing literature by incorporating the moderating role of mobile phone penetration

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into the informality-tax revenue relationship. The next chapter focuses on the

methodological section of the study.

CHAPTER FOUR

RESEARCH METHODS

Introduction

This chapter discusses the methods employed in the study. The chapter highlights the steps and procedures that guided the study in addressing its objectives. The chapter is structured into three sections. It first begins with an explanation of the research philosophy, design, and approach. The first section features the specification of the empirical model. The type and sources of data with their descriptions are highlighted in the second section of the chapter. Section Three looks at the technique and procedures used in the estimation process as well as diagnostic tests associated with the results. The third section ends with the chapter summary.

Research Philosophy

With regards to the research philosophy, Saunders, Lewis & Thornhill (2007) refer to it as the nature and development of knowledge, which supports the research approach and methodologies used in the study. According to Easterby-Smith, Golden-Biddle & Locke (2008), it is critical to comprehend philosophical issues involving evidence required, data gathering techniques, and analysis from the start of the research process. As such, the study adopted a positivism approach. According to Malhotra (2017), the positivist stance is based on the basic premise that research should be scientific in the manner of natural sciences. In particular, the study adopted positivist research because it commands an objective perspective of reality, in which the researcher seeks to measure or explain, resulting in knowledge that is simplified across diverse individuals, time periods, and locations (Harrison & Reilly, 2011).

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Research Approach

With regards to the goals and objectives of the study, the study employed a quantitative research approach to examine the effect of informality and the moderating role of mobile penetration on tax revenue in sub-Saharan Africa. The purpose of quantitative research is to evaluate and test hypotheses about natural events through the use of statistical models (Hohenthal, 2006). In particular, this study employed a quantitative research approach because of the fact that the study's results can be replicated, and it maximizes objectivity and generalisability.

Research Design

A key aspect of an excellent research is to fit your study objectives and questions to your research designs (Sinkovics Penz and Ghauri, 2008). According to Saunders et al, (2007), a research design can be broadly classified into three types: explanatory, descriptive and causal. The study adopted an explanatory research design based on the available information, such as the nature of the problem, its scope, its objectives and the data collected. An explanatory research design was adopted in order to gather background information as well as to define the terms of the research problem. Additionally, it is conducted to gain a deeper understanding of the research problem.

Model Specification

Theoretical model specification

In order to investigate the effect of informality on the tax revenue and the moderating role of mobile phone penetration on informality to affect tax revenue in the SSA region, this study adopts and extends the well-known tax

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framework developed by Heller (1975) as basis for the theoretical model specification. According to Heller's (1975) model, public decision-makers in developing nations optimize a welfare function while working within a budgetary limit while making fiscal decisions. The public decision maker utility function is given as;

$$U = (Y - T, G, D, F + L) \ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where, U_{Y-T} and $U_g > 0$; U_D and $U_{F+L} < 0$ 0, if D and F+L > 0; U_D and $U_{F+L} > 0$ if D and F+L < 0. Y-T (Y is GDP and T is tax revenue) is the private sector's disposable income; D is net domestic government borrowing (non-tax revenue); G is total government expenditure; and (F+L) is net foreign financing comprising of grants (F) and loans (L) including external arrears accumulation or decumulation (net amortization). The variables D and (F+L) can either be positive or negative, thus, the first derivatives of U with respect to D and (F+L) are either negative or positive. All variables in the model are in real per capita terms. The decision maker's budget constraint is given by:

$$G = T + (F + L) + D \ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

In order to determine the desired tax revenue, (1) maximized subject to (2). It is assumed that the utility function takes the following quadratic form:

$$U = \emptyset_1(Y - T - Y_s) - \frac{\emptyset_2}{2}(Y - T - Y_s)^2 + \emptyset_3(G - G_S) - \frac{\emptyset_4}{2}(G - G_S)^2 -$$

$$\emptyset_5 D - \frac{\emptyset_6}{2}D^2 - \emptyset_7(F + L) - \emptyset_8(F + L)^2 \ldots\ldots\ldots 3$$

Where $\emptyset's$ are positive constants. Gs and Ys and are subsistence levels of government expenditure and income respectively. Since Gs and Ys and are not observable, it is assumed that they are simple linear functions of income such that:

$$G_0 = g_0 + g_1 Y \ldots\ldots\ldots 4$$

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$$Y_S = y_0 + y_1 Y \ldots\ldots\ldots 5$$

Maximizing (3) with respect to *T*, *G*, and *D* after substituting for *G*s and *Y*s

subject to the budget constraint (2), yields the following reduced form for the

desired equation for the tax revenue-GDP ratio (*T/Y*)* after simultaneously

solving the optimal equations:

$$\left(\frac{T}{Y}\right)^* = \left(\frac{\mu + \emptyset_4 g_0 - \pi Y_0}{\pi + \emptyset_4}\right)\left(\frac{1}{Y}\right) - \left(\frac{\emptyset_4}{\pi + \emptyset_4}\right)\left(\frac{F+L}{Y}\right) + \left(\frac{\emptyset_4 g_1 - \pi Y_1}{\pi + \emptyset_4}\right) \ldots\ldots\ldots 6$$

$$\text{Where } \mu = \left(-\emptyset_1 + \emptyset_3 - \frac{\emptyset_1 \emptyset_4}{\emptyset_6} + \frac{\emptyset_4 \emptyset_5}{\emptyset_6}\right) \text{ and } \pi = \frac{\emptyset_2(\emptyset_4 + \emptyset_6)}{\emptyset_6}$$

Variable *D*, vanishes while solving for the desired tax revenue GDP ratio. We

now assume that the actual tax revenue to GDP ratio (*T/Y*) is a function of the

desired tax revenue to GDP ratio (*T/Y*)* and certain tax bases (B) as well as

the status of macroeconomic policies. In this study, the tax base is captured by

informality (INFORMAL) and mobile phone penetration (MPP). Thus:

$$\left(\frac{T}{Y}\right) = f\left[\left(\frac{T}{Y}\right)^*, INFORMAL, MPP, M\right] \ldots\ldots\ldots 7$$

Combining equations (6) and (7) gives the expression for the actual tax shares

as:

$$\left(\frac{T}{Y}\right) = f\left[\left(\frac{1}{Y}\right), \left(\frac{F+L}{Y}\right), INFORMAL, MPP, M\right] \ldots\ldots\ldots 8$$

Since β is positive and α could be either be negative or positive, the actual tax

revenue to GDP ratio (*T/Y*) is a negative function of (*F+L*)/*Y* and an uncertain

function of the inverse of per capita income (1/*Y*). Equation (8) identifies per

capita income (*Y*), foreign financing as a ratio of GDP $\frac{F+L}{Y}$ elements of the

country 's tax bases (B) also known as tax handles, macroeconomic policies

(M).

Using the generic determinants of the model, the theoretical model is finally

expressed as:

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$$\frac{T}{Y} = f(PCI, Tax\ Base, Econ\ Policies, Ext\ Environment)\ldots\ldots9$$

where PCI is per capita income, $TaxBase$ is the tax base of handles, $Econ$ $Policies$ is the macroeconomic policies, and $Ext\ Enviroment$ denotes external environment factors that may affect tax revenue.

Empirical model specification

In line with the literature (for example, Feger (2014); Terefe and Teera (2018)), equation (9) is extended to include the variables of interest: informality and mobile phone penetration. Thus, the empirical form of equation (9) is the standard model specified in equation (10):

$$TAXRV_{i,t} = \beta_0 + \beta_1 TAXRV_{i,t-1} + \beta_2 INFORMAL_{i,t} + \beta_3 MPP_{i,t} + \beta_4 \mathbf{X}_{i,t} +$$

$$\eta_i + \mu_t + \varepsilon_{i,t}, \text{i=1,2, 3,\ldots,26; t =1, 2,\ldots,11} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots..10$$

Where TAXRV; represents tax revenue as percentage of GDP, INFORMAL, represent the informal sector as a percentage of GDP, MPP represents mobile phone subscriptions (per 100 people) which is proxy for mobile phone penetration and the X; represents a vector other control variables including TOT which indicates trade openness as percentage of GDP, AGRIC which also represents the share of agriculture value added (% of GDP), INF represents inflation, consumer price index (annual %), SER is the share of service value added (% of GDP), and AID is net Official Development Assistance (ODA) received (% of GNI), GDPPC represents GDP per capita (constant 2015 US$), COC is control of corruption, μ_t indicates time-specific fixed effects and η_i individual country-specific effects and $\varepsilon_{i,t}$ indicates the error term. The subscripts *t* and *i* denote country and time period respectively.

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To achieve objective one, which examines the effect of informality on tax revenue in general, the model includes the lag of tax revenue which is specified below:

$$TAXRV_{i,t}= \beta_0 + \beta_1 TAXRV_{i,t-1} + \beta_2 INFORMAL_{i,t} + \beta_3 \mathbf{X}_{i,t} + \eta_i + \mu_t + \varepsilon_{i,t}$$

i =1, 2, 3,…, 26; t =1, 2,…,11   …………………………………11

Where, $TAXRV_{i,t-1}$ is the lag of tax revenue as percentage of GDP. The lag of TAXRV is taken in order to access whether previous year's tax revenue has any impact on current year tax revenue. Moreover, since this is dynamic analysis, there is the need to specify the lag of the tax revenue in the model. All other variable remains as defined earlier.

To achieve objective two, which examines the effect of mobile phone penetration on tax revenue in general, the model includes the lag of tax revenue which is specified below:

$$TAXRV_{i,t}= \beta_0 + \beta_1 TAXRV_{i,t-1} + \beta_2 MPP_{i,t} + \beta_3 \mathbf{X}_{i,t} + \eta_i + \mu_t + \varepsilon_{i,t}$$ i =1, 2, 3,…, 26; t =1, 2,…,11   …………………………………12

To achieve objective three, thus examining the moderating role mobile phone penetration is playing on informality to affect tax revenue; model (3) is specified below;

$$TAXRV_{i,t}=\beta_0 + \beta_1 TAXRV_{i,t-1} + \beta_2 INFORMAL + \beta_3 MPP_{i,t} +$$

$$\beta_4 \mathbf{X}_{i,t}+ \beta_5 (INFORMAL_{i,t} * MPP_{i,t}) + \eta_i + \mu_t + \varepsilon_{i,t},$$ i =1, 2, 3,…,26; t =1, 2,…,11   ………………13

Where $\left(INFORMAL_{i,t} * MPP_{i,t}\right)$ denotes an interaction term between informality and mobile phone penetration. All other variable remains as defined earlier, β_0 represents the intercept term, $\beta_1, \beta_2, \beta_3, \beta_4 \ and \ \beta_5,$ are our parameter or coefficient of interest and ε_t is the error term in the model.

