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INFRASTRUCTURE INVESTMENT IN SUB-SAHARAN AFRICA: OPPORTUNITIES, RISKS AND PROSPECTS FOR ECONOMIC DEVELOPMENT

By

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Submitted in Fulfilment of the Requirements for the Degree of PhD in Economics

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April 2020

DECLARATION

I declare that “Infrastructure investment in Sub-Saharan Africa: Opportunities, risks and prospects for economic development” is my own work, that it has not been submitted for any degree or examination in any university, and that all the sources that I have used or quoted have been indicated and acknowledged by complete references.

Signature:

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ACKNOWLEDGEMENTS

I wish to extend my gratitude to Dr Bayat and Dr Sheefeni for making this work possible. Without their dedicated guidance, nothing would have been achieved. I also extend my gratitude to my brother Dr Khaukanani. Without you, I remain lost as you continue to hold my hand patiently and you never get tired in this journey of thousand miles. To my other brother Vincent, your spirit of resilience keeps me going and I hope one day I will find time to tell your story. Lastly, to my friends, we have walked this journey together and I do not have enough words to thank you. I have come to appreciate simple things in life through you and never stop dreaming. I hope that this thesis will help in adding much-needed understanding of our continent as we continue to challenge underdevelopment in Africa.

ABSTRACT

There is considerable theoretical and empirical research devoted to the study of infrastructure investment and development and how they relate to economic growth. There is also evidence in developed economies that their economies grew following infrastructure investment. The inference can be made that infrastructure investment plays a positive role in economic growth. Sub-Saharan Africa (SSA) is immensely well-endowed with natural resources yet is the poorest region in the world. Furthermore, SSA countries have similar experiences of public infrastructure investment, such as not having enough transportation infrastructure or the lack of an adequate power supply. Where public infrastructure exists in SSA can be described as ageing, decaying, inappropriate, incomplete or dysfunctional to some degree.

The study conducted both qualitative and quantitative analyses to evaluate infrastructure investment in three SSA countries – Angola, Democratic Republic of Congo and Ghana – to determine what levels of investment, challenges and needs are currently experienced in private and public infrastructure investment in the region, particularly pertaining to transportation, energy and ICT infrastructure, and what factors may be influencing investors to avoid investing in SSA infrastructure. The research found that the DRC has the least infrastructure investment while Ghana is ahead of the three countries. The research also found that while Ghana is ahead of the three countries, its governance system is also better and is less corrupt compared to the other two economies with the DRC being at the bottom. As a result, infrastructure investment in SSA has fallen far behind its trading partners due to poor governance and corruption.

Keywords: Infrastructure services, Sub-Saharan Africa, Economic growth, Infrastructure investment, Foreign direct investment, Trade and development, Natural resources, Political stability, DRC, Angola, Ghana.

ABBREVIATIONS

AU	African Union
CAR	Central African Republic
DRC	Democratic Republic of Congo
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFZA	Ghana Free Zones Authority
IBRD	International Bank for Reconstruction and Development
ICA	Infrastructure Consortium for Africa
ICT	Information and Communication Technology
IMF	International Monetary Fund
IOSCO	International Organisation of Securities Commissions
IRMA	Initiative for Risk Mitigation in Africa
MPLA	People's Movement for the Liberation of Angola
NEPAD	New Partnership for Africa's Development
OPEC	Organisation of the Petroleum Exporting Countries
PPP	Public-Private Partnership
SADC	Southern African Development Community
SAHO	South African History Online
SEZ	Special Economic Zone
SSA	Sub-Saharan Africa
SWFs	Sovereign Wealth Funds
UN	United Nations
UNITA	National Union for the Total Independence of Angola

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Infrastructure plays an important role in the general economic activities of a country. Despite its riches in natural resources, after years of under-investment in infrastructure by public and private investors, Sub-Saharan Africa (SSA) has been turned into a poorer regional economy characterised by dilapidated public, institutional and economic infrastructure. Studies on infrastructure and economic development in SSA conducted by Calderón and Servén (2010) and by Barhoumi, Vu, Towfighian and Maino (2018) found that infrastructure performance in SSA remains among the worst globally in comparison with other developing regions.

An earlier study on infrastructure and economic growth in SSA by Njoh (2000:287) found that "there is consensus with respect to infrastructure investment needed to stimulate economic growth, in line with the theory, that states that investment in infrastructure leads to economic growth". Stated differently, an efficient infrastructure that facilitates trade will stimulate economic growth. While economic growth does not necessarily require infrastructure investment, this research argues that economic growth often occurs where infrastructure investment and development have taken place or are taking place.

Given this positive relationship, it is unfortunate that there is little evidence that local and global investors are sufficiently attracted to the investment opportunities that the SSA region offers, particularly through its abundant natural resources. That, there is a myriad opportunities is indisputable. George, Corbishley, Khayesi, Haas and Tihanyi (2016:379, citing KPMG, 2013), state that "The continent [Africa] contains 30% of the world's minerals as well as the largest reserves of precious metals, with more than 40% of global reserves of gold, 60% of cobalt, and 90% of platinum". In a research done on the state of the investment in Africa, Menson (2012:47) states that, while "trade has been a key driver of economic growth over the last 50 years for the rich western countries and some developing countries, however, this has not been the case for Africa despite the abundance of opportunities that the continent presents, particularly the SSA region with its richness in mineral resources". In their analysis of the challenges and performance of foreign direct investment (FDI) in Africa, Dupasquier and Osakwe (2006) observed the lack of investment attracted to the SSA region. Yet, were the SSA

region able to attract enough investment to exploit its known natural resources, it is likely that such activity could generate sufficient revenue to ultimately finance the region's developmental needs. Instead, despite its natural wealth, SSA "now accounts for most of the world's poor" and is the only region where the number of poor people is increasing (World Bank, 2018b: 2).

The Global Economic Prospects report on SSA's future (World Bank, 2018a: 147) contends that "competitiveness within SSA suffers as a result of poor business environments, lack of infrastructure, and high unit labour costs". All the above studies point to the fact that the poor state of infrastructure and the lack of investment in infrastructure development have hampered trade in the SSA region compared to other regions, whereas adequate investment could have played a major developmental role in the region.

SSA economies are largely dominated by trade in natural resources, most of which paradoxically remains largely unexploited, with little indication of the implementation of infrastructural development to facilitate access and allow the expanded exploitation of these resources. Kessides (2007) argues that SSA's inability to diversify its production outputs from primary to processed goods and service continues to "disadvantage" it from creating much-needed opportunities for job creation, technological development, economic prospects, growth and development of other key sectors of the economy.

The lack of diversification is compounded by inadequate infrastructure investment which, because it is characteristic of Africa as a whole, compounds the difficulty of integrating the sub-regions of Africa and realising the potential advantages of a rationalised continental African economy (such as, for example, the reduction of tariffs and other restrictions on the movement of goods within the European Union) and ensures that infrastructure investment is more expensive for SSA countries in comparison to other emerging economies. Further, infrastructure corridors that could maximise regional economic output are not properly linked, keeping the transportation costs in the region high compared to other regional economies. Asomani-Boateng, Fricano and Adarkwa's (2015) case study in Ghana on the assessment of the socio-economic impacts of road infrastructure programmes and how these influence economic corridors had a similar finding, for that country. The lack of road infrastructure linkages was highlighted by Idris and Salisu (2016) who state that "at least 80 per cent of goods and 90 per cent of passengers are still transported on roads, mostly of poor quality".

Despite the fact that some of the countries in SSA have coastlines with relatively deep harbours to facilitate maritime trade, very few of these are well linked with air, rail and road transport infrastructure, which makes even those countries with large exploitable reserves of natural resources less investor-friendly. Obi (2018) identifies these countries as South Africa (RSA), Democratic Republic of Congo (DRC), Uganda (the gas and oil in Lake Albert), South Sudan, Angola and Mozambique and Central Africa Republic (uranium reserves). Although a number of these SSA countries share borders, not enough infrastructure is shared to reduce the costs of inter-trade.

Only South Africa has well-developed infrastructure such as harbour, road and rail corridors that connect to neighbouring Namibia, Botswana, Mozambique, Zimbabwe, Lesotho and Eswatini. The inter-connectivity of the infrastructure, mainly in the Southern African Customs Union (Mozambique and Zimbabwe are not members), makes the movement of goods and services efficient. By contrast, in the DRC, which has ample natural resources and neighbours nine countries, very little infrastructure investment is shared or built to exploit or facilitate economic activities within the region.

The lack of shared infrastructure investment is also noted in the Infrastructure Consortium for Africa report (ICA, 2016) which highlights that, despite many commitments, financing of infrastructure in Africa remains sluggish and thus negatively impacts economic growth. The slow economic growth in the region is also observed in the Initiative for Risk Mitigation in Africa (IRMA) study commissioned by the African Development Bank (2013), which estimated that "almost US$93 billion per year (15 per cent of the region's Gross Domestic Product (GDP)) [was] needed for the period 2010 to 2020 to close the infrastructure gap with other developing countries" (African Development Bank, 2013:10).

While Inderst and Stewart (2014) estimate the amount needed to close the gap in infrastructure to be nearly US$100 billion per year over the six years or so following the study, the ICA (2016:6) found that:

> The total reported spend on infrastructure development in 2016 was only US$62,5 billion, consisting of identifiable African national government budget allocations, financial commitments by ICA members, development finance institutions and state

funders such as China, Europe, India, South Korea and the Arab Funds (sovereign funds).

The required amount for infrastructure investment continues to increase with no clear plan in place to reduce the backlog. In addition to commercial infrastructure, there is a great need in SSA for investment in infrastructure to support the development of human capital. A report on construction trends in Africa released annually by Deloitte (2017:9) found that "large-scale investment into social development projects such as infrastructure remains lower with only 1.2% of total investment going towards water infrastructure, with education receiving 0.2% and social development and healthcare getting 0.1% each". Deloitte (2017) and also Tukić (2018) detected only a slight increase in recent investment in SSA region, insufficient to impact the infrastructure investment backlog.

Where investment in infrastructure has occurred, some positive spin-offs in the region were observed. For instance, Amoako-Tuffour, Balchin, Calabrese and Mendez-Parra (2016) contend that the Kenya-Uganda and Mozambique-South Africa corridors facilitate the transit of goods and services, which led to better trade and economic prospects for these countries. The developments of the corridors led to improvements in access to health care, 'mushrooming' of new businesses and employment opportunities.

As a result, other infrastructure corridors were developed, such as mobile phone infrastructure which reduced the communication burden in the region. The use of Information and Communication Technology (ICT) is also explained by Fosu (2015) and Hennessy, Onguko, Harrison, Kiforo, Namalefe, Naseem and Wamakote (2016), who argue that ICT has significantly improved in the SSA region, although it remains inadequate. The effects of ICT innovations such as mobile phone banking in SSA demonstrate how investment in infrastructure can influence the pace of economic development and growth, including the facilitation of trade. In areas where there is a limited physical banking network, and especially where the lack of employment opportunities forces some of the adult working population migrate elsewhere to seek employment, such workers benefit from mobile phone banking as they are able to send remittances to their families electronically.

African countries have formed several regional economic communities, such as the Economic Community of West African States (ECOWAS), Common Market for Eastern and Southern Africa (COMESA), Economic Community of Central African States (ECCAS) and Southern

African Development Community (SADC). The development of infrastructure could easily integrate them into a regional economic 'powerhouse' through strong inter-trades. The trans-African corridors continue to be in various development stages throughout the SSA region. However, in countries such as Angola, the DRC and Ghana, investment in road, energy, rail and ICT infrastructure remains inadequate, making it difficult for efficient trade to take place in the region and to exploit the advantages of meaningful regional economic integration.

1.2 PROBLEM STATEMENT

Very little investment has been channelled into infrastructure development in SSA. As a result, all sectors of the economy face a constraining business environment characterised by the exorbitant cost of doing business, difficulties in accessing markets, difficulties in attracting professional skills and innovation, difficulties in attracting financiers, inefficient economic performance, loss of revenue and poor quality of life for employees.

The poor investment in infrastructure also makes it difficult for investors to undertake long-term commitments in the region, mainly in other investment opportunities. For instance, the start of projects is often delayed in the hope that the constraining business environment will somehow improve and reduce the cost of investment for companies interested in doing business in SSA.

The effects of socio-economic and geopolitical challenges such as the lack of infrastructure services, inadequate economic opportunities and political instability in some parts of SSA are also not making it easy for the region to improve the business environment as these effects are also contributing to the slow growth in the region. These effects further make the pledges made by the investors to infrastructure investment unattainable and where the pledges were implemented, the costs have often been significantly high in comparison with similar projects and similar development stages.

The exorbitant cost of infrastructure development in SSA was also found in the African Development Bank report (2014:3) on infrastructure costs in Africa, which additionally found that "SSA has limited data on infrastructure investment and this constrains planning of infrastructure development which leads to a dearth of competitiveness". The lack of

competitiveness is also reflective of the concentration of landlocked poor countries in SSA with no prospects of developing on their own without assistance by private investors.

While the International Bank for Reconstruction and Development study (IBRD) (World Bank, 2009:2) on infrastructure development also affirms that "many governments in developing regions are turning to the private sector to design, build, finance, and operate infrastructure facilities hitherto provided by the public sector", as they are unable to develop these infrastructures without the assistance from the private sector, SSA has not managed to attract enough private investors to develop infrastructure and exploit the prevailing opportunities.

In summary, there is sufficient evidence confirming that infrastructure investment in SSA is lagging and the absence thereof contributes towards the exorbitant cost of doing business in the region and thus fostering economic growth. The research will investigate the problem by focusing on three specific countries as case studies – Angola, the DRC and Ghana. The criteria for choosing these countries were: (i) their strategic location; (ii) their relative abundance of natural resources; and (iii) their colonial history i.e. Anglophone, Lusophone and Francophone respectively.

1.3 RESEARCH QUESTION AND OBJECTIVES

The research question for the study is: What are the present levels of private and public infrastructure investment in services such as transportation, electricity and ICT, including challenges, in the three selected countries in the SSA region, i.e. Angola, Democratic Republic of Congo and Ghana?

1.4 OBJECTIVES

Based on the above research question, the objectives of the study are:

- To provide a brief historical background of infrastructure investment in Africa and in the three countries concerned;
- To provide a detailed profile of the key economic sectors of the three countries;
- To describe the infrastructure investment trends in these three countries;
- To understand the potential impact of infrastructure development on the macroeconomic level of these three countries;

- To determine whether there is a long run relationship between investment and infrastructure development;
- To understand the risks that investors face in infrastructure investment in the SSA region.

The objectives of the research will assist in understanding factors that could stimulate investment in public infrastructure in selected countries in SSA. These factors are assumed to be influenced by the colonial history, geographical location and the abundance of natural resources.

Angola (once colonised by Portugal) also boasts mineral resources, oil and gas including vast agricultural land that still needs to be developed. The DRC (the former Belgian Congo) remains a vast country with a huge economic potential to become one of the richest economies in terms of mineral resources. Similarly, Ghana is a former British coastal colony in West Africa endowed with natural resources such as oil and gas, minerals and agricultural land. All three countries are strategically located, with coastlines and harbours that could serve neighbouring landlocked countries but lack the coordinated road, rail and harbour infrastructure that would facilitate local and regional trade. Further, because of their strategic locations, a significant improvement in infrastructure investment in these countries is likely to boost trade and economic growth throughout SSA. Based on these factors, the research focuses on case studies of Angola, DRC and Ghana. The secondary data for quantitative analysis is also based on these three economies.

1.5 RELEVANCE OF THE RESEARCH

Infrastructure investments in services such as electricity, transportation and ICT are highly relevant to the region's trade and economic growth. The study sets out to assist the understanding of the social, economic, market and political shortcomings that could be limiting infrastructure investment within the SSA region, particularly in the selected countries, to cast light on the role of private funding in the development of infrastructure in SSA, and examine the conditions attached to such funding. The study seeks to identify these drivers by investigating infrastructure investment in Ghana, DRC and Angola, as they are key to influencing growth and investment in the region. The study contends that investment in public infrastructure in Ghana, DRC and Angola such as rail, ports, power generation and roads, are

unavoidable given the current state of infrastructure in these countries and the need for inter-trade in the SSA region. Moreover, most of the infrastructure date from the colonial era and have greatly deteriorated or become largely dysfunctional.

The importance of ongoing and expanded infrastructure investment and development is emphasised by Ougaard (2018) who states that infrastructure investment in SSA has lagged behind the rest of the developing economies. In attempting to clarify the reasons for the prevailing slow infrastructure investment in SSA, this research could help stakeholders and policymakers in SSA to better address development policy and planning gaps where necessary. Furthermore, this research could assist in finding solutions to improving the low economic performance ranking of the SSA countries as defined in indices such as the Global Competitiveness Report, which has ranked SSA countries, with the exception of Mauritius and South Africa, as the least competitive in the world (Schwab, 2019).

Given the critical socio-economic developmental needs of its populations, it is urgent that a better insight is developed into both the seeming incapacity of governments to deliver infrastructure improvements and the reasons behind the lack of appetite by investors for infrastructure investment in the region, especially perplexing considering the value that such investment could unlock in terms of the region's considerable wealth in natural resources.

While previous studies have tended to assume that emerging economies share common development challenges, the study will contextualise these challenges and also show that infrastructure in the selected SSA countries presents unique challenges in comparison with other emerging economic regions. The study should not only provide policy makers with better insights into the infrastructure investment backlog but also help investors to find ways of mitigating risk when they decide to invest. Furthermore, potential investors could use the research to develop a better understanding of the challenges and opportunities involved in the region's infrastructure investment and development.

The outcomes of the research could contribute to a better-coordinated infrastructure investment and development environment for public and private sector participants, assisting countries in SSA to develop strategies that enable them to partner with private investors in funding public infrastructure projects and thereby improving the region's economic opportunities for

increasing trade. Lastly, the research will add to the existing literature and contribute to the debate on infrastructure investment in SSA.

1.6 LIMITATIONS

The research is limited due to several reasons. Infrastructure data in SSA is not easily accessible due to the region's poor record-keeping and lack of governance systems. The study relies on secondary data that was collected through third parties in certain instances and not from the countries included in the study. Therefore, it is a multiple sourcing data collection reliant on the quality of sources, which carries the risk of resulting in an unfair and subjective picture. Data unavailability and quality of data for some of the countries in the years under consideration were also considered to be a challenge, as was the risk that the case studies might not follow similar formats due to a lack of information and data in some of the sampled economies.

Language barriers may have limited access to information in official documents, which tend to be rendered in the main language of each country, i.e. French in the DRC and Portuguese in Angola (official documents in Ghana are in English). The study mitigated this risk by collecting data mainly from international organisations such as the World Bank (most sources were published in English) and also from source sites that had translation options. It is possible that some of the information relevant to the study may not have been translated for inclusion in the documents included in the research.

1.7 RESEARCH OUTLINE

Chapter One of the study outlines the problem statement, research question and objectives, relevance and limitations of the study. Chapter Two reviews the theoretical literature on economic growth. The chapter also discusses and defines what infrastructure is, including its sub-components. Chapter Three deals with the empirical literature on infrastructure investment and development. Chapter Four examines the influence and role of politics on public infrastructure investment in SSA, particularly in terms of the political economy of the three countries selected for the case studies. Chapter Five describes the research methodology adopted for the study. Chapter Six concerns the case studies as part of the research findings and Chapter Seven addresses the empirical findings of the study. Chapter Eight concludes the

study, providing a comprehensive summary, the conclusions of the study as well as relevant recommendations.

CHAPTER TWO: THEORETICAL LITERATURE

2.1 INTRODUCTION

The central thrust of this research is to investigate the reasons for poor investment in public infrastructure in SSA, particularly with a focus on three sub-Saharan countries, i.e. Ghana, Angola and the DRC. Investing in infrastructure is often seen as the panacea for economic growth and development. The chapter reviews the theoretical literature on public infrastructure investment and economic growth to understand the relationship between them.

The chapter begins by defining the concept of infrastructure and its various categories. The next section discusses theories on economic development and highlights how infrastructure development contributes to economic growth. This discussion of growth theories is augmented by a discussion of various investment theories, offering perspectives on what investors look for before deciding on whether to invest in a country. The chapter concludes by examining three theories relating to investors' motivation for infrastructure investment.

2.2 CONCEPT OF INFRASTRUCTURE

Blaginin, Khudyakova and Alimova (2017:1) explain infrastructure as "the nucleus of any economic system and should be understood as the micro, meso and macro-system of an economy and functions as the link for the economic activity". Infrastructure is also regarded as a complex and independent multi-elemental system with various services. These services are defined as roads, rail, energy, water reticulation and telecommunications. The well-being of any society is determined by infrastructure and its services. The living standards, investment opportunities and attractiveness of an economy are dependent on infrastructure services. Without adequate infrastructure, economies struggle to address and to accelerate socioeconomic programmes that lead to development and economic growth.

Modernisation of infrastructure services tends to affect the industrial re-localisation processes as well as increasing the productivity of a country. A common assumption on infrastructure investment is that affected sectors of the economy will start producing more outputs leading to more trade. As a result, more investment may take place, including the attraction of local and foreign investment into the economy once the economy has built or invested adequately in its

infrastructure capacity. Mbekeani (2010:89), for example, asserts that "infrastructure investment triggers the flow of foreign capital, considered in terms of direct foreign investment".

The above definition of infrastructure by Blaginin et al. (2017) follows attempts by several researchers to build on the pioneering work of Eucken (1955) and Jochimsen (1966). Eucken's (1955) definition of infrastructure was anchored in his theory which advocated limiting the state's task to the provision of the political framework for economic freedom to flourish. In essence, Eucken believed that infrastructure provision would flourish when government provided the political framework (institutional infrastructure) without playing an active role in the provision of other infrastructures.

Eucken (1955) considered infrastructure as the "economic constitution" which should be implemented based on the institution of the market economy. According to Eucken (1955), infrastructure is defined in terms of "institution and should be assigned the function of social integration of values with the object of economic and legal policy". Jochimsen (1966) criticised Eucken (1955) for restricting the definition of infrastructure to the state and politics. Jochimsen (1966) posits that Eucken's understanding of infrastructure was not clear enough as it did not integrate and maximise the level of economic activities associated with infrastructure. As a result, he offered an expanded definition that distinguishes between material, institutional and personal infrastructure arguing that:

> infrastructure is the sum of material, institutional and personal facilities and data which are available to the economic agents and which contribute to realising the equalisation of the remuneration of comparable inputs in the case of a suitable allocation of resources that is complete integration and maximum level of economic activities (Jochimsen, 1966:100).