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Data Source and Expected Signs

A panel annual data series from 2009 to 2019 was used for the study. The data series were sourced from World Development Indicators (WDI) of the World Bank, World Governance Indicators (WGI) of the World Bank, and Medina and Schneider (2018). It should be noted that only 26 countries from the sub-Saharan African region were selected as a result of data unavailability.

Table 1: Variables, Data Source and Expected Signs

Variable	Description	Source	Expected sign
Tax Revenue	Tax revenue as % of GDP	WDI	Dependent Variable
Informality	Size of the informal sector measured as a % of GDP	Medina and Schneider (2018)	Negative
Mobile Phone Penetration	Mobile cellular subscriptions (per 100 people)	WDI	Positive
Trade Openness	Openness to international trade, defined as the sum of imports and exports as a % of GDP	WDI	Positive/Negative
Agriculture	Share of agriculture, value added as a% of GDP	WDI	Negative
Inflation	Consumer price index (annual %)	WDI	Negative
Service	Share of service, value added as a% of GDP	WDI	Positive

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Aid	Net Official Development Assistance (ODA) received (% of GNI)	WDI	Positive/Negative
GDP per capita	GDP per capita (constant 2015 US$)	WDI	Positive/Negative
Control of Corruption	Control of corruption [- 2.5(weak) to 2.5(strong)]	WGI	Positive

Source: Adu (2021)

A Detailed Explanation of the Choice Variables

Tax Revenue (TAXRV): This can be defined as the ratio of a nation's tax revenue relative to its gross domestic product (GDP). The ratio offers a useful perspective on a nation's tax revenue because it reflects the proportion of possible taxes to the economy. It also offers a picture of the general trend of a country's tax policy and international comparisons of the tax revenues of various nations.

Informality (INFORMAL): In the economic literature, there is still disagreement on the definition and size estimates of the informal sector. Numerous studies have characterised and assessed the extent of the informal sector, omitting illegal operations (e.g., Buehn & Schneider, 2012; Elgin & Öztunali, 2012; Medina & Schneider, 2018), or including it (Alm & Embaye, 2013). The former method is employed in this study. Size of the informal economy estimates as a share of GDP are drawn from Medina and Schneider (2018). These figures were obtained using the Multiple Indicators-Multiple Causes (MIMIC) method. The MIMIC model, a specific kind of structural equation model (SEM), estimates an unobservable variable (the

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shadow economy) by using relationships between its effects and several observable causes. The MIMIC model is shown in the appendices. The "night lights" method by Henderson, Storeygard, and Weil (2012) is used by Medina and Schneider (2018) to measure economic activity. This method uses satellite data. As a result, they offer a satisfying response to the objections of earlier research based on national accounting that were related to the endogeneity problem of GDP. The analysis anticipates a negative outcome for the informal sector because it is thought to be the sector that evades taxes and is difficult to tax.

Mobile phone penetration (MPP): This is measured as the mobile cellular subscriptions (per 100 people). These are subscriptions to a public mobile telephone service that provides access to the PSTN using cellular technology. The indicator includes (and is split into) the number of postpaid subscriptions, and the number of prepaid accounts (i.e., that have been used during the last three months). It also applies to all mobile cellular subscriptions that offer voice communications. Mobile phones usage serves as an avenue through which the governments generate revenue, since there are various forms of taxes that are imposed on its usage. Moreover, it has become an avenue through which individuals pay their taxes. Once the level of subscriptions increases, we expect revenue to increase in turn. Therefore, mobile phone penetration is expected to impact on revenue positively.

Control and instrumental variables in the model

Openness to international trade (TOT): Trade openness can be defined as the degree to which a nation is open to participating in international trade. Trade openness is measured by total trade as a percentage of GDP.

According to Baunsgaard and Keen (2010), due to import taxes, trade volume can have a positive effect; however, as trade grows, the formalisation and productivity of the economy increases, providing more opportunities to collect taxes; on the other hand, an open economy lowers tariffs and trade barriers, which can have a negative impact on tax collection. Hence, the expected sign of trade can either be positive or negative.

Share of Agriculture value added (AGRIC): Agriculture is sometimes referred to as "the hardest sector to tax," according to Matsuyama (1992), because it is characterised by a significant informal sector and underground economies controlled by a high number of subsistence farmers. Inefficient tax administration puts pressure on the government, which makes it more likely that businesses won't pay their taxes, which further cuts tax revenue. In contrast, higher agricultural productivity improves agricultural output, which in turn boosts tax income and government infrastructure spending. Therefore, the expected sign for agriculture can either be positive or negative.

Inflation (INF): This is determined by the consumer price index's yearly growth rate, which represents the pace of change in prices throughout the entire economy. This is all about how government revenue reacts to price increases over time. Due to tax collection lags, its effect, known as the Oliveira-Tanzi effect, states that inflation has a negative influence on tax collections (Terefa et al.,2018). Inflation actually decreases the real value of taxes collected between the time of implementation and the time when they are actually imposed. Hence, negative relationship is expected between inflation and tax revenue.

Share of services value added (SER): The service industry has become the most significant and dynamic sector of the economy in recent years, and its contribution to GDP has been rising significantly. Furthermore, the sector contributes to job creation, international trade, and foreign direct investment. The economy is transitioning from being based on manufacturing to being based on services. As a result, a positive link between service value added shares and tax revenue is expected.

Foreign Aid (AID): The World Bank measures foreign aid as net official development assistance per capita received by recipient countries. For the economies of less developed countries in sub-Saharan Africa, where there is an obvious resource imbalance due to insufficient tax revenue mobilisation, foreign assistance is unavoidable (Terefe and Teera, 2018). However, the impact of international assistance is determined by the combined effects of grants and concessional loans. Loans exert a positive impact on taxes because they must be repaid, while grants have a negative impact because recipients can easily redirect funds to non-productive economic activities (aid fungibility). Therefore, the overall impact of foreign aid on the mobilisation of domestic resources will be negative and vice versa if the negative effect of grants outweighs the positive effect of loans. Therefore, the expected sign for aid could either be positive or negative.

Per capita income (GDPPC): This is measured as GDP per capita (constant 2015 US$). The impact of per capita income on tax collection is unclear based on the theoretical model. The amount of per capita income, which serves as a proxy for economic development affects various tax kinds differently. For instance, while increased per capita income raises the share of

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indirect tax, trade taxes are likely to decrease. As a result, the overall net effect frequently depends on which tax type accounts for the majority of a nation's tax revenue. Trade tariffs are a significant source of revenue for governments during the early phases of development and the pre-structural adjustment era, according to Farhadian-Lorie and Katz (1989). In such cases, higher per capita income is anticipated to result in lower revenue shares of total taxes. But as a country gets to higher stages of development, not only does the services sector get better, but so does the way taxes are handled, which leads to less money being spent on taxes. This makes the nation more dependent. The expected sign of per capita income can either be positive or negative.

Control of corruption (COC): It is captured by the degree to which public figures like politicians, leaders, and others used their positions of influence for personal benefit. Bribes, favoritism, the abuse of power for one's own benefit, and theft are just a few examples of the numerous ways corruption manifests. The majority of the sub-regional economies' ability to thrive is hampered by corruption since it reduces investors' confidence in making investments there. For this study, the World Bank's World Governance Indicators were used to figure out how much corruption is being controlled. It varies between -2.5 and 2.5, with a value of -2.5 suggesting a high degree of corruption and thus poor institutions and strong institutions with a value of 2.5. A positive effect on tax revenue is expected when there is higher control of corruption, because once citizens in countries have a stronger and positive view of their government as to how their taxes are being put to use, as a result, are more likely to comply with tax legislation, resulting in higher compliance and lower tax evasion.

Estimation Procedure

Performing panel analysis involves the use of two basic techniques namely the static panel and dynamic panel regression models. The static panel model consists of the fixed and random effects. The fixed effect panel regression is generally used to model time-varying predictor of the time-varying outcome variable. The random effect panel regression works the same way as the fixed effect panel regression. However, the random effect panel regression assumes that there exist between-case or subject differences in the outcome that should be included in the model. The dynamic panel model is used to remove unobserved country-specific heterogeneities. It is mostly suitable when the dependent variable depends on its own past realisations. Three main types of dynamic regression have been identified in the literature. These include the Generalised Method of Moments (GMM), Two-stage Least Square technique (2SLS) and Instrumental Variable approach (IV).

In the quest to examine the relationship between informality, mobile phone penetration and tax revenue, an estimation technique that takes care of issues of endogeneity and country-specific heterogeneities is required given that previous year's tax revenue affects that of current year's tax revenue, the dynamic panel model was suitable for the study. The situation requires the inclusion of a lagged dependent variable as an explanatory variable in the model. Generalised Methods of Moments (GMM) is the best estimation approach proposed by literature and regarded adequate for data with a huge cross-sectional unit and a relatively brief time period (Arellano & Bond, 1991: Arellano & Bover, 1995; Blundell & Bond, 1998; Blundell & Bond, 2000) for a sample of 26 countries spanning 11 years. Capable of addressing all forms of

endogeneity issues that may crop up as a result of the presence of the lagged dependent variable and the correlation between the lagged dependent variable and the error term, taking care of omitted variable bias, correcting measurement errors and generating effective internal instruments, the Generalised methods of moments (GMM) proves to be most appropriate technique for the study.

Again, GMM can be used to estimate the impact of one variable on another even if the error term is not normally distributed. This is done by relaxing the normality assumption that is needed for the Ordinary Least Square (OLS) estimation method. Moreover, with smaller time periods and relatively larger cross-sectional units, the most technique to use is the GMM estimation technique (Beck, Levine & Loayza, 2000).

According to Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (2000), the first difference in the equation will remove the constant term and the country-specific unobserved effects. This is done to eliminate all unobserved heterogeneities. Equations (10) is transformed to obtain equation (14).

$$TAXRV_{i,t} - TAXRV_{i,t-1} = (\beta_0 - \beta_0) + \beta_1(TAXRV_{i,t-1} - TAXRV_{i,t-2}) +$$

$$\beta_2(INFORMAL_{i,t} - INFORMAL_{i,t-1}) + \beta_3(\mathbf{X}_{i,t} - \mathbf{X}_{i,t-1}) + (\eta_i - \eta_i) +$$

$$(\mu_t - \mu_{t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}),\ \text{i=1,2,3,…,26; t=1,2,3,…,11}$$

…………………………14

$$TAXRV_{i,t} - TAXRV_{i,t-1} =$$

$$\beta_1(TAXRV_{i,t-1} - TAXRV_{i,t-2}) + \beta_2(INFORMAL_{i,t} - INFORMAL_{i,t-1}) +$$

$$\beta_3(\mathbf{X}_{i,t} - \mathbf{X}_{i,t-1}) + (\mu_t - \mu_{t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}),\ \text{i =1, 2,…,26;}\quad \text{t =1,}$$

2,3,…,11   …………………………..15

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We can rewrite equation (15) as

$$\Delta TAXRV_{i,t} = \beta_1(\Delta TAXRV_{i,t-1}) + \beta_2(\Delta INFORMAL_{i,t}) + \beta_3(\Delta \mathbf{X}_{i,t}) +$$

$$\Delta \mu_t + \Delta\, \varepsilon_{i,t} \quad i = 1, 2, \ldots, 26; \ t = 1, 2, 3, \ldots, 11 \quad \ldots\ldots(15a)$$

The first difference enables us to deal with the constant term and the specific unobserved country heterogeneity but introduces endogeneity bias problem since the new error term ($\varepsilon_{i,t} - \varepsilon_{i,t-1}$) as in equation (15) would be correlated with $TAXRV_{i,t-1} - TAXRV_{i,t-2}$. Moreover, all the control variables are correlated with the error term $\varepsilon_{i,t-1}$ lagged. In order to address this problem, the difference GMM estimator makes it possible for values of the explanatory variables which are lagged to be used as instruments once they meet these moment conditions; the instruments and error terms should not be serially correlated and the independent variables should be weakly exogenous.

$$E\big[TAXRV_{i,t-s}, \ \big(\varepsilon_{i,t} - \varepsilon_{i,t-1}\big)\big] = 0 \ for \ all \ s \geq 2; \ t=3,\ldots,11 \ \ and$$

$$E\big[\mathbf{X}_{i,t-s}, \ \big(\varepsilon_{i,t} - \varepsilon_{i,t-1}\big)\big] = 0 \ for \ all \ s \geq 2; \ t=3,\ldots,11$$

Given that the difference GMM suffers from weak instrumentation, Arellano and Bover (1995) and Blundell and Bond (2000) propose an estimator that allows us to combine a system of equations into differences and levels. In this case, the system GMM estimator is proposed as a more efficient estimator. Validating instruments require that there should be no correlation between the country-specific effects and the difference in the variables. This requires the fulfillment of an additional moment condition for the level equation.

$$E\big[(TAXRV_{i,t-s} - TAXRV_{i,t-s-1}) \left(\eta_i + \varepsilon_{i,t-1}\right)\big] = 0 \ for \ all \ s = 1; t =$$

$$3, \ldots, 11 \ and$$

$$E\big[\boldsymbol{X}_{i,t-s} - \boldsymbol{X}_{i,t-s-1}\big)\big(\eta_i + \varepsilon_{i,t-1}\big)\big] = 0 \; for \; s = 1; t = 3, \ldots.,11$$

Choosing between a difference GMM and a system GMM estimation technique requires an initial pooled OLS model estimation. A subsequent estimation is conducted on the same model using the fixed effect approach. A comparison is done between the coefficients or parameters of the lag-dependent variable in the two estimated models. Difference GMM estimation is then carried out. If the difference GMM estimate obtained is close to or below the fixed effect estimate, this suggests that the former estimate is downward bias because of weak instrumentation and a system GMM estimator be preferred instead (Bond, 2001). Having satisfied the conditions stated above, the system GMM is used to achieve the objectives of the study.

Model Diagnostic Test

The system GMM estimator is considered valid and consistent if the error term does not suffer from serial correlation and the instruments are valid.

Hansen test for over-identifying restrictions

Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998) proposed that the instruments used for the analysis must be valid for results to be consistent. For this to happen, the instrumented variables must be exogenous and uncorrelated with the error term.

Arellano-Bond test for serial correlation

This test enables us to assess the assumption that errors present in the first difference regression do not suffer from serial correlation.

Chapter Summary

This chapter discussed the methodological frameworks that were used in achieving the research objectives of the study. It also touched on the appropriate research philosophy, design and approach and stressed on the importance of using the positivist approach. The chapter also provided justification for the choice of both the dependent and independent variables. The chapter ended by looking at the estimation techniques employed in finding the relationship between informality, mobile phone penetration and tax revenue. Some diagnostic tests employed in the study are also presented in the final section. The next chapter discusses the estimated empirical results obtained in the study.
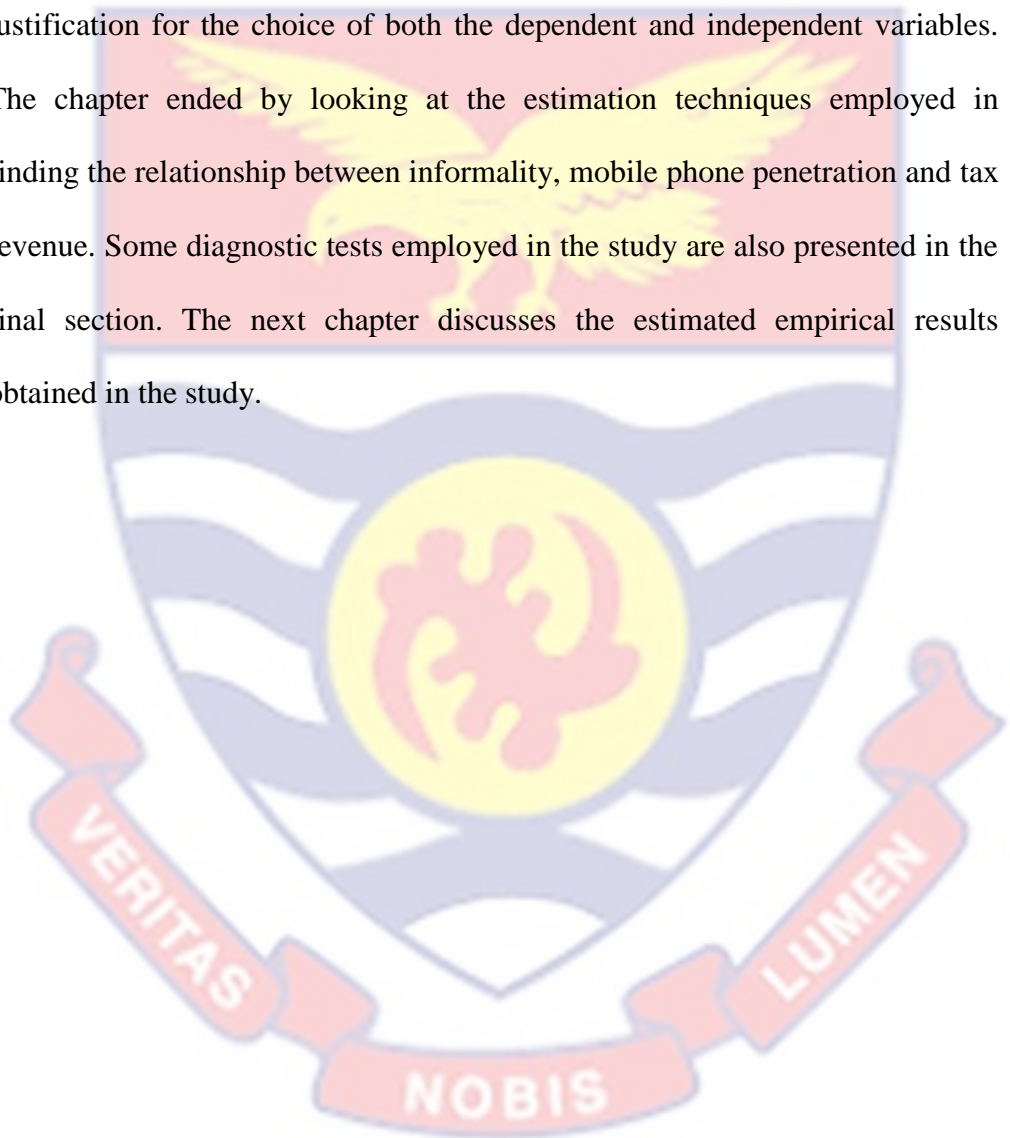
CHAPTER FIVE

RESULTS AND DISCUSSIONS

Introduction

This chapter discusses the estimated empirical relationship between informality, mobile phone penetration and tax revenue. The chapter is structured into different sections. The chapter begins with description of the summary and correlation statistics of the variables used in the study, and further goes on to provide a comprehensive analysis of the results obtained from the system Generalised Method of Moments (GMM).

Descriptive Statistics

This section of the study discusses briefly the basic statistical properties of the variables used in the study for the period 2009 to 2019. The descriptive statistics of the variables employed for the analysis in this chapter are presented in Table 2.