However, Buhr (2003) found shortcomings in Jochimsen's definition of infrastructure as well. Buhr (2003:1) contends that the "disadvantage of Jochimsen's definition of infrastructure is that he makes the material infrastructure to be an enumeration of public facilities characterised by specific attributes". Buhr (2003) argues that definitions of infrastructure should consider and emphasise more than the material infrastructure as manifested in essential public facilities. Buhr (2003) posits that the legal constitution regulating types of government tasks should be

included since government tasks lead to government expenditures and thus impact infrastructure and its related services.

Despite the perceived limitation of Jochimsen definition of infrastructure, his explanation remains a plausible basis which continues to benefit from enhancement and formulation. Buhr (2003) concedes that most of the proposed formulations and enhancements have common features. Infrastructure, according to Buhr (2003:1), should be defined as "the sum of material, institutional and personal facilities and data which are available to the economic agents and which contribute to realising the equalisation of the remuneration of comparable inputs in the case of a suitable allocation of resources that is complete integration and maximum level of economic activities".

In summary, early definitions of infrastructure emphasised institutional infrastructure where the government was expected to facilitate economic and legal policy. Over time, the definition evolved to include material infrastructure and personal infrastructure. Thus, infrastructure can be regarded as an installation of physical structures that is inclusive and acts as an agent for economic development. This definition encompasses the economic, social and political benefits accrued by a country or region when developing infrastructure for use and application in society.

2.2.1 CATEGORIES OF INFRASTRUCTURE

There are three categories of infrastructure used by stakeholders in deciding how the needs of society can be met. These categories are institutional, material and personal. Although the research is interested in material infrastructure focusing on specific infrastructure services, i.e. energy, ICT and transportation (road, rail and ports), it is important to discuss all categories of infrastructure given the influence these categories have on one another.

i) INSTITUTIONAL INFRASTRUCTURE

Buhr (2003:5) defines institutional infrastructure as "comprising of all customary and established rules of the community as well as the facilities and procedures for guaranteeing and implementing these rules by the state". In essence, without institutional infrastructure in place, the state cannot provide and guarantee the legislative, administrative and judicial structures that maintain the economic and social systems of society.

The institutional group of infrastructure deals with all regular and established rules of society. These include facilities and procedures that ensure customs and rules of society are upheld. Although infrastructure is characterised by the three categories, i.e. institutional, material and personal, the institutional infrastructure forms the foundation for other categories of infrastructure as it is the basis for society ability to function without chaos.

Institutional infrastructure has been explained by various researchers such as Eucken (1955), Tirole (1999), Buhr (2003) and Lynch (2003) as a nation's legal framework, which includes regulations and administration by all types of government, distribution of these obligations and delegation of power to different institutions of government. The institutional infrastructure guides government allocation of resources and the expenditure of revenues, including the expenditure on public infrastructure development.

ii) PERSONAL INFRASTRUCTURE

Although institutional infrastructure is largely the domain of the state, Tirole (1999) and Lynch (2003) show that personal infrastructure or human capital is developed and maintained by households, individuals and government. Buhr (2003:7) argues that "after government initiated the creation of laws guaranteeing, for instance, equal access and opportunities of schooling or demanding the general obligation of school attendance according to minimum standards, the outcome of the initiation will be the development of human capital infrastructure or personal infrastructure".

Thus, "the supply of education must follow the structure of education demand under the rules" as envisaged by institutional infrastructure. The institutional infrastructure guarantees that the policy of the economic or social order becomes what the government initiates. This includes the creation of laws that guarantee equal access to education and opportunities in general.

iii) MATERIAL INFRASTRUCTURE

According to Buhr (2003), material infrastructure is "known for representing capital goods in the form of transportation, education facilities, health facilities, and equipment" for infrastructure services such as energy and water provision. The provision of material infrastructure according to Buhr (2003) is also referred to as "social overhead capital or public

facilities" such as water provision infrastructure, transportation or government buildings. These facilities are public goods that help to drive economic activities.

Material infrastructure follows after society develops institutional infrastructure. Society achieves this by organising its activities to build material infrastructure that will enable it to facilitate economic activities. The duty of the state is to facilitate economic activities towards the initial investment in material infrastructure services. Although the state plays an important role in the development of material infrastructure, the private sector also plays a significant developmental role, as is explained in detail in the theoretical section of this chapter. The theory demonstrates how society influences the formation of institutional infrastructure and the organisation of material infrastructure by the private sector to enable higher productivity and economic activities.

In their contribution on material infrastructure, Appel, Anand and Gupta (2015) explain that the involvement of the public and private sectors in organising material infrastructure could take the form of household-oriented infrastructure, firm-oriented infrastructure and financial-oriented infrastructure. Furthermore, Tirole (1999) and Lynch (2003) explain that the investment orientation on material infrastructure by the public and private sectors may have positive or negative effects on the economic setup of a country, depending on how their functions influence the structure of the economy.

The availability of material infrastructure in an economy thus facilitates the trade between countries and also leads to economic efficiency. Without adequate material infrastructure services such as ICT, roads, power, water and rail, the costs of doing business become exorbitant, making the economy less competitive.

2.3 THEORIES OF ECONOMIC GROWTH AND INFRASTRUCTURE INVESTMENT

The contribution of infrastructure services to economic growth has been debated at length by various researchers, including Tirole (1999), Lynch (2003), Manyasa (2009) and Klenert, Mattauch, Edenhofer and Lessmann (2018). These researchers assert that investment in infrastructure services leads to better productivity and thus economic growth. Very little

research has been done to dispute this positive correlation between economic growth and investment in infrastructure services.

There are several theoretical approaches underpinning debates on the relationship between economic growth and investment in infrastructure services. These include mercantilism, cumulative causation, limits to growth, Keynesian demand-side, classical, neoclassical and the endogenous growth theories.

The researcher has been selective in discussing these theories, according to the research objectives. Similarly, the discussion on theories that claim a negative relationship between the two variables will also be selective given the limited research conducted and further overshadowed by the overwhelming research on correlations between the two.

2.3.1 GROWTH THEORIES AND INFRASTRUCTURE

Most economies aspire to seamless, efficient and uninterrupted productivity that enables growth and trade. Fowler (2017) states that some economies engage in productive activities such as infrastructure investment services to attain better economic growth than other economies. Their investment strategy is based on the theoretical understanding and assumption that advanced infrastructure services lead to economic growth and thus make the economy more competitive than others.

The argument is also based on observation of the success of economies with good infrastructure services in place and determining why these economies function better than others. Infrastructure development in developed and developing economies is disproportionate and the levels of development are supported by various theories on growth where material infrastructure services are either abundant or lacking.

An assumption can be made that the weaknesses of less advanced economies, with fewer material infrastructure services in place, are among the reasons for the lack of sustainable growth in those economies. The growth theories explain the lack of growth as being the absence of conditions that support sustainable growth, such as basic infrastructure services.

Attempts to understand and explain this phenomenon have not generated a single answer but a multiplicity of explanations through various growth theories. These theories include the classical (Smith, 1776), the neoclassical (Arrow and Debreu, 1954; Lewis 1954; Kuznets, 1955; Solow, 1956 and 1957; Fei and Ranis, 1969; Mankiw, Romer and Weil, 1992) and the contemporary endogenous growth theory (Robert, 1988; King and Rebelo, 1989; Romer, 1989 and 1990; Barro, 1991). They all explain economic growth as conditional and dependent on other factors, such as material infrastructure services, and how these factors influence investment.

These factors may differ from one area to the next as it is commonly acknowledged that economies and regions pursue developmental agenda at different paces, based on their circumstances and political ideologies. For instance, some economies with limited resources tend to optimise the resources at their disposal to advance their economic agendas and to attract more investment whereas others with abundant resources struggle to take advantage of their endowment and even fail to build basic infrastructure services. Similarly, some regions work collectively to advance regional economic growth. This may include collective trade agreements and infrastructure development through collective investment.

The different approaches to economic development by countries make it difficult to model the development of economies with natural endowments compared with those without natural endowments, when comparing levels of development and ideologies with economic growth through investment in infrastructure services. As a result, the answer to the question posed as regards the relationship between growth and infrastructure investment remains ambiguous without including other factors that influence growth.

In an attempt to explain some of the growth factors, theorists have stressed the link between economic growth and investment in public infrastructure services. For instance, developing economies present good opportunities for growth, especially where investors are looking to invest in infrastructure services projects. The lack of material infrastructure services (‘infrastructure’) in developing economies has also been linked to low investor interest in the development of other sectors and insufficient productivity.

Adam Smith (1776) explained some of the ambiguities and specifically focused on unequal economic development in a society. Smith (1776) argued that for an economy to prosper, the economy must invest more in sectors that give the country a comparative advantage. Inference can be made that this investment might include developing infrastructure services to facilitate economic activities. Indeed Klenert, Mattauch, Edenhofer and Lessmann (2016:2) state that "public investment in infrastructure has received much attention as an attractive option for accomplishing two main objectives of economic policy: promoting efficiency and growth as well as reducing inequality in wealth".

The approach advocated by Smith was arguably the basis for success in some European economies such as Germany and Britain. In developing economies, including the SSA region, there are not enough comparable advantages, except for the natural resources, that the region has to offer for investment compared to regions such as Europe and Asia. The region blames lack of capital as a contributory reason for the lack of investment while others, such as Davis (2017), blame poor governance in SSA as the cause of the lack of investment appetite in the region.

Since the development of infrastructure services is the prerequisite to facilitate the exploitation of the region's natural resources, the low levels of capital investment in infrastructure therefore ensure that the region continues to lack the relative advantages of more developed economies, disadvantages it in trade and keeps SSA reliant on donor funding and foreign aid that seem oblivious to the region's economic development needs.

Aside from the perspective of Smith above, other growth theories have been used to frame the challenges of unequal development and inefficiencies and explain how these are addressed through investment in public infrastructure services (Klenert et al., 2018). In summary, the growth theories posit that economic growth can have a decreasing effect on inequality while enhancing trade and economic growth at the same time. These growth theories are explained in more detail below.

i) MERCANTILE THEORY

Mercantilism originated in Europe in the 16th century when the economies of European countries were still dominated by agriculture infrastructure. The mercantile system was

essentially driven by a protectionist economic policy whereby governments tried to control trade and economic infrastructure to maximise exports and minimise imports. The mercantile system remained in place until the early 1900s mainly between the European economies and Africa due to Europe's colonial grip on Africa resources. The underlying function of mercantilism, according to Lipson (1948: 1), is that a "nation should be able to invest in productive infrastructure to produce enough goods and service but, above all, it must be in control of the goods and service that it trades to the other nations". Proponents of mercantilism thus expect their governments to restrict the use of local infrastructure services by the foreign companies with whom they are engaging in competitive trade.

Mercantilist economies encourage the export of more products of higher value than they import from their trading partners by investing in local infrastructure services to develop and process raw materials into advanced products, usually at an industrial scale. Thus Rankin (2011:1) posits that "the goal of economic activity, in the mercantile system, was the production and not the consumption, as classical economics would later have it". Beside trade dominance, "the mercantilists also advocate for low wages to give the domestic economy competitive advantages when trading internationally" (Rankin, 2011:1). The deprivation of technology transfer or building of infrastructure services by the mercantile system was meant to keep the economy of the trading partners within the growth path determined by the advanced economy. The narrow focus of the mercantile theory on the promotion of the nation's well-being to influence government policies to 'free' trade in favour of local investors opens the system to criticism.

One of the criticisms of mercantilism is that the system is inward-looking and only focuses on local growth at the expense of other economies. Despite the criticism, Reinert (2011:10) asserts that "the system continues to thrive in modern economies under different formats and this includes production-focused mercantilist policies". Reinert (2011) cites Germany, France and England as examples of economies where mercantilist policies are still in use, especially as applied to trade with Africa. According to Reinert (2011), the advanced economies grew from poor to wealthy countries over the years mainly by exploiting other nations through the implementation of the original mercantile policies. While these economies enjoy modern infrastructure, such as transportation, energy and ICT, their trading partners in developing economies and especially SSA, stagnate with inadequate infrastructure services. Thus, the

imbalance in trade relations between developing economies and their more advanced trading partners is mirrored by a similar imbalance in economic growth and access to better infrastructure services. The trade arrangement between these economies allows the 'exploiting' economies to increase their capital per worker, leading to continued growth in the aggregate volume of production capacity such as infrastructure services, while the 'exploited' economies continue to be deprived of opportunities to develop own infrastructure. For instance, when comparing basic economic factors such as infrastructure services, the exploited economies tend to have sparsely developed infrastructure with a high concentration of infrastructure in urban areas, tending to be specifically related to the processes involved in extracting and transporting the resources required by the exploiting economies. Thus, the productivity of labour in developing economies can be argued to be low in this system as the objective is exploitation rather than partnering or development.

According to Kaldor (1961:178–179), mercantile interests place less consideration on the trading partners while focusing on their domestic economic growth and development. The argument by Kaldor (1961) is supported by Rankin (2011:2) who posits that mercantile theory can be linked to "protectionism, rent-seeking and imperialism or economic nationalism". Thus, by depriving the exploited economy of infrastructure development and investment, growth and wealth creation in that economy is inhibited and poverty prevails. The poverty of exploited economies advantages the mercantile system as the stronger economy is better able to control the trade relationship through the exploited economies' inability to fund its development. Rankin (2011:8) argues that "in the financial world, mercantilism is widely practised through what is popularly known as investment". The investment may achieve mercantilist objectives through lending indirectly to lower-income households or poor economies, which provides the lender with an opportunity to run the deficits needed to offset the accumulating surpluses of the investing classes. The investments may also include infrastructure investment that an economy does not need and or cannot afford to build and if it is technological infrastructure, the dominant economy often provides obsolete technology at exorbitant prices.

The research argues that mercantilism may have evolved into different modern forms to maximise trade and investment. The latest form of mercantilism is sovereign wealth funds (SWFs). Like the earlier form of mercantilism, Gilson and Milhaupt (2009:1346) posit that "SWFs could make decisions for political and not economic reasons by deciding not to invest

into infrastructure needs of a country". The exploitation by SWFs has led to calls for the domestic and international regulation of SWF' investments to be regulated. According to Gilson and Milhaupt (2009), the regulation of SWFs can address "the frictions that result from the interaction of two very different conceptions of the role of government in a capitalist economy as opposed to market capitalism" without compromising investment in infrastructure through SWFs in affected economies, especially developing regions such as SSA.

The push by advanced economies in exploiting opportunities in less advanced but resource-rich economies also led Gilson and Milhaupt (2009:1346) to contend that "the developed economies expect their companies to trade and compete without foreign government intervention in order to increase their GDP while ignoring the plight of developing economies to level the playing field". The disparities in the expectations of the developed and the developing economies create a hostile investment environment for the investors and the investment destination economy, especially where the investment does not address basic infrastructure needs such as transportation and energy.

Wigell (2016:143) argues that the "neo-mercantilist geo-economic strategy is to pursue economic power objectives by denoting an economy-oriented notion of foreign policy realism". The understanding of the global political economy by neo-mercantilists in terms of a zero-sum competition is the basis of their advocacy for the control of markets, technology and resources while investing very little in the economy of the exploited host country.

The mercantilists also emphasise the importance of influencing geo-economic power to manipulate local politics and the economic players who would act as their gatekeepers. Thus, mercantilism underlines the importance of economic power as key to the national interest while applying selective multilateralism. This means that any investment that the nation or companies undertake should address national economic security concerns to keep the status quo rather than building infrastructure services, otherwise any other investment for the exploited economy may not have the support of the mercantilist government. Thus, mercantilism deliberately makes it difficult for developing economies to attract investment that will make them compete with other nations, especially in the development of infrastructure services. Furthermore, mercantilism has been criticised as being exploitive and not promoting global competitive

economic opportunities based on equality and access to the market, by building and promoting infrastructure capacity.

Mercantilism tends to contradict modern notions of a 'new world order' in which social, political and economic stability is preferred over economic security obtained through unfair trade and under-developing host economies. In summary, mercantilism does not promote mutual economic trade based on fairness and openness where economic partners can fairly gain from each other by exploiting and sharing the technological infrastructure to enhance growth, but rather is hostile to addressing investment and development challenges.

ii) CLASSICAL THEORY OF GROWTH

Unlike mercantilism, the classical theory contends that economic growth should be mutually beneficial where economies share infrastructure services or technology that enable them to increase productivity and trade. The classical theory argues that mutual benefits can be achieved when economies decide to specialise in the production process that will lead to economic efficiencies. The classical theory assumes that nations will share technology infrastructure, investing in each other's infrastructure services to increase production capacity. The theory suggests that when economies cooperate, each economy finds its comparative advantage, resulting in economic efficiency, an argument advanced by Myint (1958) and supported by Rostow (1960). According to these views, for example, the developed economies could import raw materials from the developing economies while exporting manufactured goods such as technology.

The classical theory considers investment in the economy such as in infrastructure services as the outcome of three factors that tend to create a competitive environment. These factors are labour, capital (infrastructure) and land. The theory also considers growth as a product of a sequence of various activities started by rational entities, such as infrastructure investment to influence economic development. The classical theory assumes that economic equilibrium will be reached when all entities have equally prosperous growth in the long run. Thus, classical theory advocates investing capital for public infrastructure accumulation as a way of facilitating and increasing wealth creation in society.

Based on Rostow (1960) who emphasised the importance of internal dynamics of the economy as a factor that influences the performance of the economy, Dowrick and Rogers (2002:370) suggest that research and development policies and market structure also play important roles in influencing long-term public infrastructure formation. Dowrick and Rogers (2002) argue not only that investment in public infrastructure services in developing economies should lead economies to catch up with developed economies, but that growth rates will equalise across countries in the long run. According to Dowrick and Rogers (2002:370), "growth that incorporates international technology transfer will, in the short run, show some positive effects especially [for] economies that are on technological catch-up". The views of both Rostow (1960) and Dowrick and Rogers (2002) could be considered as being mechanical since their arguments ignore factors such as the stages of economic growth and the fact that economies hardly ever catch up. Rostow's theory was discredited by Manyasa (2009) when it failed the empirical test. Manyasa (2009:3) argued that "the theory may have failed because the characteristics of economic stages are not specific enough to define relevant empirical evidence".

Among scholars who contributed to the development of the classical theory, Myint (1958:318) argued that classical theory can be achieved empirically "by opening a more extensive market for whatever part of the produce of the nation's labour that may exceed the home consumption". This argument by Myint assumes that countries will share technological infrastructure to increase productivity to enable trade in the economy. Myint (1958) further contends that "the benefit to the nations will be that international trade overcomes the narrowness of the home market and therefore provides an outlet for the surplus product above domestic requirements". Furthermore, international trade will also improve the division of labour and raise the general level of productivity within the country" when countries have enabling infrastructure services to facilitate trade.

In summary, the classical economic growth theory is limited as it does not emphasise enough the supply side factors of the economy such as the investment in public infrastructure services. The lack of emphasis on the supply side led to scholars such as Solow (1956) and Myrdal (1957) postulating that economic growth should not only be trade-driven but also be influenced by supply-side factors, such as public infrastructure investment that increases productivity.

iii) NEOCLASSICAL THEORY OF GROWTH

Neoclassical growth theory showcases the relevance of investment to influence economic growth. The theory is an extension of classical growth theory but seeks to address some of the shortcomings of classical theory. The theory considers technology infrastructure as an important variable for economic growth and provides a theoretical overview of how technological infrastructure investment can influence trade that leads to higher economic growth. In the neoclassical model of economic growth, the long-run growth of an economy can be effected by technological infrastructure progress through investing in technology infrastructure services, which are considered exogenous factors. The neoclassical theory was strengthened by Solow (1956) and Swan (1956) who suggested that economic growth is determined by an increase in labour quantity and quality, increase in capital (through saving and investment) and improvements in technology. The views of Solow (1956) and Swan (1956) assumed that technological advancement would be equally spread.

The research posits that the poor rates of economic performance in the developing economies could be due to state interference in the factors that influence the inflow of capital to augment the existing capital. The neoclassical theory argues that, in economies where there is no state economic interference, factors of production can easily be substituted based on the perfect mobility of these factors. The neoclassical model underlines the importance of domestic savings ultimately being invested in capital goods such as infrastructure services, as explained by Fei and Ranis (1969) and Iamsiraroj and Ulubaşoğlu (2015). The elementary Solow model in a Cobb-Douglas functional form for the neoclassical model is given by equation 1.

$Y = K\alpha(AL)1-\alpha$ …….. (1)

Where: $0 < \alpha < 1$, Y is gross domestic product, K is capital stock, L is labour, A is the productivity of labour and α is the elasticity of output with respect to capital, and infrastructure in particular. Equation 1 maintains the classical assumptions of perfect competition, perfect information, perfect contract enforcement, complete markets and complete contracts. The equation also assumes a fixed rate of savings, an exceptional growth path and an exceptional equilibrium.

The model also assumes that progress in knowledge is unrestrained by the boundaries of an economy and that therefore it is homogenous across countries. Furthermore, savings and population growth rates are not dependent on country-specific determinants of production. The

model infers that economies will converge to some level of income as capital flows from higher to lower capital-labour ratio economies. Solow (1956) explained the neoclassical model using the cross-country GDP variations in terms of the capital stock variations among economies. Solow argued that an increase in the rate of savings increases the output in the short run but not in the long run. He states that in the long run, it will only serve to increase the capital-labour ratio. Thus, an increase in labour-capital ratio results in a decrease in return with the possibility of disinvestment.

The neoclassical model has been challenged, based on the economic growth disparities of cross-countries. The model was challenged by researchers such as Lucas (1988), King and Rebelo (1989) and Barro (1991), who considered the model incompetent to illustrate the variances in the rates of return and international capital flows. The basis of challenging the model was that developing economies have never experienced similar levels of capital flows as the developed economies. Developed economies experience continual capital infrastructure investment compared to developing economies, thus contradicting most of the Solow neoclassical assumptions. Critics of the Solow model such as Mankiw et al. (1992) posited an improved version differing from the traditional Solow model. The "new" model was based on a production function augmented by including human and physical capital in the model. The improved Cobb-Douglas function is given below:

$$Y(t)=K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where: $\alpha, \beta > 0$, $(\alpha + \beta) < 1$, Y is output, K is capital, H is stock of human capital, L is labour, t is time period, A is the level of technology and α and β are the elasticities of output with respect to capital and human capital stock respectively.