Table 2: Summary Statistics of Variables, 2009 to 2019

Variables	Observation	Mean	Std. Dev.	Min	Max
TAXRV	286	15.5880	6.7700	4.0985	39.2576
INFORMAL	286	33.5458	7.6600	17.8	54
MPP	286	78.8562	38.8531	4.7536	173.811
TOT	286	79.2191	28.9353	28.8153	155.999
AGRIC	286	17.4960	12.8915	1.0535	58.0357
INF	286	6.1892	13.2135	-2.4096	200.367
SER	286	47.4676	10.1024	22.1315	67.6503
AID	286	6.7825	8.1905	0.0035	77.8681
GDPPC	286	2690.469	3034.459	345.635	15906.5
COC	286	-0.5375	0.6525	-1.8264	1.0269

Source: Adu (2021)

From Table 2, the total tax revenue (TAXRV) for the 26 sub-Saharan African countries is averaged about 15% as the share GDP. The maximum value is approximately 39% as the share of GDP with a minimum value of 4% as the share of GDP with an average variation of 6.8% between the SSA countries. The maximum value of 39% and minimum value of 4% shows how the region is not performing well in terms of revenue mobilisation and this can be attributed to the large size and dominance of the informal sector, poor tax systems, among others.

The informal sector (INFORMAL) which is measured as a percentage of GDP for the period is averaged at about 34% of GDP. The maximum value is approximately 54% of GDP with a minimum value of about 18% of GDP. The level to which the informal sector is deviating from the mean is approximately 7.7% within the region. The intuition behind the maximum and minimum values is that, not much effort has been put in place within the region to decrease the size of the informal sector.

Mobile cellular subscriptions (per 100 people) which is used as a proxy for mobile phone penetration (MPP) for the period has a mean value of 78.8562 and 38.8531 as its deviation from the mean. The maximum level of mobile cellular subscriptions (per 100 people) in the SSA countries is 173.811 with a minimum of 4.7536. The maximum and minimum values imply that, over the years, mobile phone penetration has increased within the SSA region.

Trade openness (TOT) has a maximum value of 155.999 and a minimum value of 28.8153 within the region. The average value of trade openness is 79.2191 with a 28.9353 variation as a percentage of GDP from the mean value. The maximum and minimum values of trade openness imply that

import levels are higher than export levels in the majority of sub-Saharan African nations, where the majority of exports are raw materials that have not been processed. Additionally, some foreign businesses based in the region export unprocessed raw materials including gold, bauxite, manganese, and oil from the majority of the countries in the region.

The average value of agriculture as a share of GDP (AGRIC) is 17.4960 with a variation of 12.8915 from the mean value within the SSA region. The maximum value of agriculture as a share of GDP is 58.0357 and a minimum value of 1.0535. The maximum and minimum value of agriculture share to GDP depicts that in most economies within the SSA region, agricultural activities has been on the rise is considered as the backbone of these economies.

Inflation (INF) which is measured as the consumer price index (annual %) has an average value of 6.1892 percent and a deviate from the mean with a value of 13.2135. The maximum inflation rate is 200.367 percent with a minimum of -2.4096 percent. Some countries such as Burkina Faso, Cameroon, Equatorial Guinea, Liberia, Mali, Togo, Zambia and Zimbabwe recorded negative inflation values and this may be linked to a fall in price of services and goods, supply exceeding demand, reduction in money supply, among other factors. The maximum inflation value of 200.367 was recorded by Zambia and this may be as a result of demand exceeding supply, increase in money supply, among other factors.

Service sector as a share of GDP (SER) has a maximum value of 67.6503 and a minimum value of 22.1315 within the region. The mean value

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of the service sector as a share of GDP is 47.4676 with a variation of 10.1024 from the mean value.

In this study, aid (AID) is proxied using the net Official development assistance received as a percentage of GNI. The mean value of aid is 6.7825 and it deviate from the mean with a value of 8.1905. It minimum and maximum values are 0.0035 and 77.8681 respectively.

Real GDP per capita (GDPPC) has a mean value of 2690.469 US dollars with average variation of 3034.459 from the mean within the SSA region. It minimum and maximum values are 345.635 and 15906.5 US dollars respectively.

Control of Corruption has an average value of -0.5375 and deviate from the mean with a value of 0.6525. The maximum and the minimum values are 1.0269 and -1.8264 respectively. A negative value of control of corruption implies that the region is weak in terms of managing corruption, whiles a positive value depicts how well the region is doing in terms of managing corruption. A negative value of -1.8264 tells the story of how poor the region is performing in terms of managing corruption.

Descriptive analysis of the dependent variable and some key independent variables in terms of regional and income groupings within the SSA.

The study then examines regional variations in tax revenue, informality, and mobile phone penetration in the 26 sub-Saharan African nations that were chosen from 2009 to 2019.

Tax revenue in terms of regional groupings

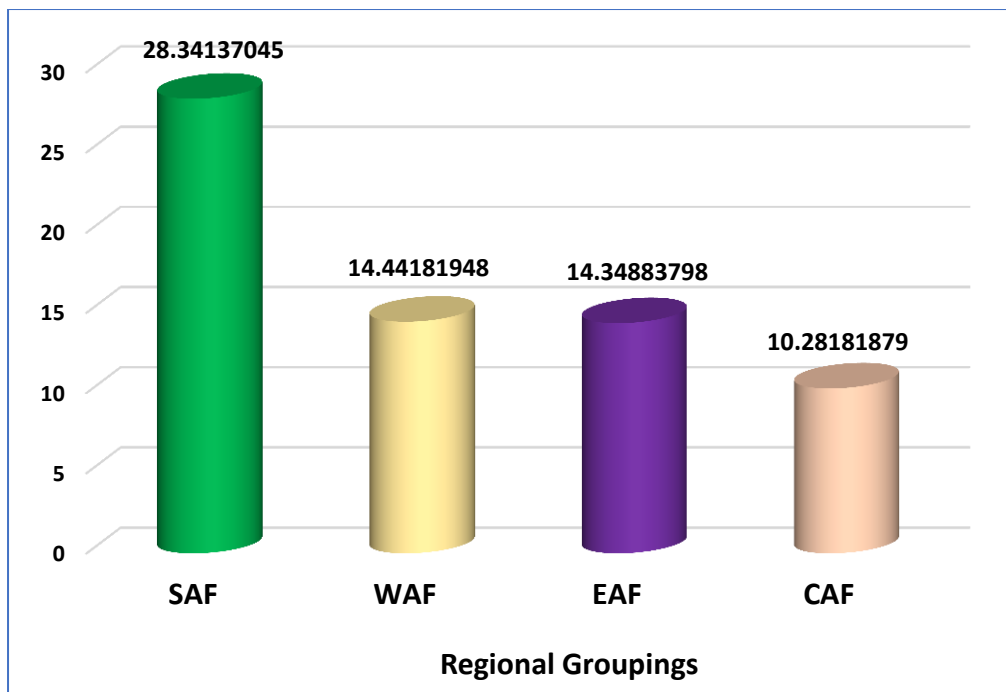The average tax revenue trends from 2009 to 2019 in the 26 sub-Saharan countries are shown in Figure 7. The bar graph indicates the variations of the regions in tax revenue as a percentage of GDP. From the graph, countries in Southern Africa have the highest tax revenue, which is approximately 28.34 percent of their GDP on average. This is followed by West African countries, which have an average tax revenue of 14.44 percent of GDP. Countries in East Africa have an average tax revenue of approximately 14.35 percent of GDP, and the region in SSA that has the lowest tax revenue is the Central African region, which has an average of approximately 10.28 percent of GDP. From the graph, it is clear that, relative to other regions in sub-Saharan Africa, the Southern African countries are performing exceptionally well. Most countries in Southern Africa mobilize more tax revenue than countries in other parts of the world.
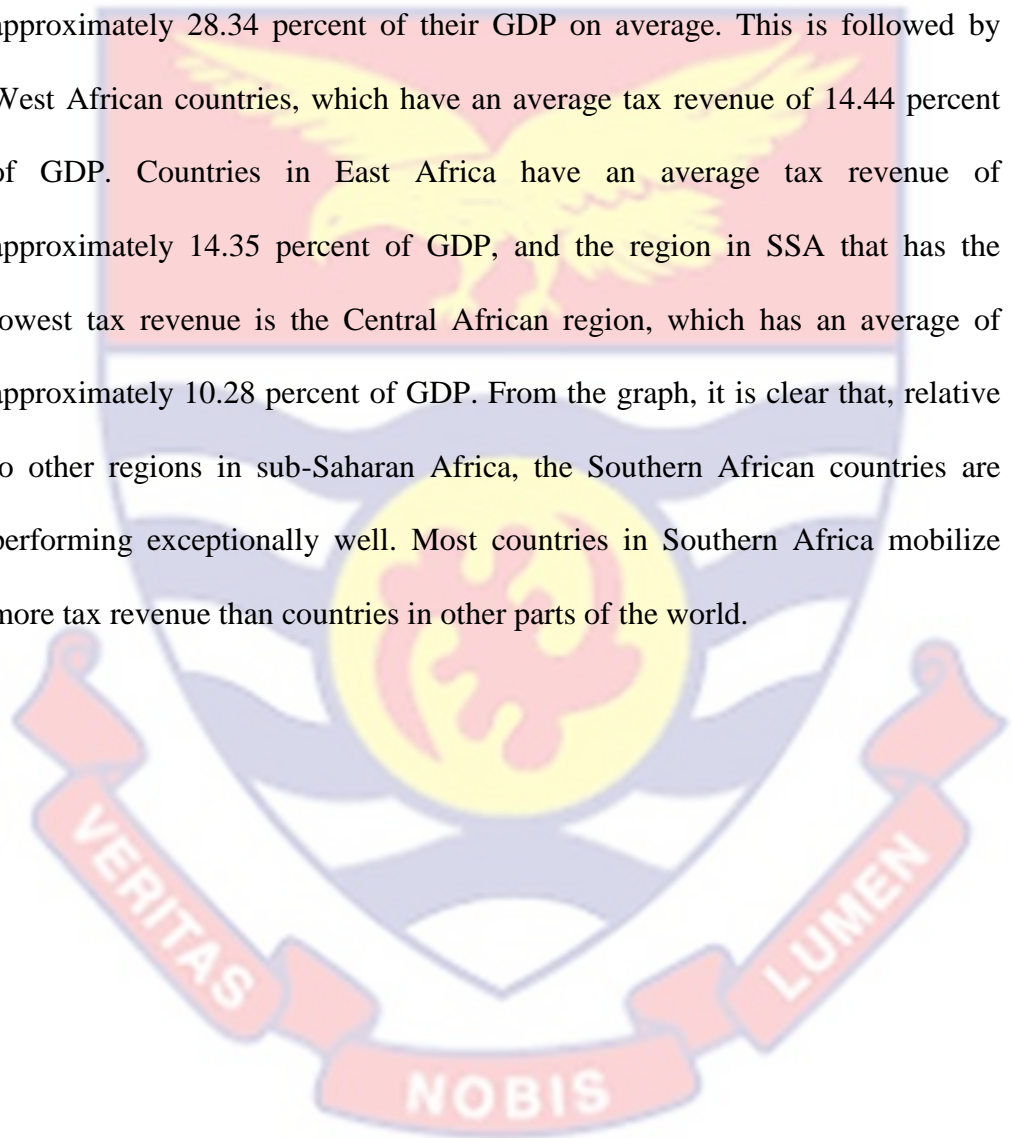
Note: SAF, WAF, EAF and CAF stands for Southern Africa, West Africa, East Africa and Central Africa respectively.

Figure 7: Tax revenue in terms of regional groupings

Source: Adu (2021)

Informality in terms of regional groupings

The trends in the informal sector measured as a percentage of GDP in the 26 sub-Saharan countries from 2009 to 2019 are shown in Figure 8. The bar graph indicates the variations of the regions in terms of informality. From the graph, countries in Central Africa have the highest informal sector, which is approximately 37.05 percent of GDP on average. This is followed by countries in East Africa, which have an informal sector of approximately 35.13 percent of the GDP. Countries in West Africa have an informal sector of approximately 33.09 percent of GDP, and the region in SSA that has the lowest informal sector is the Southern African region, which has an average of approximately 25.53 percent of GDP. From the graph, it appears that, relative

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to other regions in sub-Saharan Africa, the Southern African countries have the least informal sector.
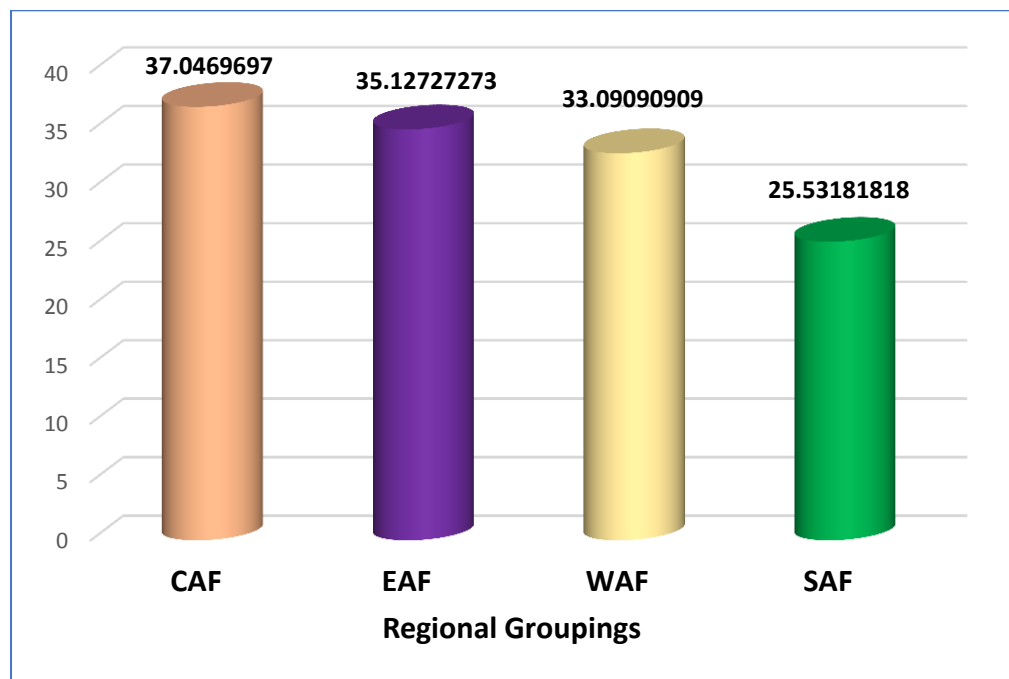
Note: CAF, EAF, WAF, and SAF stands for Central Africa, East Africa, West Africa and Southern Africa respectively.
Figure 8: Informality in terms of regional groupings

Source: Adu (2021)

Mobile Phone Penetration (per 100 people) in terms of regional groupings

The trends in average mobile phone penetration in the 26 sub-Saharan countries from 2009 to 2019 are shown in Figure 9. The bar graph indicates the variations of the regions in terms of mobile phone penetration. From the graph, countries in Southern Africa have the highest mobile phone penetration, which is approximately 119.72 mobile cellular subscriptions (per 100 people). This is followed by countries in West Africa, with an average of about 84.98 mobile cellular subscriptions (per 100 people). Countries in Central Africa have mobile phone penetration of about 68.86 mobile cellular subscriptions (per 100 people), and the region in SSA that has the lowest mobile phone penetration is the East African region, with an average of about 62.59 mobile

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cellular subscriptions (per 100 people). The graph shows that, compared to other parts of sub-Saharan Africa, the countries in Southern Africa have the most mobile phone users.
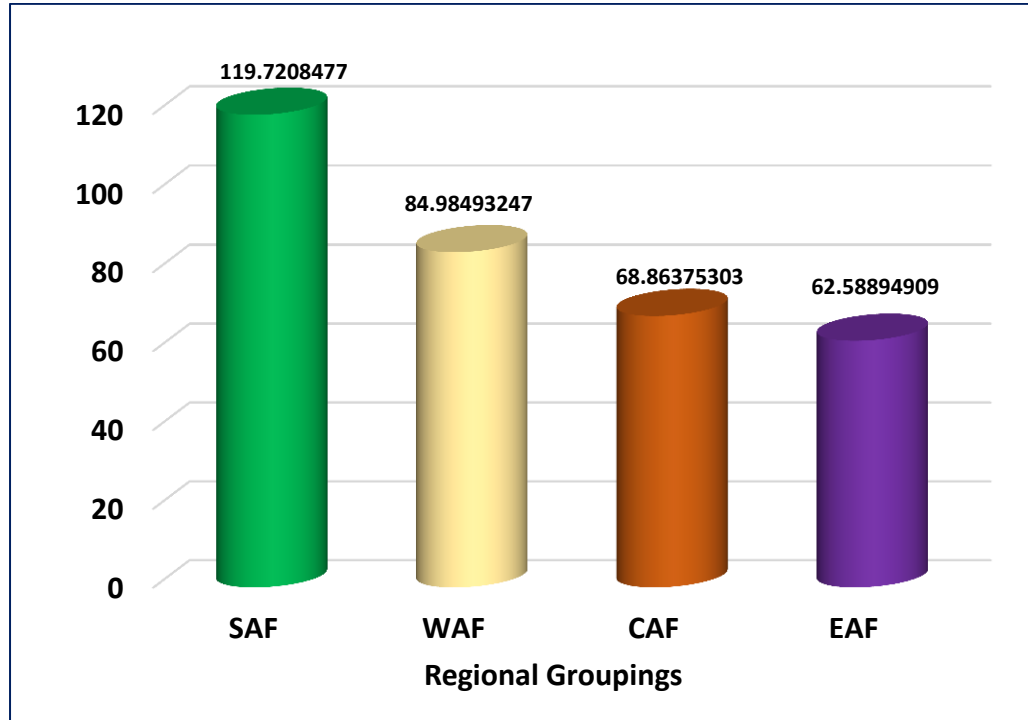
Note: SAF, WAF, CAF and EAF stands for Southern Africa, West Africa, Central Africa and East Africa respectively.

Figure 9: Mobile phone subscriptions in terms of regional groupings

Source: Adu (2021)

Correlation Analysis

The correlation between the variables employed in the study is presented in Table 3. From the table, tax revenue as a percentage of GDP is positively and significantly correlated with mobile phone penetration, trade openness as a percentage of GDP, service sector contribution as a percentage of GDP, the log of GDP per capita and control of corruption. This indicates that any percentage or unit increase in any of the variables increases tax revenue. Tax revenue is negatively and significantly correlated with informality and agriculture sector contribution as a percentage of GDP. The

correlation between inflation and tax revenue as well as aid and tax revenue are negative but not significant.

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Table 3: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) TAXR	1									
(2)INFORMAL	-0.459*	1								
(3) MPP	0.433*	-0.201*	1							
(4) TOT	0.406*	-0.176*	0.158*	1						
(5) AGRIC	-0.412*	0.145*	-0.524*	-0.375*	1					
(6) INF	-0.0003	0.063	-0.064	-0.057	-0.020	1				
(7) SER	0.526*	-0.309*	0.292*	0.129*	-0.373*	0.114*	1			
(8) AID	-0.158	0.149*	-0.431*	0.072	0.598*	-0.010	-0.041	1		
(9)lnGDPPC	0.244*	-0.240*	0.613*	0.321*	-0.803*	-0.084	0.205*	-0.579*	1	
(10) COC	0.606*	-0.515*	0.505*	0.215*	-0.251*	0.010	0.518*	-0.067	0.258*	1

Note: * represent 5% significance level

Source: Adu (2021)

Empirical Estimation and Discussions

This section presents and discusses the results from the Generalised Methods of Moments estimation. Table 4 assesses the effect of informality on tax revenue in sub-Saharan Africa. Table 5 highlights the effect of mobile phone penetration on tax revenue while the moderating role of mobile phone penetration in the relationship between informality and tax revenue is presented and discussed in Table 6.