Mankiw et al. (1992) also formulated the production functions for human and physical capital expressed by equations (3) and (4) respectively. The assumption of the human and physical capital are the same, i.e. similar production functions.

$$H(t)= S_h\, y(t) – (n+g+ \delta)H(t) \quad (3)$$

$$K(t)= S_k\, y(t) – (n+g+ \delta)K(t) \quad (4)$$

Where S_h and S_k are the fractions of income invested in physical and human capital respectively, and y =Y/AL, K=K/AL, and H= H/AL are quantities per effective labour unit, n is the growth rate of labour, g is the rate of technological advancement and δ is the depreciation rate. Mankiw et al. (1992) held the depreciation rate (δ) and technology advancement rate (g)

as constant across the economies and that $(\alpha + \beta) < 1$. Thus, physical and human capital have diminishing returns.

A study based on growth theory by Iamsiraroj and Doucouliagos (2015:117) finds that "economies converge to the same steady state growth rate in neoclassical growth theory when experiencing similar level technology infrastructure investment". Furthermore, Iamsiraroj and Ulubaşoğlu (2015) suggest that investment only affects growth in the short run although, in the long run, the economy may not experience the same level of growth. The neoclassical theory highlights the importance of domestic human capital accumulation that should be invested in capital goods such as infrastructure services. According to Iamsiraroj and Doucouliagos (2015:117) "The pure effect of investment on growth can be zero, while the effects of investment interacted with some factors such as physical infrastructure investment, human capital, financial market development and trade, might be positively correlated with economic growth".

The role of infrastructure investment cannot be underestimated in the economy. Calderón and Servén (2004) and Sahoo and Dash (2009) also suggest that infrastructure investment plays an important role in an economy, highlighting how infrastructure investment could lead to economic growth and attract FDI. Sahoo, Dash and Nataraj (2010:3) argue that "direct investment in infrastructure creates: (i) production facilities and stimulates economic activities; (ii) reduces transaction costs and trade costs improving competitiveness and (iii) provides employment opportunities to the poor". Based on Sahoo et al. (2010) and others, the research concedes that lack of infrastructure investment creates constraints for the economy and therefore slows economic growth.

The neoclassical growth theory posits that the positive effects of investing in infrastructure to influence growth can also be shown through economic performance. The developed economies are reference points as they continue to advance in growth through infrastructure investment. These economies continue to have better and attractive opportunities for investors based on their public infrastructure services.

In developed economies, infrastructure services galvanise trade. Agénor (2010) explains the phenomenon by suggesting that various infrastructure components of the infrastructure

network are complementary and only joint availability or operation generates efficiency gains. Agénor (2010:933) contends that "the network character of infrastructure capital may induce a strong nonlinearity in its productivity. This means that where there is no network infrastructure in place, public capital tends to have a low marginal productivity; however, once the network infrastructure is established and a critical mass is reached, an economy increases its productivity".

It is this increase in productivity that makes growth theory relevant and also infers that the abundance of infrastructure investment creates a seamless activity in the economy. Ansar, Flyvbjerg, Budzier and Lunn (2016:361), state that a "larger stock of infrastructure investment is thought to fuel economic growth and capital accumulation by reducing the cost of production and transportation of goods and services, increasing the productivity of input factors, creating indirect positive externalities, and smoothing the business cycle".

Additionally, the rate of capital accumulation, according to Kaldor (1961:180), "determines the rate of increase in the employment of labour". This argument is based on the assumption that there is an unlimited labour reserve in the form of a surplus population in an underdeveloped country or assumes that the rate of increase in population is itself governed by the rate of economic growth in the demand for labour. The assumption is, however, flawed since a labour reserve is not limitless and economic growth is not dependent on the rise in population.

The classical and neoclassical models can be summarised as the models that are pro-growth through convergence. They, however, approach growth differently as observed by Kaldor (1961). Kaldor (1961:180) argues that "the peculiarity of classical models as against the neoclassical theories is that they treat capital and labour as if they were complementary factors rather than competitive or substitute factors".

The capital accumulation was also explained in the augmented Solow model, through the use of Ordinary Least Squares, by Mankiw et al. (1992:433), who conclude that "capital accumulation is correlated with savings and population growth in the cross-country regressions". The augmented Solow model is also beset with its own challenges associated with quantifying the investment in capital. One of the challenges is that investment takes the

form of foregone earnings, which are difficult to measure. As a result of the challenges and limitations of the Solow model, the endogenous growth model was developed.

According to Lin (2011:196), neoclassical theory is not enough to address modern growth. The influence of technological infrastructure on growth led to the theory being challenged by Romer (1986) followed by Krugman (1991), which resulted in the development of the endogenous growth theory. The endogenous growth theory explains economic growth through divergence, as discussed below.

iv) ENDOGENOUS THEORY OF GROWTH

Romer (1986) and Krugman (1991) argued that the neoclassical theory was incomplete since it assumed that the economy will converge when there are interregional activities and thus lead to development. Romer (1986) and Krugman (1991) challenged this assumption of convergence and predicted the divergence of interregional development as a form of economic growth, also known as endogenous growth theory.

The endogenous growth model rejects the assumptions made in the classical growth model of the existence of perfect markets and diminishing returns. The endogenous model argues for imperfect markets and assumes that technological change like infrastructure development is important for economic growth. Other assumptions are that there are constant returns to scale at the firm level, existence of both monopoly and perfect market segments in the economy and increasing returns at the economy level. Romer (1990) submits that the rates of technological advancement (such as infrastructure investment) and economic growth are dependent on the size of the market and the stock of human capital.

The endogenous model proposed by Romer (1990) also proposes the inclusion of capital, labour, an index for technology and human capital. This model assumes the economy to be divided into manufacturing and research sectors. Other assumptions are that average labour (L) and human capital (H) are constant. The assumption of two broad sectors also divides human capital (H) into HA and HY where $(HA + HY) \leq H$, where HY is total human capital employed in the manufacturing sector and HA is total human capital employed in the research sector. The last assumption of the endogenous growth model by Romer (1990) is the symmetry of firms for simplicity as stated in the equations below with each equation explained in detail.

$Y(H_y,L,x) = H_y^{\alpha}L^{\beta}\sum_{i=1}^{\infty} X_i^{1-\alpha-\beta}$ (5)

Where x is the units of producer durables and is a function from a defined function space.

$\check{K}(t) = Y(t) - C(t)$ (6)

Where C(t) denotes aggregate consumption at time t.

$Y(H_y,L,x) = H_y^{\alpha}L^{\beta}\int_{\circ}^{\infty} x(i)^{1-\alpha-\beta}di.$ (7)

$\bar{A} = \delta H_A A$ (8)

Where A is the index for the total stock of knowledge available in the economy.

$Y(H_A L,x) = H_y^{\alpha}L^{\beta}\int_{\circ}^{\infty} x(i)^{1-\alpha-\beta}di.Ax^{-1-\alpha-\beta}=H_y^{\alpha}L^{\beta}A\,[K/\eta A]^{1-\alpha-\beta}$

$P_a = (1/r)\pi = (\alpha+\beta/r)av.xp = (\alpha+\beta/r)(1-\alpha-\beta)\,H_y^{\alpha}LX^{\beta-1-\alpha-\beta}$ (9)

$W_H = P_a\delta A = \alpha H_y^{\alpha-1}L^{\beta}\int_{\circ}^{\infty} x^{-1-\alpha-\beta}di = \alpha H_y^{\alpha-1}L^{\beta}AX^{-1-\alpha-\beta}$ (10)

$H_y = 1/\delta\,(\alpha/(1-\alpha-\beta)(\alpha+\beta))r$ (11)

$g = \delta H_A = \delta H - (\alpha/((1-\alpha-\beta)(\alpha+\beta))r$ expressed as $g = ™H_A = ™H - \Lambda r$ (12)

Where g denotes a common growth rate of A, Y and K.

Where Λ is a constant that depends on the technology (infrastructure) parameters α and β as given

$\Lambda = \alpha/(1-\alpha-\beta)(\alpha+\beta)$ (13)

Equation (1) is explained as "expressing output in an additively separable function of all capital goods", which, according to Manyasa (2009:45), is "a departure from the conventional formulation that assumes all durables to be perfect substitutes". From equation (1), Romer separated output into consumer and producer durable goods. Output in the consumer sector is described by an aggregate, price-taking firm, while output in the producer durables sector is characterised by dominant competition among producers. The economy is assumed to sacrifice consumer goods so that capital stock augments according to equation (2).

Among the assumptions by Romer, is the absence of indivisibility and uncertainty problems and the index for the different capital goods to be continuous and thus equation (1) can be expressed as equation (3). In this model, the aggregate stock of designs (used as the proxy for technology or infrastructure) evolves according to the rule given by equation (4). The underlying assumptions of this equation are three with two of the assumptions practical while the other one is functional form assumption. The substantive assumptions are:

The rate of technological improvement such as infrastructure development is directly related to total human capital employed (HA); and

The productivity of human capital in the research sector is directly related to the level of technology (A).
The functional form assumption is that the growth of technology (infrastructure) is linear in HA and A when the other is held constant.

Romer (1990) postulates that the price of new designs (P_A) and the rental price of human capital (W_H) are related by $W_H = P_A\delta A$ and that a representative final-output firm chooses a profit-maximising quantity x (i) for each durable good but faces constant P_A, price of capital goods and interest rate.
Given values of L and H_Y (amounts of labour and human capital used in the production of final-output goods), there exists an inverse aggregate demand function for the durable goods expressed by equation (5). Confronted with the demand function in equation (5), a firm will maximise profit as expressed by equation (6).

Equation (6) represents a firm that has a constant marginal cost and faces a constant elasticity demand curve. The choice to produce a new durable good is made by comparing the discounted revenue streams and the initial cost, P_A, of producing the design. In this case, the monopoly price is considered to be a mark-up on the marginal cost and is determined by the elasticity of demand. The last part of equation (8) shows that with exogenously determined A, this model shows similar features to those of the Solow model. Balanced growth equilibrium is assumed to exist.

Based on the various equations above it can be argued that the endogenous theory, like the neoclassical, focuses on the behaviour of the economy when economic factors such as technology infrastructure services are applied. The difference between the two theories is at the level of the firm. In his analysis of the endogenous model, Romer (1994) suggests that the longing for dominance leads to economic innovation. The endogenous theorists, according to Romer (1994), also reject knowledge as the public good which is non-excludable because individuals and firms earn profits from their discoveries. Romer (1994:13) states that "endogenous growth models accommodating the technological advancement to emphasise the role of private sector activities in the development of technology infrastructure rather than public sector funding for research".

Agénor (2010), using an endogenous approach, crucially assumes that "the degree of efficiency of public infrastructure is positively (and nonlinearly) related to the stock of public capital itself. The threshold variable is the stock of capital per worker. The introduction of this external effect leads to multiple equilibria". Agénor (2010) suggests that "the realisation of a specific steady-growth equilibrium depends on the expectations of private agents and the initial position of the economy, including the parameters characterising public policy". Agénor (2010:933) "motivates the existence of a nonlinear relationship between the efficiency of public capital and its level in two ways. The first way is based on the argument that infrastructure investment is lumpy, i.e., a certain quantity of infrastructure assets must be accumulated before it begins to contribute to the production activities in an economy". The second way is based on network effects. As stated by Agénor (2013:175):

> …economies of scale due to network externalities are a widely recognised imperfection in infrastructure services. An important characteristic of modern infrastructure is…that services are supplied through a networked delivery system designed to serve a multitude of users. This interconnectedness means that the benefits from investment at one point in the network will generally depend on capacities at other points.

The work of Romer, Lucas and others on endogenous growth, according to Button (1998:146), "draws upon longer established concepts of circular-and-cumulative causation associated initially with the ideas of Myrdal". For instance, endogenous growth "focuses on the importance of economies of scale that infrastructure services may bring, agglomeration effects and knowledge spillover [in a region or an economy] and indicates that economic growth tends to be faster in areas that have a relatively large stock of capital, a highly educated population and an economic environment favourable to the accumulation of knowledge" (Button, 1998:146).

Thus, the endogenous growth theory's position on the importance of infrastructure in the growth process may be regarded as connected to investment. The endogenous growth theory examines the inter-relationship between infrastructure investment and economic efficiency. Endogenous growth theory further emphasises the role of infrastructure services and its importance as stimuli to the economic development process. Without investment in infrastructure, including technology, economic growth is limited and the economy less attractive to investors and less competitive.

Lin (2012:16) states that "endogenous growth theory, as it came to be known, maintained the assumption of non-rivalry because technology is indeed a very different type of factor from capital and labour – it can be used indefinitely by others, at zero marginal cost". Technology investment has positive effects on an economy, in part due to its ability to address import substitution. The effect of technology on an economy creates sustained growth possibilities.

In summary, the endogenous growth theory contends that the rate of technological investment influences economic growth driven through innovation and human capital development. Endogenous growth theory complements the work done on neoclassical theory as it has introduced the importance of technological investment in an economy and challenged the assumption of knowledge as a public good.

v) DEVELOPMENT GROWTH THEORY

The development growth theory is a combination of various growth theories. According to development theory, the broad role of infrastructure in the development of an economy is viewed through cumulative causation theory and the neoclassical economic approach.

The approach according to Guild (2000:275) posits that "regions may develop by making increasingly productive use of resources such as developing infrastructure that facilitates growth, and also by taking advantage of agglomeration economies and increasing returns to scale". Thus, "development proceeds as firms and households make more use of labour, capital and natural resources". The reliance on resources is often associated with the neoclassical economic approach on development which was initiated by Solow (1956) in his growth model. Guild (2000) also emphasises the importance of infrastructure by arguing that since "infrastructure also serves as a direct factor input, higher levels of investment should raise regional output". Thus regional economic growth starts with an initial stimulus like the presence of natural resources followed by the development of infrastructure to exploit the resources.

Development theorists contend that high returns on investment in these natural resources in the region have a spillover effect of attracting more investment and agglomeration economies. One spillover effect of investment in natural resources is the development of technological infrastructure.

Kodongo and Ojah (2016:5) state that, in some economists' view, "infrastructure is regarded as part of a country's physical stock of capital and therefore a factor of production and therefore changes in the stock of infrastructure impact national output and directly induce economic growth. They further posit that "infrastructure leads to total factor productivity by lowering input costs or by expanding the production frontier". Thus, infrastructure investment stimulates aggregate demand in an economy.

Another positive effect of infrastructure investments is that it can promote regional integration by providing better public facilities that complement private investment, eliminate capacity constraints and reduce congestion. Elburz, Nijkamp and Pels (2017:1) state that "Public infrastructure – more precisely, transport infrastructure – has been widely used by policy-makers as an instrument to reduce regional disparities and promote regional growth in both developed and developing countries".

The argument was previously advanced by Lin (2012) who came up with New Structural Economics to explain public infrastructure investment as an element of growth strategy. The New Structural Economics according to Lin (2011:193) "suggests a framework to complement previous approaches in the search for sustainable growth strategies". The framework considers an economic structure where "factor endowments evolve from one level of development to another" (Lin, 2012:14).

Lin (2012:14) further asserts that the New Structural Economics is based on a number of ideas, including that "Each industrial structure requires corresponding infrastructure to facilitate its operations and transactions. Second, each level of economic development is a point along the continuum from a low-income agrarian economy to a high-income post-industrialised economy, not a dichotomy of two economic development levels ('poor' versus 'rich' or 'developing' versus 'industrialised'). Industrial upgrading and infrastructure improvement targets in developing countries should not necessarily draw from those that exist in high-income countries. Third, at each given level of development, the market is the basic mechanism for effective resource allocation".

However, Lin (2011) suggests that economic development in the regions "requires industrial upgrading and corresponding improvements in infrastructure at each level". This form of an

upgrade, according to Lin (2011:193), "entails large externalities to firms' transaction costs and returns to capital investment". The investment in regional infrastructure also leads to changes in the household decision-making process whereby households would seek to improve their welfare through location decisions. This means households may decide to settle close to infrastructure to improve their economic potential.

The growth theory is at the centre of the study which is undertaken by using related approaches, i.e. growth theory and investment theory. The investment in infrastructure development assumes that divergence in growth performance between developed and developing countries could be addressed, based on the predictions of convergence from mainstream economic theory.

The economic divergence argument was mainly due to the assumption that modern methods of production are found to be more efficient than traditional ones. This is so especially when the market is expanded to reach a point where the economy requires high productivity to meet the demand. Banerjee and Duflo (2005) and Lin (2011) argue that, contrary to the assumption, the size of the market itself is dependent on the extent to which these modern techniques are adopted.

Lin (2011:197) recalls the views of Prebisch (1950) and Singer (1950) who argued that the post-war "decline in the terms of trade against the export of primary commodities was secular and led to the transfer of income from resource-intensive developing countries to capital intensive developed countries". The thesis still largely applies to trade today. As a result, many resource-rich developing economies with well-intended government intervention policies will still not expand their market to reach the same level of development as their economic counterparts.

In summary, theories that advocate for economic growth through technological infrastructure investment abound. These theories assume that economic growth is determined by the factors that are within reach of the state and the private sector. Despite the reach and positive impact, investment in technological infrastructure has also been argued to not lead to economic growth.

2.4 INFRASTRUCTURE INVESTMENT AND GROWTH: AN ALTERNATIVE HYPOTHESIS

While it can be argued that infrastructure investment transforms economies and thus creates economic competitiveness for the host countries or regions, it can also undermine the sovereignty of countries or regions. Infrastructure investment could attract foreign investment which can easily undermine the local economies and therefore lead to monopolies, environmental degradation, and decline in economic welfare and trade practices.

For instance, where foreign private investors are in charge, especially in infrastructure development, the host economies may lose control over their strategic industries including the existing ICT, energy, water and transport sectors. Thus, allowing foreign investment in these sectors often exposes the economy to open competition and to possible hostile takeovers or collapse of the domestic investments. Multinational investors have shown over the years that investments in foreign states are mainly used to access and penetrate the market. These investors repatriate the profits they make to their home countries, leaving very little funds towards further development of the host countries. Furthermore, Verme (2005) argues that foreign investment leads to capital inflows that create a credit boom. The outcome of the boom in the households could be the reduction of their savings as they shift their consumption towards imported goods, leading to trade deficits.

Mariotti, Mutinelli and Piscitello (2003:427) state that, although foreign investors do not invest much in public infrastructure, “they exploit low-cost production in the host countries while substituting domestic employees with employees from the foreign affiliates”. The investment in the host country could, therefore, reduce the demand for the local products as a result of prospects of credit and cheap imports brought in by foreign investors without much investment in public infrastructure to enable trade.

The research argues that once the multinational investors have control over the host region or countries, they may dictate the nature of infrastructure in line with their needs while ignoring the development of the local economy. This may include moving into other sectors of the economy, such as natural resources, at the expense of the local industries without building infrastructure other than temporary infrastructure to enable exploitation. In doing so, foreign investors may also take advantage of host countries’ poor governance, financial needs and

absence of infrastructure development. Most importantly, private investors would prefer governments to reduce taxes and increase subsidies while borrowing money from the financial sector to build public infrastructure. As a result, financial resources meant for domestic investment are drained, causing a 'crowding out effect' and a general reduction in the levels of domestic investment and infrastructure capital investment.

Foreign investors may also use the host country to dump obsolete infrastructure. Dumping can occur in the form of selling outdated infrastructure at a lower cost to gain market share. The outcome of this practice could drive domestic investors out of the market while foreign investors become dominant in the market. Another outcome may be that the host region or economies continuously lag behind other economies in economic growth and development due to inferior infrastructure. The research argues that it is not always certain that investment will lead to economic growth, especially where there are restrictions posed by investors' countries of origin. The cost of the investment may make it difficult for the host economies to optimise the investment to accrue the benefits. The difficulties were also highlighted by Klenert et al. (2016:2) who argue that "previous theoretical work led to ambiguous conclusions on the distributional effects of infrastructure investment", For instance, inequality-reducing public investment was found to decrease the economic efficiency in some cases. As a result, the long-run effect of public infrastructure "investment in a productivity-enhancing stock is argued to be neutral on the distribution".

Cadot, Röller and Stephan (2016) suggest that the large firms within an economy should lobby for the investment and development of infrastructure services. Cadot et al. (2016:1135) posit "that firms with a large establishment in a given region should lobby harder than other firms for the maintenance and upgrading of that region's infrastructure, because they use infrastructure more intensively than others" and the upgrade is neutral for all firms in the long run although beneficial for trade and growth.

Ansar et al. (2016:385) found that the benefits are the results of trade-off of "quality, safety, social equity, and the environment, contrary to the conventional wisdom that these infrastructure investments are costly to the nation". Thus, various growth theories recognise infrastructure as part of a country's physical stock of capital and therefore a factor of production that enables trade.

Based on various theories, the research suggests that changes in the stock of infrastructure such as roads, rail and ICT impact national output and directly induce economic growth. These theories also recognise infrastructure as a variable that can lower the cost of production.

Kodongo and Ojah (2016:3) "SSA economies have better appreciation of the infrastructure development challenge such as funding and investment". There is also an awareness that infrastructure development will unlock the region economic potential. However, mobilisation of funding for various public infrastructure remains difficult given the weak public finance institutions in the region. The region recognises the role of private investors in infrastructure building capacity, especially in ICT infrastructure as discussed in the theories on investors' motivation section below.

2.5 THEORIES ON INVESTORS' MOTIVATION IN INFRASTRUCTURE

Investment in infrastructure continues to receive much scholarly attention as an attractive option to accomplish several objectives, including trade and economic growth and the possible impact on inequality and wealth redistribution. Private investment in infrastructure can directly influence the size of the tax base and, therefore, the ability to invest in new infrastructure or maintain the existing infrastructure has positive spinoffs for the economy. Public infrastructure can also influence the demand for private investment, as well as increasing the level of economic efficiencies, marginal productivity, production costs and competitiveness.

Infrastructure investments are directed by either private or public partnerships or public-private partnerships (PPPs). The source of the investment dictates the investment evolution theory that will be followed or considered suitable in analysing the impact of such investment. The discussion that follows, of the theories motivating for infrastructure investment, will be anchored on the role of PPPs and the relevance of location theory in investment.

2.5.1 PUBLIC-PRIVATE PARTNERSHIP THEORY

The opportunities offered by PPP remain less explored in the infrastructure investment and development space. It is well known that infrastructure forms the backbone of society's economic and social development. The public and private infrastructure investment theory suggest that donor-driven investment in infrastructure is necessary especially for economies whose budget is augmented through donation.

This argument is also affirmed by Torvinen and Ulkuniemi (2016:58) who suggest that "the infrastructure and services by the public and private sector should be seen as a necessity to preserve society's economic and social structure".

In their analysis of the normative and positive theories of PPPs, Martimort and Pouyet (2008:393) suggest that "an unequivocal commitment to privatisation is often viewed as an excessive response to the inefficiency of the public sector even when privatisation is accompanied by a convenient regulatory environment". They argue for a more pragmatic approach that includes partnership between the private and public sectors in the provision of major public goods such as infrastructure to address inefficiency.

According to Martimort and Pouyet (2008), the PPP concept, especially in public infrastructure projects, should be seen as increasing socio-economic welfare, where the return from the project exceeds the private returns. Thus, consumers can only benefit if the costs of the PPP transaction are lower, with attractive financial markets, fair risk transfer and lower end-user charges.

The process of PPP funding is in response to the swift progress in urbanisation. The PPP funding according to Wu and Bai (2017:15) helps to "accelerate domestic socioeconomic development, as it increases the insatiable demand for more and better infrastructure in the regions where there is swift urbanisation".

Risks associated with the investment in infrastructure services also play an important role for investors in the PPP processes. Medda (2007:213), in the examination of the process of risk allocation between the public sector and the private sector in transport PPP agreements, states that: "The intervention of the private sector in transport investment has shifted the responsibility, and thus fragmented the decision process, which in the past was taken on solely by the public sector".

The success of infrastructure investment is dependent on the choice of funding structure. The future of industrialisation for developing economies is dependent on the productive capacity of the economies and these include the efficient infrastructure services that facilitate and support economic activities such as trade.

2.5.2 LOCATION THEORY

Location theory emphasises the need for local economic integration through infrastructure and is mainly linked to the regional development paradigm. The theory is used to explain investment disparities and regional inequalities in different locations. The location theory argues that development is unequal from one region to the next in terms of investment such as in public infrastructure, employment and governance.

Referring to regional trends in income and employment disparities in Europe, Puga (2002:374) states that: "Traditionally, international and regional economics have explained income disparities based on differences between regions in their endowments of natural resources, factors of production, infrastructure, or technology." However, Puga (2002) suggests that the removal of obstacles such as lack of public infrastructure that facilitates the "movement of goods and/or factors would by itself cause convergence of factor returns and living standards".

The main contribution of location theory or "new economic geography brings together, in a common analytical framework, both convergence and divergence forces. Thus, the advantage of modelling such forces in a common framework, according to Puga (2002:374) is that "the theory can relate its relative strength to microeconomic conditions, and explicitly study the trade-off between the economic advantages of the clustering of activity and the inequalities that it may bring".

The location theory helps to understand the evolution factors that influence regional inequalities during a process of economic integration and investment. Bringing public infrastructure investment into regional policy may lead to better regional trade since economists generally consider the business climate as important in attracting investment growth. The importance of location is also supported by other growth theories where the business climate is argued to be important for comparative advantage as it stimulates globalisation of production.

The location theory determines the FDI movement. Although the location theory is more concerned with regional inequalities, it helps investors to understand how economic integration

can be achieved by investing in enabling infrastructure that stimulates growth. However, the location theory is only limited to microeconomic conditions and thus ignores market efficiency.

2.6 CONCLUSION

Although numerous theories deal with investment in general, including public infrastructure, these theories are all anchored on growth and return. They outline the positive and the negative aspects of investment, including demonstrating how investment can be used to attain or deter development. For example, private investment in infrastructure is argued to be good for economic growth, including trade efficiencies. However, firms and economies may not be able to capitalise on opportunities presented in infrastructure services to advance the economy or production capacity. Without infrastructure investment, capacity becomes constrained and thus puts pressure on the overall economic and competitive performance of a country. The next chapter will empirically discuss infrastructure investment and development in SSA.

CHAPTER THREE: EMPIRICAL REVIEW

3.1 INTRODUCTION

Economic growth in Sub-Saharan Africa has been below potenital for a number of years, partly due to the region's failure to attract adequate investment to build infrastructure services that would facilitate growth and counter negative political perceptions. Barhoumi et al. (2018:4) contend that the investment efficiency for Sub-Saharan African countries can easily be increased 35% to influence economic growth, based on the fact that in 2016, the region registered 1.3% growth compared with the global average growth of 3.1%. The low growth rate in the SSA region can hardly be justified given the region's wealth in minerals resources and strategic location.

Besides the argument of Barhoumi et al. (2018), George et al. (2016:379) estimated the minerals reserves as follows: "Africa is endowed with 30% of the world's minerals as well as the largest reserves of precious metals, with more than 40% of global reserves of gold, 60% of cobalt, and 90% of platinum". Despite this, the region is unable to attract enough investment to exploit these reserves.

These studies paint a bleak picture of the lack of investment, specifically the public infrastructure services in the SSA region. Saghir (2017) argues that the region may take a while to reach its full potential in infrastructure development. In their estimate of the scope of that challenge, Inderst and Stewart (2014) estimate that the region will need more than US$100 billion per year over a period of no less than six to ten years to address the infrastructure services backlog. Ruiz-Nuñez and Wei (2015) blame the challenges in infrastructure development on the low-level investment in the region. In their report for the World Bank on infrastructure investment demands in emerging markets and developing economies, Ruiz-Nuñez and Wei (2015:15) estimate that "SSA requires 58 billion dollars per year for the period 2014-2020", as compared to an average 28 billion dollars the year the region invested in infrastructure, while European International Contractors (2019:8) puts "the figure for infrastructure development in Africa at 130 to 170 billion dollars annually, with a financing gap of 68 to 108 billion euros".

The lack of funding for infrastructure has created a backlog that makes it difficult for SSA to develop economically. As a result, the region continues to lag in terms of the global infrastructure growth estimates. The lower growth in investment in the SSA region is also caused and aggravated budget deficits that remain relatively high compared to other regions, making investments in infrastructure services such as transportation, ICT and energy more difficult as the region continues to struggle to address the lacklustre growth. Numerous attempts to invest in infrastructure projects are stillborn or stymied by capacity problems. For instance, proposed projects such as the Inga dam in the DRC which could address the energy and water challenges in the region remain in the planning phase with little progress. Other envisaged projects such as the trans-Africa road and rail network and ICT networks, that aim at connecting Africa through infrastructure services and that can be seen as crucial for SSA's future development and trade, cannot proceed without substantial investment, which the region with its limited resources can hardly afford.

Illustrating this, a report by Chuhan-Pole, Calderón, Kambou, Blimpo and Korman (2018), on behalf of World Bank's Africa's Pulse, estimates that annual public spending on infrastructure in SSA was 2% of the GDP on average between 2009 and 2015. This amount, according to Calderón, Cantu and Chuhan-Pole (2018), is not enough given the backlog in infrastructure which may require at least US$2 trillion to close the gap. While the region has made some efforts to address the backlog, with the bulk of the spending (66%) being on the road transport network and 16.7% on electricity and water/sanitation infrastructure, the amount remains relatively insignificant.

Ruiz-Nuñez and Wei (2015:4) suggest that annual global infrastructure investment requirements for these sectors "amount to some 2.5% of world GDP, which would rise to 3.5% of GDP; if electricity generation and other energy-related infrastructure investments in oil, gas and coal are included".

The SSA region has among the lowest infrastructure density among the developing regions, especially in services such as transportation, telecommunication and electricity. The World Bank (2018c) data on infrastructure development shows that electricity generating capacity in SSA region was on an aggregate scale at 96 Gigawatts in 2015, and while capacity has not changed much over the years, demand for electricity is exponentially growing. As a result, the

investment growth in the SSA region on infrastructure services is poorly aligned to growth in trade and the rising domestic demand for goods and services.

3.2 INVESTMENT IN INFRASTRUCTURE AND ITS MOTIVES

Infrastructure investment underpins economic growth for development. It facilitates a multitude of productive economic activities, as well as the efficiency and competitiveness of an economy. Investing in infrastructure services can be achieved through various approaches, including the participation of the public sector, private sector, public-private sector partnerships and donor funding. The sources of investment and the motives for investment, especially in infrastructure services, may be unrelated to the stage of development of an economy. This point will be clarified in the course of the sections that follow.

3.2.1 PUBLIC INVESTMENT IN INFRASTRUCTURE SERVICES

Public infrastructure investment can be understood as any social or economic investment undertaken by the government for the benefit of the general public. The funding or investment structure of public infrastructure is guided by government policies and is usually administered through government budgets. Based in the government budget, the allocation to various services determines the level of investment in public infrastructure services and thereby influences the performance of an economy.

Sahoo and Dash (2009), in their research on infrastructure development and economic growth in India, found that there is a link between infrastructure development and economic growth. Thus, economies that specifically invest in infrastructure have better economic growth prospects than those making just general private and public investment. Conversely, the NEPAD (2015) report on regional infrastructure transformation in SSA concludes that the poor state of infrastructure services in SSA is due to the lack of economic integration and trade in the region. According to Calderón et al. (2018), if the SSA region can invest in infrastructure services such as electricity, ICT and transportation, the region can experience an increase in GDP per capita of no less than 2.6 per cent per year, in line with World Bank (2017) estimates.

Even adequate investment in just one of these services would reduce poverty and increase trade activities in the region. For example, the absence of transportation infrastructure services that link economies in SSA has locked the region out from realising trade opportunities. For

instance, despite the DRC having rich mineral resources such as coltan, copper and diamonds, ample rainfall, fertile agricultural land and the second-biggest river in the world, many of the resource-rich provinces within the country are hardly accessible by road. The lack of infrastructure adds to the high cost of production in the SSA region. Torrisi (2009) and Agénor (2010) argue that "infrastructure services have a strong growth-promoting effect on production costs" including the actual production processes. According to Torrisi (2009) and Agénor (2010), the rate of return on capital where there is investment in public infrastructure services tends to increase while in economies where there are inadequate infrastructure services, the rate of return on capital tends to decrease. The effect of infrastructure investment in promoting the economic growth rate is emphasised by Agénor (2010:933) who suggests that "the growth-promoting effect rate depends on the interactions between infrastructure services such as transportation, energy and ICT and economic segments including the savings". The argument by Agénor (2010) suggests that investment in infrastructure services will raise a country's economic ability to increase trade capacity and volumes, while not enough infrastructure investment reduces the level of economic ability, as is observed in SSA.

Especially when the private sector participates in public investment in infrastructure services, this can lead to efficiencies and capital mobilisation for other sectors of the economy. Such capital mobilisation is, however, dependent on several factors being present, including the state's strategy to encourage such investment. Chen, Huang and Rudkin (2018), for example, suggest that since it is often difficult to attract capital to a country, governments tend to use "competitive taxation rates and various incentives" to attract investors. The use of tax relief and incentives are already common in the countries of the SSA region where special economic zones have been created to attract investments, a strategy employed with great success in the Middle East.

The benefits of investing in infrastructure services were explored by Donaldson (2018) in a study conducted on India's railroad infrastructure which was in line with Ansar et al.'s (2016) research on infrastructure investment. Donaldson (2018) research estimated the impact of transportation infrastructure on the trading environment in India and the extent to which infrastructure investment reduces welfare dependency and increases productivity and trade. Donaldson (2018:900) concludes that "railroads investment improved India's trading environment by reducing trade costs, reduced interregional price gaps, and increased trade

flows including real income levels". The research by Donaldson (2018) therefore supports the view that infrastructure investment has a positive influence on the factors that influence economic growth.

The assumption by Donaldson (2018) is, however, highly reliant on the state having the capacity to invest in infrastructure services. For instance, the economic boom in Angola between 2001 and 2010 was mainly driven by infrastructure services in transportation and energy development and was funded by oil revenue. Thus, when there is a strong investment in such public infrastructure services, the economy may experience lower freight rates per unit distance for goods and services and the improvement in the efficiency of transport may create political and business stability. However, Mostafa (2018) reports that transport cost in Angola remains high compared to other SSA countries such as the DRC, by almost 7 per cent, and this reflects the country's general lack of adequate infrastructure investment.

The capacity of the state as identified by Donaldson (2018) is crucial, or as Crescenzi, Di Cataldo and Rodríguez-Pose (2016:556) argue, "if the state is weak, public investment tends to be of lower quality, with new investment in infrastructure responding more to political and individual interests than to economic and collective objectives of the state".
Ansar et al. (2016:361) note that, according to the "macro-level school of thought", "…increased public-sector investment in infrastructure increases the efficiency and profitability of the business". It should be seen then, following public sector investment in infrastructure services, private sector investment decisions and investment choices would be stimulated and trade should expand.

Ansar et al. (2016) studied the Chinese economy, where the Chinese put more emphasis on developing enabling economic factors such as building energy, ICT and transportation infrastructure. Ansar et al. (2016) observed that this investment in public infrastructure services in China had a positive effect on the economic growth of the country, mainly in provinces. These public infrastructure services linked cities and provinces through expanded networks that no only increased economic efficiency, but has also pulled China from abject poverty into one of the most important industrial hubs of the world.

Research by European International Contractors (EIC) (2019:11) shows how China has positioned its investment in Africa by suggesting that "since the proclamation of the 'Year of Africa' in 2006, China has stepped in to meet infrastructure investment needs. Chinese sovereign loans to African governments in 2017 "amounted to USD19,4 billion, marking an increase of more than 200% from USD6,4 billion in 2016". Chinese investments in Africa are mainly in the energy and transport sectors. EIC (2019:8) suggests that "Africa is expected to become the most populated and most productive continent by 2040". To sustain the expected economic growth, the continent will require heavy investment in infrastructure.

In summary, investments in public infrastructure services such as energy, ICT and transportation influence economic efficiencies, trade and growth. The government plays an important role in the investment and development of these infrastructure services, being motivated by a desire to influence trade and economic efficiencies and attract more businesses to their country. Based on the observation of Ansar et al. (2016) and others, this study can infer that public infrastructure investment should play an important role in economic integration and motivating business and trade growth.

3.2.2 PRIVATE INVESTMENT IN INFRASTRUCTURE SERVICES

Investment in infrastructure by the private sector is selective and often targets sectors where there are profit and rewards. The private investment is guided by the investment policies of the investing organisation whose decision to invest in infrastructure services is essentially based on a profit and risk matrix and is rarely influenced by a social consideration.

According to Deloitte (2017), "Development Finance Institutions (DFIs) have overtaken the governments in some African states as the largest financier of infrastructure projects on the continent". The report also suggests that 48 per cent of these infrastructure projects are in the energy and transport sectors. Energy and transport sectors in Africa remain more profitable and therefore more attractive for investors given the low base these sectors are at. In Ghana and the DRC, private sector investors have invested heavily in energy, ICT and transportation. Investor decisions are driven by a combination of factors, including whether the project is new or is an existing project. Crescenzi et al. (2016: 556) suggest that "some investors may prefer to invest to maintain existing infrastructure" based on the risk assessment. On the other hand, Chinese development institutions have identified many opportunities in Africa for new infrastructure

project partnerships with other investors who share a similar vision or may be interested in technology-driven projects that offer more returns. New infrastructure also carries with it advantages such as lower costs of production and reduced risk, through avoiding having to replace or work around redundant infrastructure.

Several studies, including Mbekeani (2010), Crescenzi et al. (2016), and a study on road infrastructure by Asomani-Boateng et al. (2015) in Ghana, have "found empirical support for the positive impact of private infrastructure investment on aggregate output". These authors argue that, like the public investment in infrastructure, private infrastructure investment also leads to trade expansion. Conversely, the inference can be made that failing to invest adequately in infrastructure may also affect the economy adversely by increasing the cost of production and reducing competitiveness. However, when infrastructure services are in place, Mbekeani (2010:89) argues, "it creates one of the most important aspects in regional development". For instance, improvement of transport and communication networks have contributed towards the free flow of goods and capital in some regions. These services create territorial access for private sector investors and thus give them access to economic opportunities. In effect, the presence of infrastructure services can trigger the flow of capital investment towards investment opportunities such as the new industries typical of a modernised economy. As more infrastructure networks develop, a snowball effect can ensue wherein the productive structure of the economy is further diversified.

Faridi, Chaudhry and Ramzan (2015:534) support the view that infrastructure provision is crucial to achieving development and growth in an economy. The success of infrastructure provision can be measured as capital stock that is meant to provide public goods and services. But its provision is not limited to the state as it has a direct impact on the production capacities of both the state and the private sector. This compels private investors to invest in infrastructure that facilitates production. For instance, in SSA, the private sector invests in solar energy and other forms of energy generation to alleviate the challenges of energy shortages that many countries on the continent experience when the public infrastructure or a state-sanctioned provider cannot guarantee supply. Despite evidence that private investors are investing in infrastructure, their role remains low in SSA relative to the huge backlog in infrastructure. Private investors also tend to choose the area of infrastructure to invest in, in line with their risk and reward matrix.

Commenting on the backlog, Mbekeani (2010:89) states that "the low public spending on infrastructure has not been counterbalanced by enough private sector participation in SSA". The low participation by the private sector in infrastructure services, according to Mbekeani (2010:89), resulted in insufficient provision of infrastructure services, especially in developing economies already constrained by heavy external debt. Thus, in sum, the level of private investment in infrastructure services remain inadequate in SSA.

3.2.3 PUBLIC-PRIVATE INVESTMENT IN INFRASTRUCTURE SERVICES

Public-private investment in infrastructure services are partnerships between private sector entities and state entities. The opportunities offered by Public-Private Partnerships (PPPs) remain less explored in the development and innovation of infrastructure services. It is well known that infrastructure services support society's economic and social development. The view of Torvinen and Ulkuniemi (2016:58), who state that "the infrastructure services should be considered as a necessity that preserves society's economic and social structure", is consistent with the general understanding within the private and public sectors.

PPP infrastructure investments could be in any services such as transportation, communication, sewage, water and electricity. The concept of PPP is closely related to concepts of privatisation and the contracting out by the government of services that can be managed by the private sector. As a governance mechanism, the PPP concept could be applied to a number of activities that help economies to achieve their objective through the sharing of costs and benefits. Osei-Kyei and Chan (2015a) argue that PPP has created benefits for some economies such as Mozambique, where transportation infrastructure development was conducted as a joint venture between the government and the private sector. The authors found that PPP investment also influenced the use of technology innovation, in which the private sector seems to have expertise and resources, while governments seem less interest in technological innovation. The costs associated with this technological infrastructure innovation and scarcity of funding make the partnership between the private sector and the state more viable. The two parties can share risks while building a long-term partnership in building and operating the infrastructure. In Ghana, power infrastructure was divided into three entities, i.e. generation, transmission and distribution. The private sector can play its part in PPPs at any entry point in the energy infrastructure. South Africa recently introduced the concept of PPPs with independent power

producers, where private investors would build power generation plants and sell the electricity to Eskom for transmission and distribution.

Chou and Pramudawardhani (2015:1136) argue that "PPP presents an opportunity in harnessing the innovative capacity and capital from the private sector". They further argue that government benefits from the participation of the private sector in managing and financing public infrastructure, and in doing so, effectively outsource the risk to private entities while freeing government to focus on policymaking, regulation and planning.

Without a clear policy in place, investors tend to stay away. Investors want the assurance of policy certainty before committing to the investments. In countries like the DRC where there is policy uncertainty due to political instability, there is less interest by investors, especially in infrastructure investment, although the government has been on a drive to lure investors. This included the DRC offering to partner with private investors in the mining sector to speed up the pace of development in that sector. Jain (2015) and Osei-Kyei and Chan (2015b) describe this form of intervention as important, especially where the PPP is clearly aimed at development.

While PPPs might be seen as ideal, Osei-Kyei and Chan (2015b: 1336) caution that "In spite of a huge interest by governments in PPP worldwide, its implementation is still experiencing lots of impediments which need critical attention". According to Osei-Kyei and Chan (2015b: 1336), among the obstacles encountered with PPP, are the "high cost of transaction, lengthy procurement process, lack of appropriate skills, unattractive financial markets, incomplete risk transfer and higher end-user charges". These impediments are critical in the development of infrastructure services and their management thereafter.

Thus, while PPP infrastructure projects increase socio-economic participation, consumers can only benefit if the costs of PPP transactions are lower, the procurement process is faster, enough appropriate skills are in place, they are attractive to financial markets, there is fair transfer of risk and end-user experience lower charges. The PPP is about sharing risk while developing innovative processes in the efficient management of transportation, energy and ICT services.

3.2.4 DONOR INVESTMENT IN INFRASTRUCTURE SERVICES

Donor-driven infrastructure investment is common in poor economies, especially where the budget of a country is supported by donor funding. Donations are usually sourced from the developed economies that have political or economic interests in that country or region. The donation is frequently in the form of a grant-in-aid in a specific sector, such as the development of schools, a health facility, the water supply or the road network.

Many developed economies have formed donor agencies to help them coordinate foreign aid funding aimed at distributing the funding in accordance with their interest. Countries such as the United States of America and the United Kingdom work through USAID and Oxfam respectively, who manage and distribute the funds in various developing economies, while China uses a multitude of state-owned organisations. The criteria for determining who or what qualifies for funding vary from donor to donor but all would reflect implicitly or explicitly, the objectives of the donor towards the recipients. Countries such as China and European countries with interests in the SSA economies see donor funding as an opportunity to influence the economic direction of these developing regions by donating to infrastructure building. Such 'aid' may have more to do with the geopolitics of the donor country than genuine altruism or philanthropy. Regarding infrastructure, foreign donor funding in Africa is essentially in response to the urbanisation of the developing economies. As a result of rapid urbanisation, many of these developing economies have no financial capacity to invest in infrastructure services and thus little capacity to relieve the increasing pressure on existing infrastructure, which results in the decay and disintegration of the urban environment as the urban population increases.