Effect of Informality on tax revenue in sub-Saharan Africa

Table 4: Effect of Informality on Tax Revenue

Variables	Model 1	P > |t|
Tax revenue (-1)	0.4353*	0.086
	(0.2434)	
Informality	-0.1763*	0.080
	(0.0966)	
Trade openness	0.0364*	0.077
	(0.0197)	
Agriculture (%GDP)	-0.3127***	0.019
	(0.1248)	
Inflation	0.0833	0.527
	(0.1298)	
Service (%GDP)	0.0144	0.843
	(0.0721)	
Aid (%GNI)	-0.0932	0.350
	(0.0978)	
Log of GDP per capita	-4.9506***	0.015
	(1.9009)	
Control of corruption	2.2566**	0.040
	(1.0428)	
Constant	54.4205***	0.007
	(18.5783)	

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Diagnostics	
F Stat	170.17
Prob > F	0.000
AR (1)	0.024
AR (2)	0.690
Hansen test	0.155
Number of Obs.	260

Note: Robust standard error option used; Robust standard error in parentheses; *p< 0.1, **p< 0.05, ***p< 0.01 indicates significance at 10%, 5% and 1% respectively.
Source: Adu (2021)

Table 4 above illustrates the effect of informality on tax revenue within the SSA region. The results shown in column 2 indicate that, the lagged value of tax revenue is significant at 10 percent alpha level, confirming that current period's tax revenue is influenced by that of the previous period and therefore the need to specify a dynamic model.

As shown in column 2, informality, the main variable of interest, was estimated to be statistically significant at 10 percent and negative. Thus, all things being equal, a percentage increase in informality will lead to a fall in tax revenue in the sub-Saharan African region by 0.1763 percent. This result is consistent with the findings of Mawejje and Francis-Munyambonera (2016) and Nnyanzi et al. (2016), who also found a negative relationship between the informal sector and tax revenue. The underlying assumption is that the informal sector includes any operations that are not disclosed to tax authorities specifically with the aim of avoiding paying income taxes resulting from legal or criminal actions and that do not conform with any laws. Thus, the informal sector evades and avoids taxes since their activities are not regulated by law, which results in a fall in the tax revenue. Moreover, the informal sector is one

of the most difficult sectors to tax in terms of taxation since its activities are not easy to track, hence, leading to a decrease in the tax revenue.

Effect of other control variables on tax revenue

Trade openness was estimated to be significant and positive at 10 percent alpha level. It shows that a percentage increase in trade openness will lead to a 0.0364 percent increase in tax revenue in sub-Saharan Africa. This result is consistent with the studies by Nnyanzi et al. (2016) and Teera et al. (2018) as expected. The positive coefficient for trade openness suggests that taxes on exports and imports are easily mobilised and managed within the region due to the lack of administrative complexities. Thus, countries in sub-Saharan Africa have open economies and trade with other countries. This leads to more tax revenue coming in because of the trade.

Agriculture was also estimated to be significant and negative at 1 percent alpha level. It shows that a percentage increase in the share of agriculture to GDP will lead to a 0.3127 percent decrease in tax revenue in the sub-Saharan Africa region. This result is consistent with the studies by Addison and Levin (2012) and Coulibaly et al. (2019) as expected but contradicts the findings of Terefe et al. (2012). The negative coefficient of agriculture implies that agriculture sector is often considered "the hardest sector to tax," given the prevalence of massive underground economies and informal players that are dominated by subsistence farmers. Fiscal authorities are under pressure due to ineffective tax administration, which also increases the likelihood that firms will try to avoid paying taxes, further lowering tax revenue.

The log of GDP per capita was also estimated to be negative and significant at 1 percent alpha level. It indicates that a dollar increases in GDP per capita will lead to a 0.049506 percent decrease in tax revenue in the sub-Saharan Africa region. This result is in conformity to the study by Nnyanzi et al. (2016) but is in contrast with the findings by Ayenew (2016), Besley and Persson (2013) and Terefe (2017). Per theory, higher GDP capita reflects development and an increase in taxability but over the decades, most sub-Saharan African countries are characterised by informal sectors which is difficult to tax, evades tax, and also poor tax administration systems, even though most countries in the region are experiencing growth and development. Hence, leading to a reduction in the tax revenue in the SSA region.

Tax revenue is positively impacted by corruption control, with a coefficient of 2.2566 that is significant at a 5 percent alpha level. This suggests that an improvement in corruption management leads to a rise in tax revenue in the SSA region. This result is in line with the findings by Nnyanzi et al. (2016). The positive coefficient of control of corruption indicates that, when measures are put in place to curb corruption, thus, states using mobilised revenue for its intended purposes, desisting from embezzlement of funds and punishing offenders who are corrupt, this will result in the increase level of tax revenue within the region.

Moreover, inflation and service as a share of GDP were estimated to be positive and statistically insignificant as well as aid was estimated to be negative and statistically insignificant.

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Model Diagnostics

In the model, the value for AR (2), which is 0.690, was not significant. Therefore, the study failed to reject the null and concluded that there is no second-order serial correlation between the error terms. The value for the Hansen over-identification test, which is 0.155, was also not significant, and so the study failed to reject the null hypothesis that the instrumented variables are exogenous. Hence, the models and instruments were deemed valid and consistent.
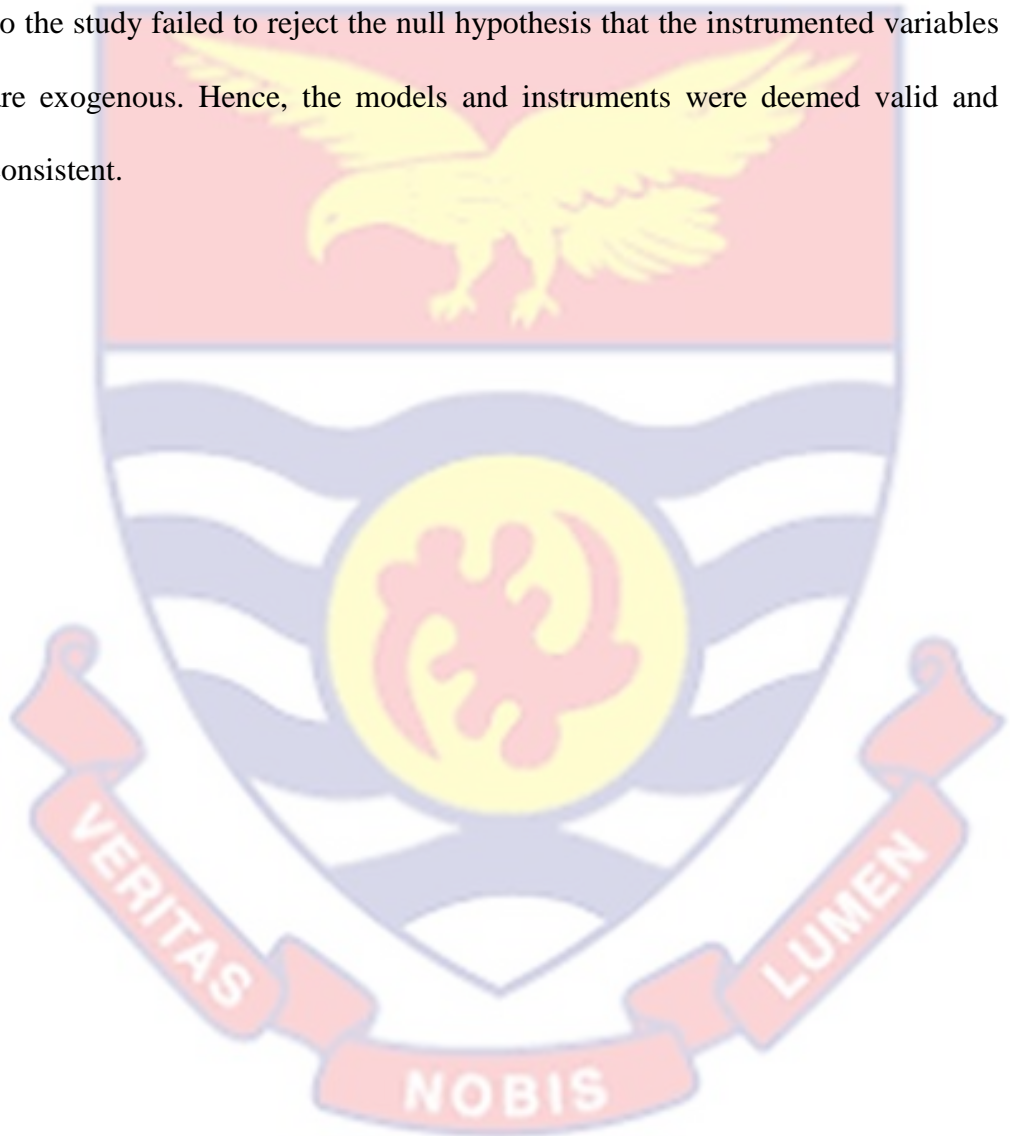
Effect of Mobile Phone Penetration on tax revenue in sub-Saharan Africa

Table 5: Effect of Mobile Phone Penetration on Tax Revenue

Variables	Model 2	P > |t|
Tax revenue (-1)	0.7611***	0.000
	(0.1059)	
Mobile phone penetration	0.01922**	0.043
	(0.0090)	
Trade openness	0.0208**	0.045
	(0.0099)	
Agriculture (%GDP)	-0.0927**	0.053
	(0.0457)	
Inflation	0.0354	0.724
	(0.0990)	
Service (%GDP)	0.0201	0.396
	(0.0233)	
Aid (%GNI)	-0.0414	0.214
	(0.0325)	
Log of GDP per capita	-2.0318***	0.013
	(0.7583)	
Control of corruption	0.7737**	0.058
	(0.3890)	
Constant	16.6587***	0.018
	(6.594764)	
Diagnostics		
F Stat	827.69	
Prob > F	0.000	
AR (1)	0.013	
AR (2)	0.697	
Hansen test	0.232	
Number of Obs.	260	

Note: Robust standard error option used; Robust standard error in parentheses; *p< 0.1, **p< 0.05, ***p< 0.01 indicates significance at 10%, 5% and 1% respectively.
Source: Adu (2021)

Table 5 above illustrates the effect of mobile phone penetration on tax revenue in the SSA region. The results shown in column 2 indicates that the lagged value of tax revenue is significant at 1 percent alpha level, confirming that current period's tax revenue is influenced by that of the previous period and therefore the need to specify a dynamic model.