For instance, China has intensified their donor-driven programme in Africa in countries such as the DRC, Mozambique and Djibouti and inference can be made that these infrastructure donations by China may be a gesture to take part in the scramble for Africa's resources. China donated US$200 million to build new AU headquarters in 2012. Further assistance from China was announced during the China-Africa Forum for Cooperation (FOCAC) 2018 summit, where China committed US$60 billion towards infrastructure development in Africa[1]. These

[1] https://www.focac.org/eng/

investments are focused on infrastructures such as railways, highways, ports, oil and gas fields and power plants.

The Chinese donor funding has transformed the setup of infrastructure in developing economies such as the SSA, with increasing trade in some regions. The investment from China is however unique since it focuses on infrastructure rehabilitation and expansion in SSA and it is a combination of grant and loan. For years, Western donors had less interest in the infrastructure expansion of developing economies such as SSA. The role of China in Africa mainly in infrastructure services has attracted the attention of other donor funders who are sceptical about the generosity of China. These donors are mainly European countries that were dominant in Africa before rapid expansion by China into Africa. These donors question the motive of China investment in infrastructure services in Africa. As a result, the European based donors infer that the donor infrastructure investment by China is driven by China's needs for resources in Africa. Their inference is based on the booming manufacturing in China and the country's ambitions to dominate the global market in the manufacturing sector.

The suspicion that China is unfairly focused on Africa as a source for cheap raw materials contrasts with the more positive view of Wu and Bai (2017:16) that "Global investment that follows infrastructural advance not only boosts local employment but also generates spillover effects, such as skill development, management experience, and technology transfer, which also help to reduce the high unemployment rate in Africa". Although foreign donors have traditionally put conditions for the donation, Chinese donors have not place any conditions although they continue to be accused of undue political pressure in Africa. Despite the accusation, the investment by China places a greater emphasis on the multiple effects that their investment brings in an economy. China's investment in Africa has a clear competitive advantage especially for a continent that is starting from a lower base. For instance, according to the China-Africa Forum for Cooperation (FOCAC) (2018), China offers a combination of donations and loans[2]. Often the loans are quoted lower especially for investment in infrastructural development, on conditions that Chinese technologies are used and its efficient engineering skills are included in the construction schedules.

[2] https://www.focac.org/eng/

The critics have often argued that a lot of the raw materials come from Africa, making the donation less impactful to Africa. Although the advantage of development for the infrastructure services accrues to Africa, in terms of technology, markets and experience of success, a donor such as China will continue to reap more benefits.

Given the attitude of China towards dictatorship and governance in Africa, China-Africa relations creates a conundrum for the region to develop a monitoring and evaluation mechanism since China approach is "non-intervention". However, China expects countries in Africa to accept its offer without "questioning". This includes evaluation of Chinese technology to Africa which are in the main not suitable and in some instance obsolete and therefore amount to dumping. The assistance by China should in theory help SSA region to develop and also increase accountability especially for the resources-rich economies such as the DRC and Angola that are currently building public infrastructure with the proceeds from the exploitation of natural resources.

In summary, the success of infrastructure investment in increasing economic growth in SSA is dependent on the choice funding. For the SSA region to succeed, the region should increase the development of infrastructure investment to attain economic growth and production efficiency. The future of industrialisation in Africa relies on the infrastructure capacity to facilitate trades.

3.3 GOVERNANCE, RISKS AND CAPITAL FLOWS

Investors in public infrastructure services are often confronted by challenges beyond their control, such as the country's economy having insufficient capacity to finance the proposed infrastructure services, currency debasement and political instability. Albuquerque (2003) suggests that foreign direct investment (FDI), a critical component of international financing mechanism, is dependent on the economic and political stability of a country. FDI is arguably less volatile than other forms of capital flows since it generally targets long-term capital-intensive projects and the focus of large-scale projects for governments goes beyond the economic benefits that are the primary interest of investors. For example, electricity generation or new rail infrastructure also carry social benefits for members of a society, especially in developing economies.

Albuquerque (2003) argues that any other form of capital flow in developing economies is more at risk than FDI because FDI is difficult to expropriate. As a result, investors are often willing to invest in mega capital projects, including infrastructure services, and view these as less volatile compared to other forms of investments. Even in an unstable economy, such as the DRC, such projects can still attract capital investment as opposed to other, more risky opportunities. The risk of investing in infrastructure services may also originate in the country from which the FDI is sourced. For instance, the poor economic performance of a major economy may reduce the availability of FDI, or redirect the FDI to other beneficiaries, thereby adversely influencing the economic performance of an economy where the investment had been destined. Shah (2017) conducted a comparative study that found the poor economic performance of developed economies had adversely affected FDI flow to developing economies. According to Shah (2017:3), the poor performance of the developed economies drastically reduced the available capital for possible investment in developing countries, which contributed to the poor economic performance and growth of the developing economies that would have been the recipients of the FDI.

The macroeconomic risks in developing economies in infrastructure services create further doubt among private investors, given the amounts of capital required and the possibility that a developing economy may default. Macroeconomic factors also influence the financial stability of a country (Giglio, Kelly & Pruitt, 2016), while Shah (2017:3) goes so far as to argue that "macroeconomic steadiness and stability in the host market has to attain new significance in the global stage of investment". Macroeconomic risk factors measure the business climate and can be simplified as cost, transport, market, labour as well as tax regimes and regulations. According to Lahimer (2017:4), macroeconomic risk "erodes the positive effects of global commitments, integration, regional, worldwide harmonisation and also makes the progressive influence of trade and investment liberalisation mute". Thus, the macroeconomic instability gives rise to a number of risks for investors that may influence the trade and investment in mega infrastructure projects in developing economies.

Lahimer (2017:4) defines business climate as "the sum total of a place's human and capital resources including infrastructure, public policies, and attitude that affect the formation and operation of a business enterprise". A good business climate is not just about generating profits but is also about sustainable growth, cost containment and risk mitigation. Although economic

risks are high in developing African economies, Lahimer (2017:3) opines that "in Africa, the relationship between FDI and business climate is less clear".

Investors consider the business climate in terms of cost and price risks but also in terms of the choice of location. Bartels et al. (2009:142) explain that "business and investment climate motivate location decisions as they measure country risk, operating and market risks". The motivation for a location as a factor to attract investment is particularly relevant in a globalised economy where investors can almost literally choose to invest in any country. Quer, Claver and Rienda (2012:1092) suggest that "a decision on location choice for multinationals is to determine favourable locations where regulative institutional constraints are less repressive to FDI activity so that multinationals can more readily conform to the regulative constituents of the host countries". The assessment of the location for investment, especially in mega infrastructure services, includes the assessment of country political risk, in which the presence of projects that have already been launched or the activity of other multinationals is influential. Thus, Kariuki (2015:348) argues that "the presence of foreign firms in an economy may be an incentive for other multinational companies to come and invest into a host nation". Lahimer (2017) expands the motivation of location theory, which was initially explained by Bartels, Alladina and Lederer (2009), by referring to "the market munificence in the host economy for multinational products". Lahimer (2017:2) contends that "the degree of macroeconomic development required for infrastructure provision to enable a transnational corporation to invest and to optimally make use of its resources is dependent on the economic conditions of the host country". Access to technological infrastructure, according to Lahimer (2017:2), is "is an important factor for optimal functioning of the FDI".

The instability in developing economies may indicate the failure of national policies to mitigate risks. The perception of such failure may result in foreign investors being hesitant to invest in an environment with a high level of uncertainty, despite the availability of opportunities to invest in infrastructure services or exploit natural resources.

3.4 COUNTRY RISK AND INVESTMENT FLOWS

Investors tend to emphasise social and political factors when measuring the country risk factors for investment (Montes & Tiberto, 2012; Sari, Uzunkaya & Hammoudeh, 2013). Country risks involve the exposure that investors are likely to face in foreign states. These risks are mainly

political and economic stability, exchange controls and market regulations such as the protection of local industries against foreign investment. The country risk profile gives potential investors a sense of whether the country will be able to meet its financial obligations. Deceanu, Pintea, Thalassinos and Zampeta (2010:227) describe "Country risk analysis as a strategic tool in supporting decisions and reducing uncertainty." They argue that a country should "anticipate economical changes or incidents that may affect the development of transnational business - macroeconomic, financial or socio-political fragility of a state which are likely to choke financial or commercial operations". Other country risk factors include the foreign debt that a country has to service, whereby countries with higher foreign debt levels tend to have higher risk exposure compared with lower indebted countries. World Bank data (2017) shows that there is a very high level of indebtedness in developing economies relating to the developed economies. The debt exposure of SSA countries may thus negatively influence private investors' willingness to consider investing in SSA.

Private investment and consequent FDI flows depend on the perceptions of the risks and opportunities in a country. For instance, Cleeve (2012:470) found that FDI flows were "shifting away from countries with large oil and mineral reserves toward the industrial and service sectors, such as textiles, telecommunications, and banking" due to price volatilities in the commodity sector. Despite the diversification, the mining sector in Africa continues to attract more investment than other sectors on the continent. Other than price volatility, Cleeve (2012) also suggests that corruption and political risk rank highly among the constraints on investment in the development of infrastructure services through FDI. The roles of political risk and institutional factors in SSA in determining infrastructure services investment through FDI make the region a less attractive location for some investors.

Distance is a risk factor for some private investors. According to Cleeve (2012:470), United States investors "tend to be concentrated in countries that are the least distant physically and institutionally from the United States'. Japanese investors also concentrate FDI in the relatively nearby countries of Southeast Asia. While the US and Japanese investors mitigate the distance factor by investing in countries that are close to them, European investors may be less negatively influenced by distance because of Europe's history of colonial rule in Africa. Since much of the accumulated wealth and the resultant sophisticated infrastructure in Europe were funded by the abundant natural resources of Africa, not least of which was the trafficking of

millions of its people, there persists among investors the idea of Africa as a resource-rich area with great investment potential. The political instability in SSA may even have attracted some investors who seek the high returns often derived from mega-infrastructure projects in politically unstable environments and corrupted economies. Thus while some investors often withhold investment, perceiving the environment as too risky for their risk appetite, other investors may still be willing to pursue investment, even in environments where the risk is high. Subasat and Bellos (2013:127) have argued that rent-seeking multinational firms often overlook country risks such as corrupt politicians and policy makers.

According to Subasat and Bellos (2013:127), "a poor governance environment may provide fertile ground for large multinational firms with considerable sources to finance rent-seeking activities". These activities may include expensive and risky mega-projects such as energy or transport infrastructure. It is well known that some developing economies have undertaken energy and transport infrastructure projects that they could not afford or were otherwise not capacitated to undertake.

Country risks play an important role in FDI decisions pertaining to infrastructure investment, especially in capital-intensive projects. Although the logical assumption is that investors would avoid developing regional economies such as SSA, where governance is often poor, some foreign investors have continued to profitably invest there in sectors such as energy, ICT and transportation.

3.5 FOREIGN EXCHANGE RISK AND INFRASTRUCTURE INVESTMENT

Private investment in foreign countries is exposed to payments and receipts in the currency of the host economy. These payments and receipts for international trades are subject to exchange rate fluctuations and exposed to speculation, economic and political instability, and other risks. As a result, foreign investors always price in the exchange rate risk in accordance with the risk profile of the country and will, where possible, avoid investment in such states. Menkkhoff, Sarno, Schmeling and Schrimpf (2012:681) suggest that some investors are less concerned with exchange rate risk, arguing that "if investors are risk-neutral and form expectations rationally, exchange rate changes will eliminate any gain arising from the differential in interest rates across the countries".

Few multinational investors are not exposed to exchange rate risk when embarking on infrastructure service projects since their operations cut across various countries. Also, their operational and capital costs may be in different currencies since they may raise capital in one country to invest in or undertake a project in another country. Mancini, Ranaldo and Wrampelmeyer (2013:1807) explain the phenomenon of investors using multiple currencies, by arguing that "the trading strategy of these multinational investors consist of borrowing in low-interest-rate currencies and investing in high-interest-rate currencies". Borrowing by these multinational firms for mega-infrastructure projects gives them access to currencies that are mostly used in international trade, where they will pay a low interest rate when they borrow since these currencies tend to be more liquid and exhibit lower liquidity sensitivities. The practice also allows them to avoid paying the high interest rates of borrowing in countries where currencies tend to be less liquid and have higher liquidity sensitivities, as in developing economies. Multinational firms that fail to mitigate exchange and interest rate risks associated with the economy of a country where the mega-project is undertaken may encounter cost overruns that could make the project less viable.

3.6 CORRUPTION AND INFRASTRUCTURE INVESTMENT

Corruption is the major challenge in developing infrastructure services in SSA. Corruption in SSA is making it harder for investors to address its infrastructure services backlog. Ola, Mohammed and Audi (2014:210) cite corruption as defined by the World Bank as "the abuse of public office for private gains". However, corruption can also be initiated by private investors, a common allegation in Africa where bribes are offered to public representatives to circumvent public policies and procedures to gain competitive advantage. The scope of corruption includes patronage and theft of any state resources meant for public benefit. This understanding of corruption, therefore, encompasses the abuse for gain of state infrastructure and infrastructure services by public representatives, officials and their connected persons.

In Africa, corruption and fraud may be the most discussed risks. Rating agencies, non-governmental organisations and governments view fraud and corruption as threats to the social and economic development of a country. Transactive corruption has reduced capital and portfolio investment in SSA, contributing to lower GDP growth due to a lack of coordinated infrastructure services in the region. A number of initiatives have been made by the AU and other regional bodies to improve the state of infrastructure in SSA but, as a result of corruption

and other factors, the region continues to experience a high level of inadequate infrastructure. For instance, in Nigeria, Idris and Salisu (2016:136) describe inadequacy that "ranges from irregular and inadequate supply of electricity and piped water, including fuel scarcity, unreliable health care services, unstable educational institutions, bad roads, malfunctioning ports and erratic telecommunication services". These conditions in Nigeria are found in several SSA countries, including Ghana, the DRC and Angola.

Lambsdorff (2003) explains this effect of corruption as impacting the production capacity of the regional SSA economy and the development of infrastructure services to the extent that, according to Lambsdorff (2003:230), "there is a relationship between the ratio of investment to GDP and corruption, i.e. high level of corruption should manifest through lower productivity". Lambsdorff (2003) further explains that when corruption lowers GDP growth, the effect will increase the ratio of net capital inflows to GDP for debtor countries and decrease it for a creditor. As a result, fewer resources may be channelled into infrastructure projects. Lambsdorff (2003:234) also suggests that, if the government lacks the capacity to deliver services and or manage the economy, "public servants may create artificial bottlenecks to increase their income through corruption. Once corruption becomes embedded, governance tends to be less concerned with expertise and open to political pressure".

The results of such political pressure, other than embedding corruption, include bureaucratic inefficiency and unstable governance. The African Union (2016) has stated that the aptitude of government is key to stable governance[3]. Without stable governance, strong legislative power and popular support for the government, corruption is likely to increase, dominate the economy and undermine stability. Once law enforcement, the political system and the judicial system can be influenced through corruption, the system that maintains the stability sought by investors, is undermined and, if allowed to continue, will render a country unstable and less attractive to investors. Wei (2000), Jain (2001), Lambsdorff (2003) and Asongu and Kodila-Tedika (2016) affirm that the absence of stability is viewed as the primary channel through which corruption deters investment. Once investors acquire the perception that, as Lambsdorff

[3] This was actually a joint publication of the African Union, African Development Bank and United Nations Economic Commission for Africa.

(2003:234) puts it, “an orderly succession of power [is] being substituted for a system where power can be bought”, they tend to become alienated and skeptical about the prospects of investing in developing markets such as the SSA.

Since infrastructure projects are funded through a mix of public budgets, development finance institutions and private funding, and poor governance and corruption make it difficult for private investors to participate, Idris and Salisu (2016) suggest that for the developing region to address the infrastructure shortage, the conditions should be created to enable the private funders to increase the share of private capital and this has to include addressing corruption.

3.7 GOVERNANCE AND INFRASTRUCTURE INVESTMENT FLOWS

Good governance is a requirement of public projects associated with high investment flows, especially capital intensive, large projects such as new infrastructure services. Various studies, including Shapiro and Glicksman (2002) and Lucas (1988), suggest a positive association between investment flows and good governance. Shapiro and Glicksman (2002) examined rates of capital formation in developing countries as compared to developed countries and accept the need for “plausible efforts by host economies to appropriate economic rents associated with FDI through taxation”. Further, in defining the ‘appropriate’ tax regime, Shapiro and Glicksman (2002) suggest that “FDI will be attracted to regions that are characterised by more favourable governance of factors such as taxation”. Thus, the authors perceive that good governance can also be manifested through the tax regime of a country.

The application of good governance practices such as fair taxation and efficient tax collection can help economies to build their own infrastructure and reduce reliance on borrowing to fund it. As a result, there is growing interest in governance codes and rules in developing economies including the SSA with a focus on mega infrastructure projects such as energy, transportation and ICT services, although it has to be conceded that governance, while improving, is still a new concept in developing regions such as the SSA. Private institutions such as the Mo Ibrahim Foundation continue to collaborate with regional bodies to encourage good governance, being convinced that regions with strong governance are more likely to have strong infrastructure services with strong economic development. The work of Akyüz and Cornford (2002) in the European Union supports this view. According to Akyüz and Cornford (2002), the successful economic integration in Europe was due to good governance whereby an “exchange-rate

mechanism was created to keep their currencies within the prescribed limits and for other circumstances threatening orderly conditions in the market for a member country's currency". The success of this measure enables the European Union member countries to borrow cheaply when developing a mega infrastructure service and thus reduce risks for the project. The governance mechanism also monitors international banking developments and disseminates data on the subject from national creditor sources of member states. This mechanism is also responsible for setting rules for international capital movements and is designed to protect the economic wellbeing of the member states in the EU. Akyüz and Cornford (2002) call governance of the financial sector a process to "strengthen the defence of financial firms against destabilisation due to cross-border transactions and risk exposures".

Given the role of financial firms in funding infrastructure projects, the financial institutions collaborate with other bodies such as the International Organisation of Securities Commissions (IOSCO), which has a membership consisting of securities regulators and exchanges globally. The IOSCO, according to Akyüz and Cornford (2002), has "gradually extended its remit from one concentrating primarily on information sharing to the setting and promulgation of standards for the functioning of exchanges and securities firms and for surveillance of cross-border securities transactions".

Good governance was also recognised by the IOSCO and established forums such as the Financial Stability Forum, wherein most central banks globally play an important role, especially on issues of financial regulations to finance mega-infrastructure projects. The regulations are aimed at the governance of financial flows and stability to protect investors in cross-border investments such as infrastructure projects. The regulations also assist in the combatting of illicit financial flows.

Akyüz and Cornford (2002) and Talamo (2011) also affirm that improvement in governance in the EU improved the provision of non-debt creating private capital flows to emerging economies that were not exclusively FDI. Although the total net outflows to emerging economies such as the SSA are not sufficient in real terms, the increase is worth noting. From the SSA's perspective, the low inflows can be attributed to poor governance in the region that leads to a lack of appetite by investors. According to Akyüz and Cornford (2002), the International Monetary Fund (IMF) (2017) as well as Calderón and Servén (2010), the

investment in emerging economies like the SSA region remains subdued, especially in the development of infrastructure services. Akyüz and Cornford (2002), paint a fairly static view, suggesting that the "net capital inflows less net factor payments abroad including interest payments on external debt and profit remittances remain at about the same level".

Governance of cross-border financial activities has increasingly become a feature for investors who are pursuing opportunities in other countries. Akyüz and Cornford (2002) argue that the "opening of the capital account in developing markets presents profitable opportunities for portfolio diversification not only for lenders and investors in industrial countries but also for asset holders in these markets themselves". However, the process also carries with it governance challenges given the difference in countries.

Good governance helps in attracting FDI flows that play an important role in regional and global economic integration. Economies have relaxed their trade policies to attract more FDI to infrastructure services development from areas such as the EU. In seeking to attract investments through the practice of good governance, countries in developing regions such as SSA adopted structural adjustment programmes to qualify for financial assistance such as loan capital or aid from the World Bank and other global funders. The focus of structural adjustment is not only to improve governance but to improve trading conditions for companies in which the funding entity has an interest. Talamo (2011:2) explains structural adjustment as the process that "increases the number of host states providing attractive opportunities for multinationals in terms of cost advantages, economies of scales and multi-plant economies". It should be noted that the influence of multinational firms has also been used to lobby for change in the policies of host economies. Talamo (2011:2) states that these changes could be in the form of "tax rate, fiscal incentives, and financial incentives", especially where the multinational firms are engaged in mega-infrastructure projects. The lobbying entity could also be trying to secure some form of protection for their investment through a change in governance, such as reducing or suspending certain labour rights or government guarantees to cover local suppliers' contributions. The lobbyist's objective is to persuade the host government of the operating assumption of the lobbyist that, once the host economy liberalises – the core demand of most SAPs, more FDI inflows will take place to assist governance infrastructure development.

Governance infrastructure includes public institutions and policies created by governments to facilitate economic and social relations. Shapiro and Glicksman (2002) state that a "constructive governance infrastructure includes: an effective, impartial and transparent legal system that protects property and individual rights; public institutions that are stable, credible and honest; and government policies that favour free and open markets". The determinations associated with events of country-specific risk by the rating agencies play an important role in how private funders approach the financing of mega-infrastructure projects. Shapiro and Glicksman (2002) state that "private rating agencies typically determine these events by assigning weights to various economic, political and institutional factors that define the investment environment". Gallagher (2015) suggests that private investors are concerned with the weighting given by private rating agencies when deciding when to invest capital. Thus, Referring to governance in developing economies, Talamo (2011:10) argues "it acts as a catalyst to raise the degree of transparency of internal financial markets and by increasing the country's political credibility abroad". Such credibility can be the key to inspiring investor confidence and unlocking funding for complex projects such as mega-infrastructure projects in energy, ICT or transportation.

CHAPTER FOUR: THE INFLUENCE OF POLITICS ON PUBLIC INFRASTRUCTURE INVESTMENT IN SSA

4.1 INTRODUCTION

Countries and regions pursue universally use economic theories and methods to influence and shape political and economic direction. Haggard and Webb (1993:143) explain the objectives of the political approach by suggesting that "economic reforms, regardless of their aggregate effects, have distributive consequences that create benefits for some while imposing hardship and loss on others". Thus, the politics applied to public infrastructure services investment shapes how growth and development can be attained. Successful investment is in direct proportion to the level of political influence and leadership experienced. Reasoning thus, good political leadership results in accountability and good governance, rewarded with increasing investment. By contrast, bad political leadership has a negative effect on investment as it increases uncertainty for the economy. The influence of politics on governance has also impacted the provision of public infrastructure such as roads, power supply, water supply, rail and telecommunications as well as the institutions responsible for trade liberalisation, regulations, the legal system and the educational system.

This research observes that infrastructure is a combination of physical (i.e. rail, energy, roads and telecommunications) as well as institutional (i.e. trade liberalisation, contract enforcement, anti-trust regulation and banking sector reforms) elements. The research further accepts that the functioning of infrastructure is decided by political forces as well as market forces. In the SSA region, public infrastructure services are mainly provided by the state and therefore are regarded as public goods to enable trade and investment. Historically, the provision of public infrastructure services as public goods in Africa dates back to colonial rule. During colonial rule, the colonial powers decided the type of infrastructure to develop and prioritise, based on the colonial strategy and objectives. The main aim here – as is extensively explored in the next section below – was not to provide infrastructure to benefit the colony or its inhabitants, but infrastructure that contributed economic and geopolitical benefits to the metropole. The colonial infrastructure spatial planning has survived into the postcolonial era, albeit influenced by different political factors and economic structures and benefitting new political elites who, while they may harbour less altruistic motives than the common good for pursuing public

infrastructure investment, are adept at incorporating responses to public demands for infrastructure improvements in their election platforms.

According to Meagher (2012), infrastructure like roads, ICT and electricity determines the quality of life of consumers and influence the amount of investment an economy can attract for economic growth. Furthermore, infrastructure services influence economic competitiveness and allow economies to increase production. The unimpressive economic performance of Africa, according to Ghosh and Meagher (2015), is influenced by the low levels of infrastructure investment that "give local firms strong grip and monopoly power" since foreign investors may find the local market less attractive.

In explaining the influence of politics on the development of infrastructure service, the chapter will reach into the colonial history of SSA but largely limit the discussion to three representative countries within SSA. These countries were mainly selected based on their colonial economic history, i.e. reflecting the Anglophone, Francophone and Lusophone experiences corresponding to the three colonisers most involved in SSA. The infrastructure left behind after the end of colonial rule, which differs vastly between the countries, the presence of natural resources and their strategic locations influenced the selection of Ghana, DRC and Angola for this study.

4.2 THE EVOLUTION OF PUBLIC INFRASTRUCTURE AND THE INFLUENCE OF COLONIALISM IN SSA

Gold Coast (Ghana) gained independence from Britain in 1957 and Belgian Congo (now DRC) in 1960. Most French, British and Belgian colonies followed in the 1960s, while the Portuguese colonies now known as Cape Verde, Guinea-Bissau, Angola and Mozambique only attained independence in the mid-1970s after protracted uprisings and a leftist coup in the Portuguese metropole (the so-called Carnation revolution) toppled the Salazar dictatorship. The end of colonial rule had economic impacts in the colonies, especially in infrastructure services.

Colonial infrastructure services were mainly required in the capital city and commercial hubs and were built to serve the interests of the colonial power and co-opted colonial elites. In Angola for instance, there was very little urban infrastructure development. After the collapse of Portuguese rule and independence, a protracted civil war broke out in Angola, which

prevented meaningful infrastructure development. Similarly, Congo experienced instability when the post-colonial leader Patrice Lumumba was assassinated. Like Angola, Ghana and many other colonies, the DRC did not have enough transportation infrastructure, adequate power supply or urban infrastructure during colonial rule since the existing infrastructure was built to serve a small colonial population. The infrastructure services such as electricity, water and road network were concentrated in the cities with a lack of development in the periphery where the plundering of natural resources took place. Jerven (2016) describes this process of colonial plunder as the period of destruction and destitution of Africa. In his assessment, Jerven (2016) observes that the poorest non-European areas 500 years ago are now among the richest and that, conversely, the formerly richest areas in Africa are now are among the poorest due to economic deprivation by Europe.

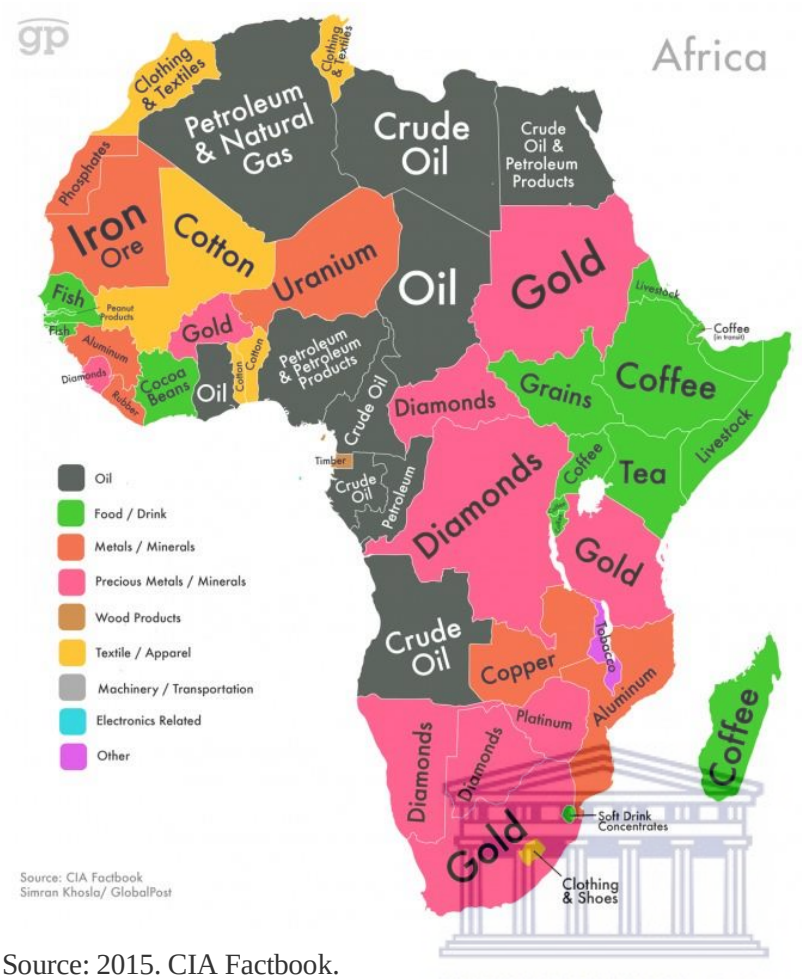
The process of colonising these African economies was achieved through a meticulous process of investing in public systems of institutionalised oppression. Thus, the first physical infrastructure involved colonial administration buildings, the military, courts and prisons. The economic institutions in the colonies were built with the sole purpose of extracting whatever commodity the colonial powers deemed valuable. Road, rail and communication systems were only instituted where they served the purpose of subjugation and extraction. Schools were allowed only to produce lackeys and educate the children of the elites. Economic incentives drove innovation and efficiencies to the extent that, even beyond the colonial rule, the systems continued to function. For instance, the Cape colony in South Africa was merely a strategic refreshment station for Dutch ships initially. The first infrastructure followed economic dictates and was a fort, later upgraded to a castle largely constructed of stone quarried from the nearby Table Mountain. The next infrastructure was a slave lodge and a granary, followed by judicial buildings, canals and roads. So well established and efficient was the infrastructure of the Cape colony that the colony in Natal, the Union government that followed in 1910, and even the new system called apartheid which followed the Second World War were generally modelled on it. Much of this colonial infrastructure even survived into post-apartheid rule including Parliament and a deracialised judicial system.

Colonisation in SSA essentially followed the same pattern; a period of conquest and exploration, followed by expropriation of the land and repurposing it and its people for economic exploitation that benefited the colonising country. Because it was competitive and

the competing colonisers all had notions of the racial inferiority of the colonised people, the process of colonising and subjugating Africa was brutal and rapid. Within a relatively short time, the indigenous economies were completely reorganised: subsistence agriculture refocused in plantations exploiting mass labour to produce dozens of non-native crops for the European market such as cocoa, bananas, tobacco, wine grapes, cassava, maize and rice; exploitation of minerals was industrialised; natural forests plundered and replaced by plantations; and animal species decimated for the export of wildly profitable meat, skins, ivory and trophies. Moreover, in a crime against humanity for which the perpetrators have never been brought to book, millions of humans were commoditised, forced into slavery and dispersed around the world to produce fabulous wealth in Europe and the Americas. Those that remained, as well as the slave descendants when slavery finally became morally unconscionable in the metropoles, were as badly exploited in the late colonial and post-colonial eras as cheap, mostly manual labour.

In essence, the colonial process not only reorganised the economic setup of the colonised countries, but it also obliterated the indigenous economies of SSA to the extent that when independence came, the former colonies were completely absorbed into commoditised, global trade, industrialised and monetised and, crucially, left with no financial reserves with which to rebuild their ravaged countries. To progress at all, the former colonies had no choice but to fund their development through debt sourced from European investors. In other words, the wealth stolen from Africa was loaned back to it, at a very high cost. SSA has continued to be treated as a supplier of cheap resources for the developed economies. Many economies are still destabilised by lack of diversification and technology, and their reliance on colonial staple commodities leaves them highly vulnerable to price manipulation by brokers, the collapse of markets during gluts or the effects of natural phenomena such as drought. Figure 1 below illustrates the extent of the reorganisation process. It is noteworthy that not a single commodity depicted represents an industry that existed in the precolonial period.

Figure 1: Distribution and type of key natural resources in Africa



Source: 2015. CIA Factbook.

Numerous researchers point to the negative effects of colonialism on African economic development and the lack of public infrastructure development, including Guillaume and Stasavage (2000), Collier (2000) and Jerven (2016). During colonialism, investment in infrastructure that did not contribute directly to the exploitation of commodities was seen as an unnecessary cost and politically unjustifiable in the home country. Thus, a post-colonial economy 'inherited' some infrastructure that was useful, such as a dam that had supplied a timber plantation, or the apparatus that protected the security of the coloniser, such as police and army structures, but only negligible development of infrastructure that would have benefited the quality of life of the colonised population, such as roads between villages, medical facilities, schools and universities, or the infrastructure to supply amenities outside urban environments and labour compounds, such as water, sewerage and electricity. Understandably, these were the benefits the people expected independence to bring them, and the infrastructure development mandate that they gave to their political leaders. As mentioned,

without financial reserves, the only ways to provide the social capital desired was to raise the funding by continuing the production system of colonial commodities and raise any shortfall through debt financing. In both cases, the negotiating advantage in the transactions remained wholly with Europe and other major economies, who were able to dictate the terms of both trade and loans. Through various means, legal and illegal, the former colonisers have since continually intervened in these sovereign nations to influence their political and economic direction to advance their own countries' interests.

Austin (2010) notes the important point that, while European financial institutions rushed to introduce postcolonial Africa to the possibility of raising loan finance, "colonial administrations were ironically restricted in their resort to money markets by the metropolitan insistence that each colony be fiscally self-sufficient and balance its budget". In the post-colonial rule, the former colonies were soon burdened with loans that were expensive and with very little focus on infrastructure investment. Although SSA benefitted from a commodity-driven economic boom in the 1970s into the early 1980s, it was not enough to improve the state of public infrastructure, contrary to the experience in East Asia, where surpluses from the economic boom were invested in public infrastructure (Austin and Broadberry, 2014).

Instead of promoting democratic process and building good governance, the colonial power created dependency, a relationship that continued through the few elites who were given enough power to safeguard the interest of the colonial powers since they depended on the former colonies for natural resources. The dependency theory, developed to explain the lack of development in Latin America in the 1960s, applies equally to Africa. The dependency theory expresses the idea that resources move from a 'periphery' of poor and underdeveloped economies to a 'core' of wealthy economies, thereby funding wealth creation in these economies at the expense of the poor and underdeveloped economies (Ahiakpor, 1985). This theory not only explains post-colonial exploitation by the former coloniser but also provides a theory for how any wealthy country can exploit any poor country regardless of whether they had a colonial relationship. For example, the USA, whose colonial experience in Africa was confined to the social experiment of Liberia, has created a dependency relationship with many African countries, through its dominance of the World Bank, the IMF and multinational corporations. Where possible, the movement of resources is effected at the least cost and with

only the bare minimum development of infrastructure, restricted to those services that ease the flow.

While all post-independence public infrastructure on the continent was inadequate, the degree of public infrastructure 'inherited' differed between Anglophone, Francophone and Lusophone countries in SS. Public infrastructure in Anglophone colonies was somewhat more developed than that of former Portuguese and Belgium colonies. This was exacerbated by postcolonial warfare in all the former colonies of Portugal and Belgium in Africa, which all but destroyed the sparse public infrastructure left behind. The colonial view of these wars was that they were evidence that colonial rule had enforced peace among 'warlike' people. Other views observed the forcing together of cultures that co-existed relatively peacefully when Europeans arbitrarily drew borders to create territories, or pointed out the standard colonial practice of co-opting part of the population, usually on cultural-ethnic lines, to assist the subjugation of others. However, some researchers (Bates, Coatsworth and Williamson, 2006; Ong'ayo, 2008) suggest that these wars were sponsored by the former colonial powers to continue their exploitation under the cover of political uncertainty or chaotic governance, aided by rent-seeking, corrupt political elites, such as in much of the Congo/DRC postcolonial history. Whether intended or not, such political instability not only puts existing public infrastructure at risk but distracts governments from further development of public infrastructure. Furthermore, the perception of risk caused by political instability or conflict can be advantageous to donors, investors and foreign development institutions. For example, Hopkins (2009) suggests that the "idea that development is linked to risks is a truism which economists have made operational by devising concepts such as specialisation and opportunity cost". In other words, political risk, which some authors have argued is fomented by those safeguarding former colonial interests, can be the justification for selective investment and development of infrastructure services under terms advantageous to the investor/funder, adding a cynical twist to the ongoing pillaging of Africa's resources.

It can be argued that for many countries in SSA, investment in post-colonial public infrastructure era has been driven by political elites with ulterior motives of making corrupt gains from the infrastructure projects either directly or through rent-seekers and business proxies. Thus, even after many decades of post-colonial 'independence', democratic

progression in countries such as Angola or the DRC has hardly impacted positively on the public infrastructure development process.

Having discussed in general terms the influence of colonialism and postcolonialism on public infrastructure development in SSA, the study attempts to understand the role of politics in the current framework of public infrastructure development and investment in SSA by examining some of the background of its development. Although several countries were selected for closer examination based on their colonial past and their representativeness of different colonial experiences, including Mozambique, only three of these economies – Angola, Democratic Republic of Congo and Ghana – were included in the case study for the research. Public infrastructure development, governance and corruption are discussed below with specific reference to these countries, whereafter the chapter concludes with some introspection on the current investment climate and the role of new players in the infrastructure space in SSA.

4.3 PUBLIC INFRASTRUCTURE DEVELOPMENT IN ANGOLA

The war for Angolan independence was fought between 1961 and 1974 against the Portuguese government. It ended after a leftist military coup overthrew the Caetano government and abruptly ended the Portuguese Colonial War in Guinea-Bissau, Cape Verde, Sao Tome and Principe, Angola and Mozambique. In Angola, the war formally ended when the new Portuguese government signed the Alvor Agreement with the three liberation movements: People's Movement for the Liberation of Angola (MPLA), National Union for the Total Independence of Angola (UNITA) and National Liberation Front of Angola (FNLA). The parties (excluding FLEC, the secessionist movement in Cabinda) agreed to form a government to oversee the transition to independence but the abrupt abandoning of the colonies had created a power vacuum that sparked a civil war. The conflict was exacerbated by the Cold War involvement of the USSR and Cuba, supporting the socialist MPLA, and the USA and its allies, who supported both the FNLA and UNITA. The protagonists in the anti-apartheid conflict were also drawn into choosing sides, with SWAPO and the ANC supporting MPLA and the apartheid government committing SADF troops and logistics to support FNLA and UNITA. The Cubans and SADF were already engaging directly in 1975. The MPLA became the de facto government in November 1975 but the war continued even after apartheid ended and only ended with the death in battle of UNITA leader Jonas Savimbi in 2002. Along with the destruction caused by the civil war, the Portuguese government's repatriation of 200,000

Portuguese citizens living in Angola, who had constituted the management strata of both government and the economy, had a devastating effect on public infrastructure and governance generally, which lingers to this day. For example, Pushak and Foster (2011) estimated that the country has a total road network of 62,560 km, of which the country has managed to upgrade only 17 per cent to tarmac, mostly in urban roads. The number of tarred roads increased significantly from early 2000, but Durovic (2016) suggests most are of poor quality. According to the World Bank (2016), over 60 per cent of the country's public rail network is not functional. Despite good rainfalls and extensive rivers, the water supply infrastructure was frequently targeted and damaged in the civil war and rebuilding has been slow since. The system also needs expanding since it was designed for colonial purposes. For example, the water supply system that supplies Luanda, according to Pushak and Foster (2011), was built during the Portuguese rule for not more than a million inhabitants yet the present population exceeds 2,5 million. After the Portuguese who ran the city left in 1975, they were replaced by Cuban technicians but the city struggled under the influx of refugees fleeing the war and slums proliferated while amenities declined. However, Luanda is the main seaport and export hub of Angola as well as the capital city and this has prompted tremendous growth in infrastructure projects in recent years, funded by a boom in oil and diamond revenues. The expansion was necessitated by the "demand post-war that resulted in serious congestion, with traffic volumes increasing more than tenfold, from 30,000 to 346,000", according to Pushak and Foster (2011). The end of the civil war also made Luanda a convenient port for the Democratic Republic of Congo, Zambia and other neighbouring countries. The growth in demand necessitated the expansion of port infrastructure. Pushak and Foster (2011) suggest that, despite the re-investment in public infrastructure, Luanda continues to struggle with aging and inadequate public infrastructure.

The power supply in Angola remains challenged as the government continues to rely on infrastructure built during the colonial era. The World Bank (2016) estimates that less than 30 per cent of Angola's population has access to electricity, lower than the 46 per cent average of resource-rich economies in other parts of Africa. Despite access to electricity improving in recent years (World Bank, 2016), the inadequate power supply in Angola is a huge impediment to private sector investment. The World Bank (2016) suggests that 90 per cent of firms outside Luanda rely on generators, producing about 900 MW of power daily, equating to almost a third of their own power needs.

While investment opportunities in Angola have focused on mining, oil and gas, opportunities in the agricultural sector are hardly being promoted. In the rail sector, the World Bank (2016) and Baptista (2018) state that Angola has low freight density in comparison to other economies in the continent.

Despite over 60 per cent of the infrastructure budget being invested in building roads (World Bank, 2016), the lack of transportation, power, warehousing and other logistical infrastructure may be impacting on the agricultural sector not enjoying similar government support. The low density in public infrastructure is widespread and, although there is a development plan in place to address the backlog, the political dominance of the MPLA has been bedevilling the reform of public infrastructure due to accompanying corruption and poor governance, as explained in the following section.

4.4 GOVERNANCE, CORRUPTION AND INFRASTRUCTURE DEVELOPMENT IN ANGOLA

Corruption is the biggest threat to development in Angola. Corruption perception indices, such as the World Bank's Governance Indicators database (WB), the Corruption Perception Index (CPI) of Transparency International (2018), and the corruption index of the Political Risk Services International Country Risk Guide (ICRG, 2017) conclude that corruption has discouraged investors in Angola since the end of colonial rule and civil war. Transparency International (2019) placed Angola 146th out of 180 countries in its 2019 CPI.

Vicente (2011) studied corruption and natural resources in the former Portuguese colonies, including Sao Tome, Angola and Cape Verde and found that revenue from resource extraction such as diamonds and oil has increased corruption in Angola. According to Vicente (2011), the discovery of oil in Angola helped politicians to buy votes and allocate patronage to their rent-seeking supporters. Vicente (2011:29) suggests that corruption also affected other services such as "courts and the allocation of subsidies/procurement and state jobs". This includes the allocation of resources to build public infrastructure such as road, rail, harbours, telecommunications, energy, health care and justice.

Corruption in ports undermines revenue collection in Angola. It can take over 120 days or more for the port authority to clear goods and this has negatively impacted the economic trade in

Angola. Vicente (2011:29) argues that "the increase in customs corruption may be a symptom of increased private consumption" and therefore it is not in the interest of the elites whose consumption is potentially funded through the creation of artificial bottlenecks in the ports for the public ports infrastructure to be modernised since efficient ports do not benefit corruption. Konijn and Van Tulder (2015), in their research on resources for infrastructure swaps in Africa, observe that the increase in Chinese-funded infrastructure projects in Angola during the presidency of Dos Santos led to an increase in corruption and poor governance. Schubert (2018) analysed the post-war economic boom with reference to the construction of the new city outside Luanda and the upgrade of the road infrastructure in and around Luanda and found that the country lacked good governance practices with regard to corruption. The family of Dos Santos has been implicated in several cases under investigation. For instance, the Mo Ibrahim Index (2016) notes that a US$15 billion project was awarded in 2015 to the former president's daughter Isabel without following due process. The project was meant to revamp Luanda public infrastructure, including road, rail, port, water supply and energy, Other projects awarded to the political elite and China include the construction of a hydroelectric power station at an estimated cost of US$5 billion, roadworks at a cost of almost a US$1 billion and a state port (Porto de Luanda) at a cost of US$1,5 billion.

Despite the negative perception of corruption, Angola is China's biggest trade partner in Africa, with China continually investing in Angolan public infrastructure since 2004, by granting lines of credit and loans to fund infrastructure in exchange for crude oil. Alden (2009:9) explain the financial arrangement between China and Angola as "packaging infrastructure development with resources, used as a guarantee in countries that have a bad credit record, but abundant resources". Chinese oil companies have also begun to acquire rights to directly exploit oil fields in partnership with Angola, which previously only sold rights to the western oil companies that currently still dominate Angola's oil industry. China safeguards its interests through public infrastructure packages that also guarantee the supply of labour and other advantages. As elsewhere in Africa, China has consistently maintained its 'no interference' policy in the domestic affairs of Angola which includes not publicly commenting on corruption allegations. The election of President Joao Lourenco, whose success was partly achieved on an anti-corruption ticket, has not yet led to change in governance, although his government has acted against the former president's family members, including charging his son, Jose Filomeno de Sousa dos Santos, formerly the head of Angola's $5 billion sovereign wealth fund, with fraud

and money laundering in 2019, in connection with the transfer of $500 million from the central bank to a Credit Suisse account in London. Dos Santos's daughter Isabel was fired as the chair of state oil company Sonangol and was also under investigation for corruption in 2019.