Column 2 shows that the main variable of interest, mobile phone penetration, was estimated to be statistically significant and positive at 5 percent. Thus, all things being equal, a unit increase in the level of mobile phone penetration will increase tax revenue in sub-Saharan Africa by 0.01922 percent. This result is consistent with the study by Koyunco et al. (2016) and Effong et al. (2020), which explained that higher mobile phone penetration result in increase in the overall sustainable tax revenue. The intuition behind this is that, as mobile phone penetration is on the rise, and mobile phones also serving as a medium through which tax revenue can be mobilised, this will in turn increase the level of tax revenue in sub-Saharan Africa. Also, there are some forms of taxes that are imposed on the usage of mobile phones, and as mobile penetration increases, so as the level of tax revenue.

Effect of other control variables on tax revenue

Trade openness was estimated to be significant and positive at 5 percent alpha level in model 2. It indicates that a percentage increase in trade openness will lead to a 0.0208 percent increase in tax revenue in sub-Saharan Africa. As expected, this result is in conformity with the studies by Addison and Levin (2012) and Zarra-Nezhad et al. (2016) but in contrast with the findings by Agbeyegbe et al. (2004), and Davoodi and Grigorian (2007), who argue that countries shift away from trade taxes due to trade liberalisation and

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therefore, there is a reduction in tax collection as trade openness increases. The positive coefficient for trade openness indicates higher level of trade openness results in higher total taxes and this effect is generated from trade taxes. Also, if imports are sufficient to outweigh the revenue losses from lower tariff rate, this leads to an increase in tax revenue.

Also, in model 2, agriculture maintained it sign and was also estimated to be negative and significant at 5 percent alpha level. It indicates that a percentage increase in the share of agriculture to GDP will lead to a 0.0927 percent decrease in tax revenue in the sub-Saharan Africa region. This result is consistent with the studies by Addison and Levin (2012) and Coulibaly et al. (2019) as expected but contradicts the findings of Terefe et al. (2012). The negative coefficient of agriculture implies that agriculture sector is often considered "the hardest sector to tax," given the prevalence of massive underground economies and informal players that are dominated by subsistence farmers. Fiscal authorities are under pressure due to ineffective tax administration, which also increases the likelihood that firms will try to avoid paying taxes, further lowering tax revenue.

The log of GDP per capita maintained it sign in model 2 and was also estimated to be negative and significant at 1 percent alpha level. It indicates that a dollar increases in GDP per capita will lead to a 0.020318 percent decrease in tax revenue in the sub-Saharan Africa region. This result is in conformity to the study by Nnyanzi et al. (2016) but is in contrast with the findings by (Ayenew, 2016; Besley & Persson, 2013; Terefe, 2017). Per theory, higher GDP capita reflects development and an increase in taxability but over the decades, most sub-Saharan African countries are characterised by

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informal sectors which is difficult to tax, evades tax, and also poor tax administration systems even though most countries are experiencing growth and development. Hence, leading to a fall in the tax revenue in the SSA region.

Tax revenue is positively impacted by corruption control, with a coefficient of 0.7737 that is significant at a 5 percent alpha level. This suggests that an improvement in corruption management leads to a rise in tax revenue in the SSA region. This result is consistent with findings by Nnyanzi et al. (2016). The positive coefficient of control of corruption indicates that when measures are put in place to curb corruption, thus, states using mobilised revenue for its intended purposes, desisting from embezzlement of funds and punishing offenders who are corrupt, this will result in the increase level of tax revenue within the region.

Moreover, inflation and service as a share of GDP were estimated to be positive and statistically insignificant as well as aid was estimated to be negative and statistically insignificant.

Model Diagnostics

In the model, the value for AR (2), which is 0.697, was not significant. Therefore, the study failed to reject the null and concluded that there is no second-order serial correlation between the error terms. The value for the Hansen over-identification test, which is 0.232, was also not significant, and so the study failed to reject the null hypothesis that the instrumented variables are exogenous. Hence, the models and instruments were deemed valid and consistent.

How Mobile Phone Penetration moderates the effect of Informality on Tax Revenue

Table 6: Examines how Mobile Phone Penetration moderates the effect of Informality on Tax Revenue

Variables	Model 3	P > |t|
Tax revenue (-1)	0.8659***	0.000
	(0.0848)	
Informality	0.2427*	0.095
	(0.1396)	
Mobile phone penetration	0.1084**	0.053
	(0.0533)	
Trade openness	0.0276*	0.083
	(0.0153)	
Agriculture (%GDP)	-0.0017	0.961
	(0.0345)	
Inflation	-0.0071**	0.020
	(0.0028)	
Service (%GDP)	0.0108	0.617
	(0.0212)	
Aid (%GNI)	-0.0395*	0.080
	(0.0217)	
Log of GDP per capita	-0.5935	0.163
	(0.4132)	
Control of corruption	-0.1703	0.633
	(0.3519)	
Informality*Mobile phone penetration	-0.0029*	0.078
	(0.0015976)	
Constant	-4.9806	0.455
	(6.5695)	
Diagnostics		
F Stat	1798.07	
Prob > F	0.000	

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AR (1)	0.017
AR (2)	0.721
Hansen test	0.628
Number of Obs.	260

Note: Robust standard error option used; Robust standard error in parentheses; *p< 0.1, **p< 0.05, ***p< 0.01 indicates significance at 10%, 5% and 1% respectively.
Source: Adu (2021)

The results on how mobile phone penetration moderate the relationship between informality and tax revenue in sub-Saharan Africa is presented in Table 6. The study first discusses how the control variables affect tax revenue in this model.

The value of the dependent variable after it has been lagged remains significant and positive at a 1 percent alpha level. This makes it clear that a dynamic model is needed so that the endogeneity in the model can be fixed. This clearly means tax revenue from the past has an effect on tax revenue now and in the future.

Effect of other control variables on tax revenue

Trade openness was estimated to be positive and significant at 10 percent alpha level in model 3. It shows that a percentage increase in trade openness will lead to a 0.0276 percent rise in tax revenue in sub-Saharan Africa. As expected, this result is in conformity with the studies by Addison and Levin (2012) and Zarra-Nezhad et al. (2016) but in contrast with the findings by Agbeyegbe et al. (2004), and Davoodi and Grigorian (2007), who argue that, countries shift away from trade taxes due to trade liberalization and therefore, there is a reduction in tax collection as trade openness increases. The positive coefficient for trade openness indicates higher level of trade openness results in higher total taxes and this effect is generated from trade

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taxes. Additionally, a rise in tax revenue results if imports are adequate to offset the revenue losses from lower tariff rates.

Inflation was also estimated to be significant and negative at 5 percent alpha level in model 3. It shows that if inflation increase by 1 percent, it will lead to a 0.0071 percent decrease in tax revenue in sub-Saharan Africa. The result from this study is consistent with the findings by Teera et. al. (2018), who explained that due to lags in the tax collection, inflation affect tax revenue negatively. Thus, between the time that the tax is first implemented and the time that it is actually imposed, the real value of the money that is collected through taxation will, as a result, decline due to inflation.

Aid was also estimated to be significant and negative at 10 percent alpha level. It shows that if aid increases by 1 percent, it will lead to a 0.0395 percent decrease in tax revenue in sub-Saharan Africa. This result is in conformity to the findings by Castañeda (2018) but contradict the findings by Gaalya, (2015) and Teera et. al. (2018), who found out in their studies that aid has a positive impact on tax revenue and argue that the case for foreign aid is extremely simple in economies of less developing nations when the poverty cycle is present. The negative coefficient of aid implies that inflow of money in the form of foreign assistance is unavoidable for developing nations found in SSA, where due to low tax revenue mobilisation, there is a clear resource gap (Terefe & Teera, 2018). This because most aids which come into most SSA countries are in the form of grants and grants negatively affect tax revenue because recipients easily redirect funds to non-productive economic activities (aid fungibility). Hence, domestic revenue mobilisation will be negative.

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Moreover, service as a share of GDP and control of corruption were estimated to be positive and statistically insignificant as well as agriculture as a share of GDP and log of GDPPC was estimated to be negative and statistically insignificant.

Moderating Role of Mobile Phone Penetration

The inclusion of the interacted terms of informality and mobile phone penetration in Model 3 does not adequately explain the moderating effect of mobile phone penetration on informality and tax revenue. To establish the moderating effect, the study calculates the marginal effect of informality on tax revenue at the means of the mobile phone penetration variable.

Finding the moderating role of mobile phone penetration gives,

$$\frac{\Delta TAXRV_{i,t}}{\Delta INFORMAL_{i,t}} = \beta_2 + \beta_3 MPP_{i,t}$$

$$\frac{\Delta TAXRV_{i,t}}{\Delta INFORMAL_{i,t}} = \beta_2 + \beta_3 \overline{MPP}$$

$$\frac{\Delta TAXRV_{i,t}}{\Delta INFORMAL_{i,t}} = 0.2427 + (-0.0029)(\overline{MPP})$$

Substituting the mean value of mobile phone penetration of 78.8562 from the descriptive statistics gives;

$$\frac{\Delta TAXRV_{i,t}}{\Delta INFORMAL_{i,t}} = 0.2427 + (-0.0029)(78.8562)$$

$$= 0.2427 - 0.22868298$$

$$= 0.0140$$

This means that on the average, with mobile phone penetration, 1 percent increase in the informal sector would lead to a rise in tax revenue by 0.0140 percent. The implication is that, mobile phone penetration increases the effect of the informal sector on tax revenue. Hence, mobile phone penetration once increased has a significant and positive effect on tax revenue

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on its own as a variable and influencing the informal sector positively to increase tax revenue. Therefore, for the sub-Saharan Africa region to accomplish much in terms of informality impacting on tax revenue positively, mobile phone penetration in the informal sector must be given greater attention.

Model Diagnostics

In the model, the value for AR (2), which is 0.721, was not significant. Therefore, the study failed to reject the null and concluded that there is no second-order serial correlation between the error terms. The value for the Hansen over-identification test, which is 0.628, was also not significant, and so the study failed to reject the null hypothesis that the instrumented variables are exogenous. Hence, the models and instruments were deemed valid and consistent.