4.5 PUBLIC INFRASTRUCTURE DEVELOPMENT IN DRC

The former colony of Congo (now DRC) has been challenged since its independence from Belgium in 1960 by stagnating infrastructure, which has been caused and exacerbated by political conflict and corruption. Six months after his election, Prime Minister Patrice Lumumba was executed by Belgian-sponsored rebels. A coup in 1965 began the long dictatorship of Mobuto, whose brutal regime was supported throughout by the USA because of its avowed anti-communism and was only ousted by forces led by Laurent Kabila in 1997.

From 1998 to 2003, the already fragile infrastructure inherited from the colonial era was devastated by warfare that involved nine countries. After Kabila's assassination in 2001, he was succeeded by his son, Joseph. Although comparatively stable politically, the DRC, the biggest country in SSA by area and possessing vast riches in natural resources, is poorer in infrastructure than most of SSA and thereby unable to reach its economic potential. Despite the dilapidated infrastructure, the DRC remains attractive to investors interested in natural resources. Older active investors include Belgian companies with new investors proliferating mainly from China.

The Congo's colonial inception was as the private property[4] of King Leopold II of Belgium who, in 23 years of genocidal barbarism, directly caused the enslavement and death of millions of Congolese for the sake of amassing an incredible fortune derived from ivory and rubber. Ironically, much of this wealth was transferred to Belgium and invested in public buildings and other infrastructure that survive to this day. It could be argued that from an investor's perspective, nothing has fundamentally changed from the colonial era, in the sense that the main focus of investment remains the extraction of natural resources while committing as little capital to infrastructure development as possible. It is no accident that the two most developed

[4] He was allowed by the Berlin Conference in 1885 to personally rule Congo as the Congo Free State, an area 76 times larger than Belgium.

large urban centres aside from Kinshasa are both mining towns – Mbuji-Mayi (diamonds) and Lubumbashi (copper).

The inability to develop infrastructure in the DRC and lack of capital has in recent years forced the government to enter into agreements with countries such as China to assist in building public infrastructure in exchange for payment in natural resources, much like Angola has done. Kabemba (2016) states that China signed an agreement to build public infrastructure such as roads in the DRC in exchange for US$6 billion worth of minerals. The minerals that China is targeting are copper and cobalt mined at the Sicomines. There is little evidence of capacity in the DRC government to monitor the delivery of either end of this agreement with China. Aside from transportation infrastructure, there is a serious shortage of power generation and distribution infrastructure to support the country's economic activities. For example, although The World Bank (2016) estimates that the country produces over a million tons of copper, the mining sector operates below its production capacity as production is hampered by the lack of an adequate power supply. The mining sector is often forced to reduce operating hours by a rationed power supply. Investors such as the World Bank and African Development Bank are hoping investing in the country's electricity infrastructure will help improve the economic outlook for the DRC and the region. The World Bank reported in 2017 that it was investing US$147 million in the DRC Electricity Access and Service Expansion project to improve the power supply infrastructure in the country and augment the existing network. The project was expected to be completed in 2022 but this might be realised delayed by political uncertainty. The inadequate power infrastructure services in the DRC is also made worse by the lack of road networks linking the provinces, further complicating prospects of attracting investment to the provinces within the DRC.

Due to its vast size, history of political instability, historical neglect and geopolitically strategic location, developing the public infrastructure of the DRC will require the cooperation of all internal stakeholders, the governments of the neighbouring states, international bodies like the United Nations (UN) and IMF, development agencies, governments of developed economies and their financial institutions, and the World Bank.

4.6 GOVERNANCE, CORRUPTION AND INFRASTRUCTURE DEVELOPMENT IN DRC

Countries in the SSA including the DRC are among the world's most underdeveloped as a consequence of and yet are associated with inadequate public infrastructure, poor governance and corruption. Nkohkwo and Islam (2013:254) point to a need to understand the "complex and inter-connected encounters between good governance and development when countries resolve conflicts and decrease corruption to spur growth, strengthen democratic governance, raise health and education levels and protect the environment".

The DRC is regarded as one of the most corrupt countries in the world, currently ranked 168th out of 180 countries on the Corruption Perception Index of Transparency International (2019). In just one of many reported cases, the Africa Progress Panel, chaired by Kofi Annan (Africa Progress Panel, 2013), found that DRC lost at least US$1,4 billion in revenues between 2010 and 2012 when corrupt officials sold the country's mining assets below value. The amount lost could have been used to finance public infrastructure development. In the DRC, poor governance and corruption have become a threat to the viability of the state because they threaten prospects for investment in key sectors. According to Nkohkwo and Islam (2013), the DRC government has not been able to develop basic ICT services to connect provinces.

Nkohkwo and Islam (2013:254) argue that corrupt governments are reluctant to introduce ICT infrastructure in the public sector because "it becomes a threat to the viability of corrupt practice and also power". For instance, ICT has the potential to promote transparency in the public sector as it is easier to monitor communication and compliance and to enable audit trails and investigation of suspicious or corrupt transactions or behaviour in government departments. ICT could also be used to manage elections and thus reduce the possibility of vote-rigging. One of the reasons put forward as an explanation for the lack of ICT infrastructure in the DRC is the lack of ICT skills and the capacity to manage ICT in the public service. Although the lack of ICT skills in the country is indisputable, there is also no political will to organise skills that will manage the ICT public infrastructure development.

4.7 PUBLIC INFRASTRUCTURE DEVELOPMENT IN GHANA

Ghana, a former colony of Britain, is a beacon of hope in West Africa because of its relatively stable and mature democracy. According to Ho and Iyke (2018:1), "In 2010, Ghana was rated

the 5th most stable, the 17th best governed and the 13th highest in respect of human capital development." Until disrupted for a time as a consequence of the global financial crisis, "The country was also regarded as one of the fastest-growing economies in the world, being rated the 10th highest per capita GDP in Africa, with a rate of unemployment at 5.20 per cent, and the highest per capita GDP in West Africa in 2013" (Ho and Iyke, 2018:1, drawing from the World Development Indicators, 2014). According to the World Bank (2016), like most SSA countries, Ghana struggles with the maintenance of the existing public infrastructure such as roads, rail, power and water supply, due to the economy's inability to produce a level of growth to fund public infrastructure maintenance.

Due to past economic problems, along with a reliance on debt-financed development, Ghana's accumulated debt had ballooned to a debt-to-GDP ratio in 2016 of 70 per cent (African Development Bank Group, 2018). The importance of maintaining infrastructure was assessed by Ho and Iyke (2018), who recommended that rather than accumulate more debt, Ghana should implement macroeconomic policies that grow human capital and that will attract FDI in foreign aid rather than debt, which is unsustainable in the long run.

Baptista (2018:30) assessed energy security in SSA and found that, despite "an influx of international interest and investment in energy projects, designed to address the energy crisis and climate agendas, only US$4,7 billion was invested in energy between 2003 and 2013". This was well short of the US$43–55 billion per annum needed by Africa as a whole, as estimated by the African Union. Baptista (2018:31) suggests that infrastructure such as "energy is decided by the technology and design available and the system is greatly influenced by initial conditions and events that lead to its adoption". This observation applies to Ghana, which generates the bulk of its electricity through hydroelectrical power, and a small percentage from diesel power stations. It has also begun very large-scale solar energy plants but these have been beset by project delays. Although Ghana has large reserves of natural gas and crude oil it has struggled to deliver the construction of infrastructure projects required to exploit these economically, and failures particularly in developing the gas industry have cost its economy billions of dollars in lost revenue. To date, there is no infrastructure in place to use oil or gas to power electricity production.

Notwithstanding its record of good governance and stability, Ghana has not managed to attract adequate FDI flows to support public infrastructure development. While Okafor, Piesse and Webster (2015:876) have noted that "the oil reserves has helped some of the economies to improve their business environments, liberalise policy regimes, and offer incentive packages to foreign investors to attract FDI", the oil and gas industries in Ghana are relatively new and, lacking local technical expertise, the country has had to rely on foreign investors to exploit the resources.

4.8 GOVERNANCE, CORRUPTION AND INFRASTRUCTURE DEVELOPMENT IN GHANA

Ghana has been politically stable since transitioning to multi-party democracy in 1992 and benefits from good governance. Having been ranked 80 out of 180 countries in the Corruption Perception Index (Transparency International, 2019), it is certainly not corruption-free and there have been many allegations of corruption in public procurement bids for public infrastructure projects as well as cases involving corruption in the police or judiciary. However, as a whole, it does not experience corruption on the scale or in the form of the cronyism and rent-seeking observed in some of its neighbours or in the other two case study countries. The government has also shown serious intent in addressing it by creating the Office of the Special Prosecutor to help fight corruption.

4.9 NATURAL RESOURCES AND THE PROSPECTS OF PUBLIC INFRASTRUCTURE INVESTMENT IN SSA

Natural resources in Africa and especially in SSA remain the primary pull factor for outside investment. Natural resources have unfortunately also incited conditions that are not conducive to attracting investment, particularly FDI. Countries with abundant natural resources, such as Angola (oil, phosphates, iron, diamonds, bauxite, uranium, feldspar) and the DRC (oil, diamonds, gold, copper, cobalt, tin, coltan, timber), have had serious civil wars and continue to experience political instability. Angola and the DRC lack technical capacities to leverage private investment capital flows for the exploitation of natural resources so that the revenues generated can fund building the public infrastructure services that will make the economy more efficient and productive, and in turn boost economic growth and wealth creation. These economies also do not have strong governance in place to manage challenges associated with the developmental state such as the various forms of corruption. Rather, corruption has been

observed to be endemic in these economies, and characteristic of their political elites. These countries use much of their resources to fund enforcing political stability rather than building social capital through the development of public infrastructure. The pillaging of financial resources has also delayed development and increased the risk of political and economic instability in these countries, which will further undermine governance and FDI. By contrast, Ghana has better prospects of attracting FDI to fund infrastructure as it has better governance, more stability and less corruption.

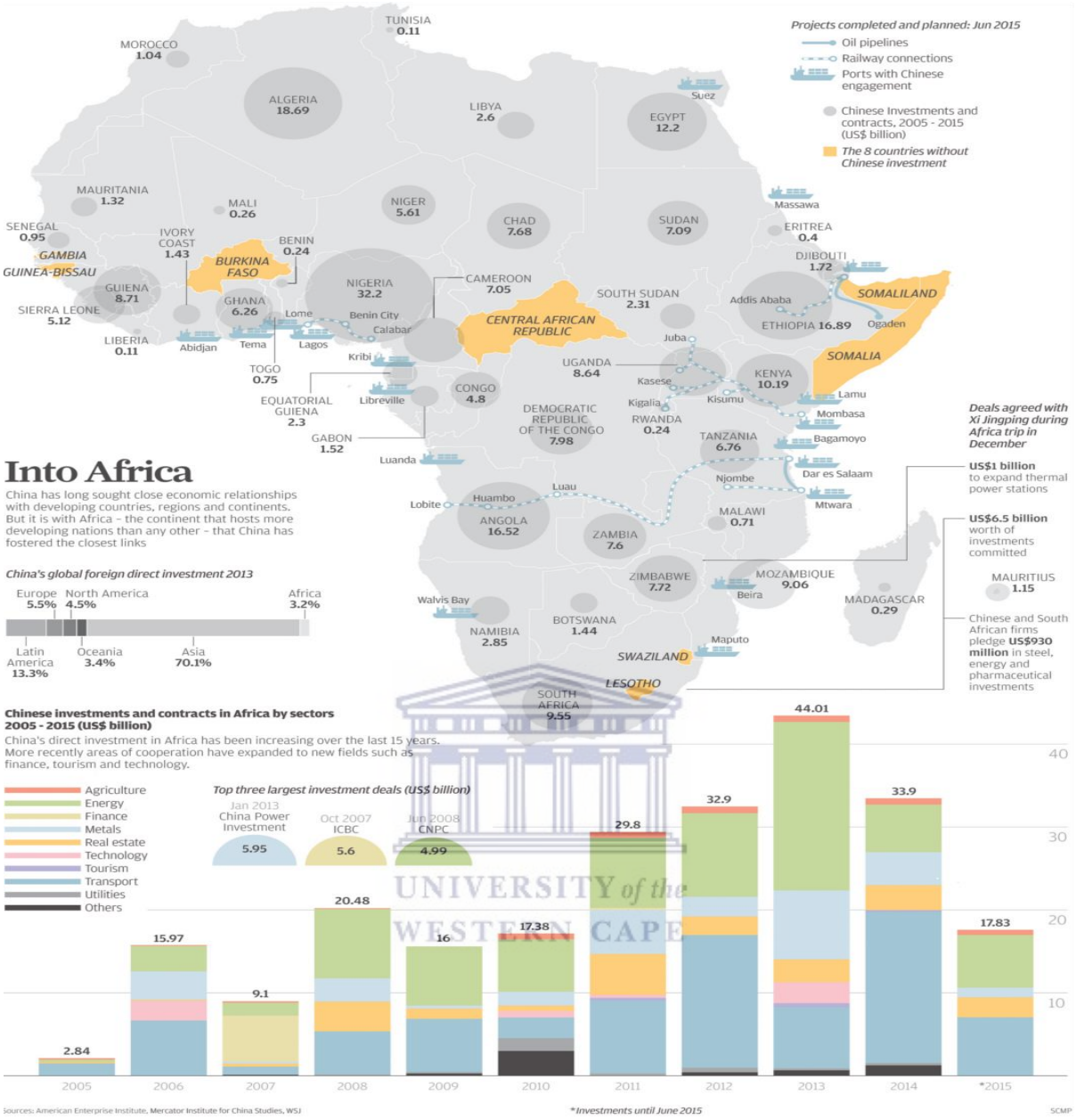
Sarangi (2017) has suggested that "international trade is an engine for inclusive economic growth and poverty reduction and it has been a significant source of public and private finance in developing countries". Having recovered from the global financial crisis, the world's stronger economies have a greater demand for the natural resources that SSA's developing economies have in abundance and therefore international trade with the rest of the world should constantly increase. But benefitting from this growth depends on being able to supply the resources efficiently, which means dealing with the public infrastructure backlogs without succumbing to political strife or corruption. Brahmbhatt, Canuto and Vostroknutova (2010:107) researched natural resources and development strategy, and posit that the "negative long-term growth effects of natural resources are mostly related to oil and minerals and the reason for this effect is that oil and minerals easily become concentrated 'point source' resources that can easily become the object of rent-seeking and redistributive struggles". Agricultural commodities, on the other hand, have little evidence of negative growth effects as prices fluctuate since this sector is more open to competitive entry. The important success factor according to Brahmbhatt et al. (2010:107) is governance, whereby higher agricultural commodities prices "have a significant positive impact on growth in exporting countries with good governance while high oil and mineral prices mostly have a negative impact on long-term growth in exporting countries with bad governance".

4.10 CHINESE INVESTMENT AND PROSPECTS OF INFRASTRUCTURE DEVELOPMENT IN SSA

The abundance of natural resources has influenced investors such as China to invest in resource-rich economies in SSA, including Ghana, Angola and the DRC. China, in particular, has offered the region loans, lines of credit and payment in natural resources as ways to fund Chinese assistance with building rebuild public infrastructure. This allows countries to avoid

the ballooning debt that has handicapped their development and forced many into disadvantageous structural adjustment programmes and trade agreements with developed economies. China continues to make strategic investments on the continent, especially in mining and infrastructure development. The map below shows the extent of Chinese investment over a key ten-year period.

Figure 2: Chinese infrastructure investment in Africa, 2005–2015



Source: 2015. American Enterprise Institute and Mercator Institute for China Studies.[5]

FDI from China has increased substantially in Africa in the recent past reaching 46 countries as indicated in Figure 2, mainly focusing on metals, energy and infrastructure. According to the World Bank (2016), Chinese investment was equivalent in 2013 to US$44 billion in Africa

[5] Viewed in February 2020 at: https://www.scmp.com/news/china/diplomacy-defence/article/1887975/infographic-chinas-total-investment-africa

and further funding of more than US$60 billion was committed during a China-Africa summit in 2018. It is noted as a matter of concern that the public infrastructure built by China under the natural resources exchange programme for infrastructure for countries such as Tanzania, Zambia, Kenya, Angola and the DRC may incur unplanned costs since most of these countries have limited capacity to negotiate or monitor the implementation of these projects. It may be prudent for SSA countries involved in China-Africa infrastructure projects to involve other the public and international institutions to play a role in monitoring and evaluating the project delivery to ensure that the interests of vulnerable and weak economies with poor governance such as Angola and the DRC are protected.

CHAPTER FIVE: RESEARCH METHODOLOGY

5.1 INTRODUCTION

The methodological choice for the research is the case study approach. Both qualitative and quantitative methods are used to analyse the different case studies. This chapter discusses the research methodology in detail – the research approach, the methodological choice taken by the research, time-series horizon, data collection method, data analysis, credibility of the data used in the research, ethical consideration and limitations of the research.

5.2 RESEARCH APPROACH

The research is conducted through the case study approach. Yin (2015:8) suggests that "the case study's unique strength is its ability to deal with a full variety of evidence". The evidence for the case studies is gathered from qualitative as well as quantitative methods. The quantitative and qualitative evidence are then triangulated to integrate the information and data to answer the key research objectives.

5.3 METHODOLOGICAL CHOICE

Data and information from SSA are difficult to obtain, including historical information for the region since SSA does not have a single reliable data depository where information is kept relevant to the study. This is one reason for the use of the case study approach, with evidence collected from a mixed-method approach to overcome the hurdle of missing data or otherwise inaccessible information. Using a mixed-method to undertake the research allows the researcher to access multiple sources of information. Schell (1992:1) argues that a case study approach that includes the mixed method "is the most flexible of all research designs, as it allows the researcher to retain the holistic characteristics of real-life events while investigating empirical events". The mixed-method also allows the researcher to address 'how' and 'what' questions emanating from the research question.

The study conducted an in-depth review of archival literature, journal articles, databases, books and other empirical evidence to support the objective of the research in answering the research question. The choice of case studies based on evidence collected from the mixed method is an appropriate and relevant methodology and has the flexibility appropriate to answering the

research question, particularly as SSA is seen as one geographical location but has different economies and levels of infrastructure development.

5.3.1 CASE STUDY RESEARCH STRATEGY

Noor (2008:1602) defines the case study as "an empirical enquiry that investigates the contemporary phenomenon within its real-life context using multiple sources of evidence". Zainal (2007:2) outlines the advantages of design in the case study method as follows:

> (1). It is the only viable method to elicit implicit and explicit data from the subjects. (2). It is appropriate to the research question. (3). It follows the set of procedures with proper application. (4). The scientific conventions used in social sciences are strictly followed. (5). A 'chain of evidence', either quantitatively or qualitatively, is systematically recorded and archived. (6). The case study is linked to a theoretical framework.

The case studies assist the study to highlight key problems and opportunities in public infrastructure services that influence investors' decisions and to understand why these problems exist in SSA, where economies seem to share a number of economic and social challenges that are unique to the region, and how these problems impact and influence the economic development of SSA region and infrastructure investment.

Battleson, Booth and Weintrop (2001) suggest that case study research can advance the best solutions based on evidence gathered. The research argues that the solutions to the research question for this study would be grounded on the material conditions that exist in SSA regional infrastructure and attained through the diverse case technique described by Seawright and Gerring (2008), which allows 'maximum variance' to be achieved. Since each case studied confirms to a whole country's experience, maximum variance can be achieved through a careful selection of country economies that reflect the SSA region's socio-economic development in relation to public infrastructure investment, including the aspects of their colonial legacies, natural resources and political conditions that would enable the study to answer the research question. Due care has been taken to ensure that the sample is representative. The selection of three economies in the region represents 6.5 per cent the total number of SSA countries, which is considered sufficiently representative of the sample size to meet the objectives of the study. It is, however, acknowledged that case study research that is

based on three economies cannot encompass all the specific challenges facing public infrastructure services investment in every country across the region.

The advantage of the case study for this research, as explained by Yin (1984:23), is that the case study research approach can also be "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used." The flexibility of this approach is that it does not rely only on one particular data collection method but embraces both quantitative and qualitative research traditions. This makes it ideal for a study of SSA where information is often disjointed.

The case study approach involves the investigation of both qualitative (process) and quantitative (outcome) phenomena through which complete observation, reconstruction and analysis of the cases are achieved (Zainal, 2007). The case study approach for this study can be exploratory, descriptive and explanatory. These three approaches create flexibility for the study and allow more options for the study to gain insights, although one option is sufficient to conduct the study. The option taken to conduct the research includes the descriptive approach. This approach was chosen by the study on the basis of its flexibility to describe and explain the characteristics of important factors in research. Although the descriptive approach can be extensive, for this study, the descriptive research approach was limited to determining the cause and effect of lack of investment flows into public infrastructure services in SSA.

The learnings from the three case studies will generate enough variation for the research to be used to analyse the research problem and help the study to reach the research objectives (Knoblauch, Flick and Maeder, 2005). These variations help the study to identify and understand the critical factors that influence public infrastructure investment and also allow the research to reach findings and conclusions that can be generalised across other SSA countries. This is confirmed by Noor (2008:1603), who contends that that case study "allows generalisation of results from the findings and this is achieved through the use of multiple case approach", although Noor (2008) also warns that case study has been criticised for lack of scientific rigour and reliability. This concern is dealt with in this study through ensuring that the number of cases is representative.

The research selected the cases for study from a list of countries comprising the SSA region from the available literature. The colonial history, geographical locations and natural resource endowments were considered before countries were selected based on data availability. The first case study to be undertaken is replicated into two other cases since three case studies are included. The study predicted that, given the similarities of public infrastructure challenges in the SSA region, similar patterns should be found in all selected cases. Should similar patterns be found, Noor (2008:1604) suggests that "the study will have more confidence in the overall results". Thus, the research overall will be regarded as consistent in the findings and be argued to be robust. The use of the case study to determine a "robust relationship between public infrastructure investment and economic growth" will be achieved through detailed contextual analysis of a limited number of factors and their relationships with the public infrastructure investment and economic growth. In establishing the relationship, the case study follows a structured format where key problems and issues are outlined. This entails summarising issues in line with the research objectives. Furthermore, it outlines all facts related to the research to identify the most important issues that the study can use to answer the research question. The next step of the case study entails identifying various issues affecting public infrastructure in SSA to propose solutions or recommendations for the problems. In sum, the case studies follow a multiple sources approach where information is gathered and replicated across three sample cases to collect similar information across the selected sample. Other methods used to collect and analyse data on infrastructure investment are outlined below.