Chapter Summary

The chapter presented the descriptive statistics and correlation analysis of the variables employed in the study. This was followed by a discussion of the results obtained from the GMM estimation technique. The first objective sought to examine the effect of informality on tax revenue in the SSA region. The results indicate that informality has a negative effect on tax revenue in the SSA region. Objective two sought to estimate the effect of mobile phone penetration on tax revenue in sub-Saharan Africa. The results showed that mobile phone penetration has a positive and significant effect on tax revenue in Sub-Saharan Africa. Objective three also sought to assess how mobile phone penetration moderates the effect of informality on tax revenue in the

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SSA region. The results revealed that mobile phone penetration positively

moderate the effect of informality on tax revenue.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter discusses the summary, conclusions and recommendations made from the study. The chapter is divided into three main sections. The first section provides a summary of the entire study. The summary section presents an overview of the problem, objectives and the research methods that were used in the study. The second section highlights some conclusions drawn based on the results obtained from the study. The third section of this chapter presents some policies and recommendations to relevant authorities based on the findings of the study. This section also points out some possible areas for further research.

Summary

Tax revenue is key to state growth, including social amenities, construction of roads, public spending, and other state-funded projects in every country. Tax revenue mobilisation has become a major challenge in less developed countries, receiving considerable attention. In most sub-Saharan countries, revenue mobilisation is very low due to the large size and dominance of the informal sector. Over time, the informal sector in SSA has shrunk, but not to the extent that is expected. Various measures are being put in place by various governments and heads of state to curb this dominance of the informal sector so as to mobilise enough revenue. The purpose of this study was to examine informality, mobile phone penetration and tax revenue in sub-Saharan Africa from 2009 to 2019. Specifically, the study investigated the effect of informality on tax revenue in the sub-Saharan African region. The

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study also examined the effect of mobile phone penetration on tax revenue within the sub-Saharan African region. Lastly, the study again went ahead to examine how mobile phone penetration moderate the effect of informality on tax revenue within the sub-Saharan African region. Over an 11-year period, the study used the system Generalised Methods of Moments (GMM) technique on 26 SSA countries. The World Development Indicators (WDI), the World Governance Indicators (WGI) of the World Bank, and Medina and Schneider (2018) were the main source of dataset for the study.

The findings from the study indicate that, in sub-Saharan Africa region, the size of the informal sector as a percentage of GDP which was used to represent informality has a significant effect on tax revenue in the sub-Saharan African region. Thus, any increase in the size of the informal sector leads to a reduction in tax revenue. This is not surprising because, the informal sector is one of the sectors in most SSA economies that is very difficult to tax.

The study again discovered that mobile phone penetration was significant in affecting tax revenue. Thus, increases in the mobile phone penetration brings about an increase in the tax revenue. Based on the variables which were used as control variables in the study; trade openness and control of corruption has a significant and positive effect on tax revenue whereas agriculture, inflation and the log of GDP per capita also has a significant and negative effect on tax revenue in the sub-Saharan Africa region.

Lastly, from the interactive effect between informality and mobile phone penetration, findings from the study indicate that, mobile phone penetration positively moderate the effect of informality on tax revenue in the sub-Saharan African region. This result is not surprising because over the

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years, the use of mobile phones in the informal sector has been on the rise and some actors in the informal sector use mobile phones as a means of paying their taxes.

Conclusions

The study concluded, based on the first objective, that informality impacted negatively on tax revenue within the sub-Saharan Africa region. Therefore, much attention should be given to the informal sector in terms of revenue mobilisation. Secondly, mobile phone penetration led to increases in the tax revenue. Therefore, mobile phones can be used as an instrument for mobilising tax revenue in the sub-Saharan Africa region as other developed economies have adopted. Finally, in assessing the moderating role of mobile phone penetration on informality to affect tax revenue and the result indicated that mobile phone penetration was effective in playing this moderating role. Hence, much attention should be given to how actors in the informal sector in the sub-Saharan African region use mobile phones.

In concluding this section, the study confirmed that, informality and mobile phone penetration affect tax revenue within the sub-Saharan region. Hence, the use of mobile phones as a medium for mobilising tax revenue should be taken into consideration. Moreover, the informal sector cannot be overlooked in terms of revenue mobilisation since it forms a greater portion of most sectors in developing economies, and also considered as one of the sectors that is very difficult to tax.

Recommendations

The purpose of this study was to examine the effect of informality on tax revenue with more emphasis on the role mobile phone penetration play in

moderating this effect. The findings of this study based on some other control variables revealed that informality, mobile phone penetration, trade openness, agriculture, inflation, the log of GDP per capita and control of corruption influenced tax revenue in one way or the other. The following recommendations are made in light of the current study's findings and conclusions.

First of all, strengthening the special government agencies established and tasked with identifying, registering, educating, and advising all informal sector operators on how to keep accurate records, market their goods, access cheap financing, among others, will help them feel recognised and will encourage voluntary compliance with regard to paying taxes.

Also, governments need to build and improve infrastructures related to new mobile technologies as well as modernise their tax administration. However, they must also adopt best practices in tax legislation in order to take full advantage of mobile phones usage.

Finally, mobile phones usage in business activities within the sub-Saharan region has been on the rise since it aids in facilitating transactions. The positive effect of the moderating role of mobile phone penetration on tax revenue through the informal sector suggest that there should be some form of consumer education by governments together with telecommunications agencies in order to help improve awareness on the benefits of using mobile phone to transact businesses and the ease of payment of taxes through the usage of mobile phones.

Area for Further Research

The study concentrated on the relationship between informality and tax revenue and the moderating effect that mobile phone penetration has on that relationship. Studies in the future could consider disaggregating tax revenue into several forms and considering how mobile phone penetration affect each form of tax revenue. Also, studies in the future could consider using other forms of measurements for informality proposed by Alm and Embaye (2013) to assess it moderating role on mobile phone penetration in affecting tax revenue.

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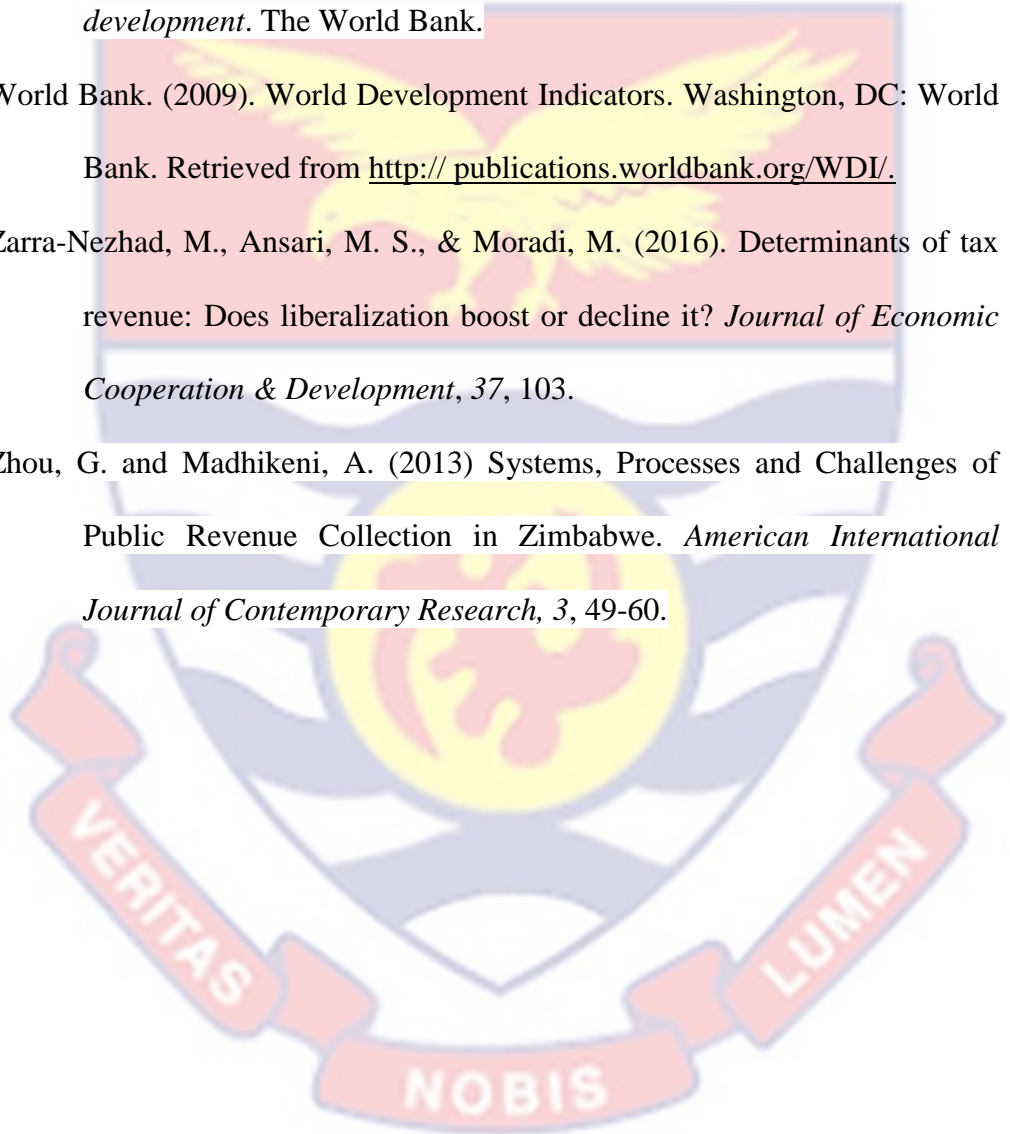
APPENDICES

A: List of countries used in the study

Angola	Madagascar
Botswana	Malawi
Burkina Faso	Mali
Cabo Verde	Mauritius
Cameroon	Mozambique
Central African Republic	Namibia
Congo Republic	South Africa
Cote d'Ivoire	Tanzania
Equatorial Guinea	Togo
Ethiopia	Zambia
Gabon	Zimbabwe
Ghana	
Kenya	
Lesotho	
Liberia	

B: Informal Economy Estimation, the MIMIC model (Medina & Schneider, 2018)

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