5.3.1.1 CASE STUDY DATA COLLECTION

The data collected through the case study is both quantitative and qualitative. The qualitative data collected is arranged in themes as this helps the research to outline common factors across the three economies chosen for the case studies. The information for the case study was collected from existing materials and documents (secondary), including academic journals and books, discussion papers, government reports, developing agencies' reports, newspapers, magazine articles, research websites and any other reputable sources.

Data on public infrastructure and investment is often difficult to obtain, therefore, most data of the study will come from peer-reviewed academic journals which means the data is already tested with relevant feedback. The research developed profiles of critical factors relevant to the public infrastructure investment in SSA. The profiles assist the research with triangulating the

data, in accordance with Lune and Berg (2016) who explain the importance of "use of multiple lines of sight" in data triangulation. These factors assist the study to paint a coherent picture of public infrastructure investment in SSA to develop accurate knowledge about the challenges facing infrastructure in the region. The data on these critical factors was collected based on previous public infrastructures service projects such as roads, bridges, ports, airports, railways, power, water supply, telecommunication networks and other information technology services. Countries have been studied before using a case study approach, according to Zhang (2005), including a study of Malaysia's sewage system improvement by a US-UK consortium of companies. The research on public infrastructure used the approach developed by Zhang (2005:4) of focusing on critical success factors (CSF) that are important to the success of infrastructure development. The case study gathered data on the following critical factors that influence investment in public infrastructure:

(1) *Investment environment,* which is the economic arrangement for development at national, regional and international levels where the effect on the values of assets or investments are influenced by external and internal factors.

(2) *Economic feasibility,* which is the likelihood that the public or private sector is able to impact the society positively and to secure and manage funding with minimum wastage.

(3) *Investment consortium,* which is public, private or public-private sector structure with the objective of investing in a common activity or merging resources to achieve common interest.

(4) *Financial package* is the pre-arranged financial package offered to the public, private or public-private sector to undertake or finance the intended projects, either in the form of a grant or a loan.

(5) *Risk allocation,* which is the process of sharing identifiable external and internal risks after a process of quantifying and qualifying the risks with the aim of mitigating the risk. The risk can take different economic, legal, contractual, political, environmental or social forms.

The success of these factors was measured and collected data used to determine whether they influence investment in public infrastructure, and how. The section below explains how the research measures the success or failure of critical factors for the study.

5.3.1.2 MEASURING CRITICAL DATA USED

The research collected a variety of data sets. Five critical factors, as above, were used to determine their relevance and also to measure the relationship between public infrastructure

and investment in each critical factor. Each factor was sub-divided into sub-critical factors to gain more insight, following Zhang (2005):

Critical Factor	Sub-factors
Investment Environment	(1) political system; (2) economic system; (3) local financial market; (4) currency exchange risk; (5) legal framework; (6) governance; (7) community dynamics; (8) relevance of public infrastructure; (9) risks; (10) wellbeing of the economy.
Economic Viability	1) demand for the public infrastructure envisaged; (2) competition from other infrastructure; (3) profitability of the public infrastructure to attract investors; (4) cash flow generation from public infrastructure to attract lender; (5) availability of skills needed for the normal development of the public infrastructure.
Investment Consortium (with technical strength)	(1) key enterprise or entrepreneur; (2) public infrastructure management structure; (3) stable government authorities; (5) partnering skills; (6) multidisciplinary participants; (7) sound and innovative technical solution; (8) cost-effective technical solution; (10) environmental impact; (11) public safety and health considerations.
Financial Package	(1) country's fiscus; (2) investment, payment and drawdown schedules on public infrastructure development; (3) sources and structure of finance facilities; (4) level of country's debt and equity finance or equity/debt ratio; (5) financial charges and interest rate financing; (6) debt financing mechanism that minimises refinancing risk; (7) interest/exchange rates regime.
Institutional Risk Allocation (in the development of public infrastructure for investors)	(1) legal agreement (2) loan agreement; (3) insurance agreement; (4) supply agreement; (5) operation agreement; (6) guarantee letters.

Based on the critical factors' sub-divisions, the research gathered enough data from the case studies to establish the relationship between investments and public infrastructure in line with the research question. Since it is secondary data, information could be attained quicker using the critical factors approach, thus contributing to the efficient conduct of the study.

5.3.1.3 DATA COLLECTION AND CASE STUDY

It is important to explain in detail the nature of quantitative data that will be used to support the research. These variables or factors are explained to demonstrate their relevance to the study. Among the sources of data for the study were the World Bank Global Economic Indicators (WBGDI), World Development Indicators (WDI) category, also known as the World Bank databank. The World Bank databank is one of the richest sources of data, making it more relevant for the study. The World Bank databank is easily accessible and data is continuously

deposited making it easier to update the study and fill gaps in the data collected. Collecting data from this source supports the aim of sourcing the greatest possible amount of information on public infrastructure and investment in SSA. The study aims to access the secondary quantitative data sources of information, namely economic data, investment data, financial data and risk allocation data. Listed investment companies on the stock exchanges such as the JSE are good sources of investment data. The JSE remains one of the biggest exchanges in terms of market capitalisation and the top exchange in Africa. Companies that are listed in the JSE have diverse investments throughout Africa. These include investment and banking institutions that participate in some of the development projects and are therefore good sources of data on public infrastructure investment in SSA. The African Development Bank and the African Union have a strong footprint in almost all the economies in Africa, making them a great source of data on the economic development of Africa, including social and economic security. Also worth noting as a valuable source of data used in the study is the annual Mo Ibrahim Foundation's Africa Index, which is current and publicly accessible, and the various corruption indices that provide useful bases for comparison in factors of corruption, governance and transparency.

5.3.2 DATA ANALYSIS AND INTERPRETATION

Since this research is conducted through the mixed method, the research established themes from the case analysis. The themes were then analysed once the information from the cases reached saturation. This was done once it was established that there was a reliable picture based on the research question and objectives. Each theme developed was contextualised and placed in a specific format or file in accordance with Braun and Clarke's (2006) guidance for thematic analysis.

During analysis, care was taken to ensure that the categories of data fit and reflect the analysis without being forced to fit the categories. This was achieved with the assistance of the constant comparison method, developed by Glaser and Strauss (2017), who also explain the relevance of data used in the analysis. The research follows a mixed-method approach, therefore the outcome of the analysis for both case study analysis and quantitative analysis was integrated through triangulation in line with the key objectives of the research.

5.3.3 DATA MODIFICATION, CLEANING, CODING AND INPUTTING

The research was conducted using the secondary data technique, therefore the collected data did not require cleaning or coding. Thus, the study followed a direct input of data for E-views to analyse.

5.3.4 QUANTITATIVE ANALYTICAL STRATEGY

The public infrastructure investment has a sizeable amount of data that can easily be explained through a quantitative analysis strategy. The main purpose of this quantitative strategy is to quantitatively establish the relationship between infrastructure investment and economic growth. This is achieved by establishing correlations between the dependent and the independent variables through the empirical model. The overriding objective is to construct a reliable and valid model that can provide unbiased results.

The model seeks to assist in answering the following questions, namely: (1) what are the factors influencing investors to lack investment interest in countries within SSA despite investment opportunities in the region; (2) what could stimulate investors' interest in participating in public infrastructure investment in SSA?

To answer these questions, the research specifies that the regression equation estimates the model for each country selected, as follows:

$$INF_{it} = \alpha + \beta_i INV_{it} + \gamma_i GDP_{it} + \delta_i CPI_{it} + \theta_i RIS_{it} + \rho_i ED_{it} + \varphi_i + \epsilon_{it} \quad (1)$$

Where:

- INF_{it} is the infrastructure investments annual data during 2005–2017.
- CPI_{it} is the consumer price index in selected SSA economies.
- GDP_{it} is the gross domestic product in selected SSA economies.
- INV_{it} is the gross fixed capital formation in selected SSA economies.
- RIS_{it} is the lending rate associated with investing in selected SSA economies.
- EXD_{it} is the external debt in selected SSA economies.
- ϵ_{it} is a vector of error terms and φ_i is a vector of individual country effects reflecting unobservable country heterogeneity.

The model applied by the research includes five control variables, namely, GDP, investment, CPI, risk and external debt. According to Kersan-Skabic and Orlic (2007), investors prefer economies where opportunities to maximise profit are clearly defined, signalled by market size. In their analysis, demand in a country is explained through market size and this is attained by

the size of the gross domestic product (GDP). As a result, GDP is used as a proxy of market size in this study.

Investments in infrastructure are used as the dependent variable in the model while gross fixed capital formation (proxy of investment) progress is the primary explanatory variable. GDP, CPI, risk and external debt are included as control variables. The framework of the research model is premised on the studies by Lewis and Ritchie (2003) and Kersan-Skabic and Orlic (2007), which explain the investment, including in infrastructure, as being determined by market size, macroeconomic conditions, financial risk, perception of risk, financial development and privatisation. These studies affirm a positive relationship between infrastructure investment and CPI, gross fixed capital formation, market size, macroeconomic factors and financial development. The study argues that there is a negative association between infrastructure investment and governance, financial risk and perceptions of risk.

CPI is included in the control variables in this model. Erdal and Tatoglu (2002) explain that investors are attracted to invest in economies where the environment offers price stability. Thus, lower CPI creates certainty for the investors and this may include attracting investors who are risk-averse.

The macroeconomic environment requires stable prices and this is important for attracting investment. As a result, the reliability of a country's monetary and fiscal policy is key in attracting investment. The performance of the macroeconomic environment is reflected through economic growth, negligible budget deficits and stable prices in the economy. If the economy experiences price instability, Fedderke and Romm (2006) suggest that erosion of investment happens and this increases the risk premium. The research uses lending rates as a proxy for risk. Risk perceptions include political, governance and foreign exchange stability.

Lewis and Ritchie (2003) explain risk as the factor that discourages investment in an economy. For instance, exchange rate volatility risk leads to currency instability and therefore investment uncertainty. A stable currency allows investors access to currencies that can be used for imports and repatriation in the case of FDI. The risk is further measured by the quality of governance by factors such as corruption, interventions in property rights and political uncertainty. Lewis

and Ritchie (2003) and Negishi (2007) explain that there is a need to reduce the perception of risk and ensure that a predictable political atmosphere prevails in an economy.

The research also uses external debt to model financial risk as a proxy. Financial risk plays an important role in the decision-making process for investors. Negishi (2007) suggests that economies with higher debt service payment-to-export ratios often have a greater probability of a balance of payment (BOP) crisis and this results in the imposition of restrictions on profit and dividends remittances for foreign investors and consequently slows investment flows for the host economy. The research envisages a negative relationship between investment inflows and financial risk.

5.4 TIME HORIZON AND DATA COLLECTION FOR THE STUDY

The research is conducted by using a time series approach to analyse the historical data related to public infrastructure services for the period 2005–2017. The frequency of the data is quarterly. The advantage of using a time series approach for this research is that the approach allows the researcher to compare the influence of independent variables related to public infrastructure investment over a defined period. The research relies on secondary data collected from three countries in the SSA region, i.e. Angola, the Democratic Republic of Congo and Ghana. This secondary data is collected from the archival records of various organisations, including the World Bank, AU, development institutions, government institutions and other private sources. The secondary quantitative data was limited to the 2005–2017 period. The reason for limiting the data to this period is that secondary data in SSA has its own inherent challenges such as the likelihood of possible gaps (missing data). The process and technique of data collection are explained in the sections that follow.

The data collection for the study is collected from the populations of economies in the SSA region. Pettus-Davis, Grady, Cuddeback and Scheyett (2011:382) explain population as "the total set of persons of interest for the study". These economies had equal possibilities to be included in the research, however, samples were targeted based on geographical location, culture and economic history. Thus, the targeted sample was guided by the colonial past and natural resources endowment. The main former colonial powers in the SSA region were Belgium, Britain and Portugal. The public infrastructure in each former colony reflects the colonisers' attitudes and their long-term development plans at the time. For instance, the British

were credited with ‘functional’ public infrastructure planning in their colonies as they created a habitable environment in which they could live, whereas the Belgians invested as little as possible in public infrastructure services, making their infrastructure less functional for the rest of the population.

The sample selection also considered this reality since public infrastructure in the SSA region has not developed equally. For instance, in South Africa, industrialisation stemming from mining activities during apartheid helped the development of certain public infrastructure although this was limited to certain areas and access was restricted. The cities of Johannesburg and Kimberley, for instance, owe their existence and entire early development to the mines. By contrast, mining activities in Angola and the DRC did not have nearly the same effect. In Angola and Mozambique, infrastructure developments were centred around the colonial administrative centres and ports of Luanda and Maputo respectively and much of these were negatively impacted by war.

In choosing the samples from the population, these parameters were considered, and only three economies from the total of 46 countries were required by the study to answer the research question, being Angola, DRC and Ghana. The information to be measured will be the physical infrastructure components such as roads, electricity transmission lines, ICT and rail lines.

5.4.1 SAMPLING PROCEDURE AND SAMPLE SIZE

The research sampling followed a purposive selective sampling technique. The procedure focused on a sample of selected SSA countries based on the Vector Error Correction Model and case study. The quantitative econometric model used yearly data and the time frame covered 13 years (2005–2017). The data for the variables used in the econometric model was measured on a quarterly frequency. This sampling technique was convenient for this study since its approach saved time and allowed the research to be completed within a reasonable period.

5.5 LIMITATIONS

The research had a number of limitations and these included the sample size for the study, i.e. only three countries out of 46 countries were included for the research. The selected countries have missing data and it was difficult to access data from these countries due to poor data

recording by the central banks and government departments. Language was a factor, with information being in Portuguese and French in Angola and the DRC, respectively, while in English in Ghana.

The data quality for the proposed years was also a challenge especially for the quantitative part of the study. As a result, the study had to convert annual data into quarterly data to augment the existing data. The use of case studies also assisted in the research to support the quantitative analysis.

5.6 RESEARCH TECHNIQUE

The quantitative technique employs time series econometric techniques including unit root, Granger causality, impulse response function, cointegration and forecast error variance decompositions by using vector autoregression (VAR) framework. These tests are aimed at ensuring that the data is integrating and is of the same order.

Sheefeni (2015:919) explains the VAR as a "system of dynamic linear equations where all the variables in the system are treated as endogenous". This system allows the technique to give each variable an equation, which specifies each variable as a function of the lagged values of their own and all other variables in the system. The general vector autoregression process is described by a dynamic system whose structural form equation is given by:

$$A\Psi_{\tau} = \Psi + \Omega_1\psi_{\tau-1} + \Omega_2\Psi_{\tau-2} + + \Omega_{\pi}\psi_{\tau-\pi} + B\mu_{\tau}$$

where A is an invertible$^{(nxn)}$ matrix describing coexistent relations among the variables; Y_t is an (n x1) vector of endogenous variables such that; $y_t = (Y_{1t}, Y_{2t}, ..., Y_{nt})$; Ψ is a vector of constants; Ω_i is an (n x n) matrix of coefficients of lagged endogenous variables ($\forall\, t = 1,2,3,..., p$); B is an (n x n) matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system; and μ_t are uncorrelated or orthogonal white-noise structural disturbances i.e. the covariance matrix of μ_t is an identity matrix $(\mu_t, \mu'_t) = 1$

Based on the vector autoregression, the research first proceeds to conduct the unit root or stationarity test since time series data often displays trends and may not necessarily be stationary. In a case where the unit root test exhibits non-stationarity, this may suggest that

variance, covariance and mean are not constant over time and therefore the results may be spurious. Thus, the unit root test helps to determine if the regression model will be spurious or not to address the problem. The unit root test is tested with various methods that may include the Augmented Dickey-Fuller Test (ADF), the Johansen and Juselius technique and the Phillips-Perron test.

The second step will be a cointegration test to establish whether the variables will converge in the long run to some equilibrium or not. Thus, the Johansen cointegration test is applied to establish any cointegrated equations and this is achieved through the process of differencing of the VAR structure. The third step is the causality test which helps in understanding cause and effect relationships of variables to forecast, as argued by Granger (1969), by using twin factors of VAR to establish the relationship of variables. The VAR helps in establishing the impulse response analysis and forecast error variance decomposition. The impulse response function traces the response of endogenous variables to one standard deviation shock or examines the effect of shocks to the dependent variables. The sections that follow discuss the tests mentioned.

5.6.1 STATIONARITY

Stationarity tests are a process that assesses whether the statistical parameters (standard deviation and mean) are constant or not over time. Gujarati and Porter (2004) explain stationarity by stating the relevance of autocorrelation and the importance of stationarity process properties, which are dependent on the lag and do not change over time. Gujarati and Porter (2004) further suggest that the covariance values between the two periods are not dependent on the actual time at which covariance was computed but on the gap between times.

While affirming Gujarati and Porter's argument, Brooks (2008) explains that classical regression assumes that both dependent and independent variables are stationary and the errors should be zero mean and finite variance. Conducting stationarity data testing helps the researcher avoid the spurious regression problem and also determines if the series will have a strong influence on its behaviour and properties. Another test for the quantitative model is the Augmented Dickey-Fuller test. Harris (1992) and Gujarati and Porter (2004) explain that the order of integration is tested by using the Dickey-Fuller test. Thus, the stationarity of a time series can be tested with a unit root test. The Dickey-Fuller (DF) and the Augmented Dickey-

Fuller (ADF) are the most frequently used unit root tests. According to Gujarati and Porter (2004), the calculated value of ADF will then be compared with the critical value. For instance, if the value is higher than the significant value, the null hypothesis is rejected that the series has a unit root, and therefore confirms that the series is stationary.

The disadvantage of the Dickey-Fuller test, according to Harris (1992) and Gujarati and Porter (2004) is that most analyses of the Dickey-Fuller type tend to accept the null hypothesis of the unit root more frequently than is warranted. As a result, the test is weak to detect false null hypotheses, making it difficult to account for autocorrelation in the error term. As a result, a further non-stationarity unit root test in the form of the more comprehensive Phillips-Perron test was conducted. There is no difference in tests conducted with ADF tests, however, the Phillips-Perron test integrates an automatic correction to the DF procedure and this allows for autocorrelated residuals. According to Brooks (2008), the Phillips-Perron tests lead to similar conclusions as the ADF tests.

5.6.2 PAIR-WISE CORRELATION

Gujarati and Porter (2004) and Brooks (2008) describe pair-wise correlation as a matrix technique to establish the exact relationship between the variables used in the research. In this research, the pair-wise correlation will be conducted to establish relationships between the six variables used and this will be in the matrix format. The relationship will be conducted for each of the three countries included in the study.

5.6.3 COINTEGRATION TEST

Brooks (2008) argues that if two variables that are integrated at order one I(1) are linearly joined, then the combination should be incorporated into the order I(1). Gujarati and Porter (2004) explain the cointegration test as a technique that checks whether the variables are cointegrated or not. For instance, if the data series appear to move together over time, then it suggests that there is an equilibrium relationship that exists within the series. Cointegration can be tested in many ways, including the Engle-Granger approach which is residual-based, a bounds test for cointegration, and the Johansen and Juselius technique, which is based on maximum likelihood estimation on a Vector Auto Regression (VAR) system. The first two are applicable for a single equation modelling approach while the latter is applicable for the system of the equation modelling approach.

The Johansen and Juselius technique (1990) was conducted, which is based on maximum likelihood estimation on a VAR system test for a long-run equilibrium relationship. This technique was suitable for the study because of the involvement of VAR systems of equations and the advantage of the technique is that it allows the identification of all cointegration vectors within the given set of variables.

Stationarity of VAR was also conducted to attain stability for VAR model and this is modelled as VAR(1) $Yt = \mu + AYt{-}1 + \varepsilon t$

Thus, substituting backward

$Yt = \mu + AYt{-}1 + \varepsilon t$

$= \mu + A(\mu + AYt{-}2 + \varepsilon t{-}1) + \varepsilon t$

$= (I + A)\mu + A\ 2Yt{-}2 + A\varepsilon t{-}1 + \varepsilon t$

A VAR(1) will be stable if $\det(I - Az)\ 6{=}\ 0$ for $|z| \leq 1$ since stability requires that all the eigenvalues of A be smaller than one in absolute value. Thus, a condition for stationarity is that a stable VAR process should be stationary. Furthermore, the technique also involved the use of optimal lag length to estimate VAR and this was guided by the criteria of the variables.

5.6.4 DIAGNOSTIC TEST

The Diagnostic test determines the stochastic properties of the model. This test includes the heteroscedasticity residual normality test and Lagrange multiplier. Furthermore, the diagnostic tests were also be conducted on the estimated VAR as discussed below.

5.6.4.1 HETEROSCEDASTICITY

Heteroscedasticity can be conducted in different ways, as explained by Engle and Sheppard (2008), Muller and Stadtmuller (1987) and Brooks (2008). Brooks (2008) states that there are some formal statistical tests for heteroscedasticity, including the White test (1980). The White test is important as it has some assumptions that suggest that the regression model estimated is of the standard linear. The null hypothesis for the White test is homoscedasticity. If the research fails to reject the null hypothesis, then the research will have homoscedasticity. However, if the research rejects the null hypothesis, then the research will have heteroscedasticity.

5.6.4.2 RESIDUAL NORMALITY TEST

Brooks (2008) explains that one of the most commonly used tests to check normality in the data is the Jarque-Bera test. The Jarque-Bera test applies the property of a normally distributed random variable where the entire distribution is categorised by the first two moments (the mean and the variance). The Jarque-Bera test compares the third and fourth moments of residuals or measure of skewness and kurtosis. The measure of skewness indicates if the distribution degree is not symmetric about its mean value while the kurtosis measures how heavy the tails of the distribution are. The residual normality test makes a small sample correction to the transformed residuals before computing the Jarque-Bera statistic.

A significant Jarque-Bera statistic will point to non-normality in the residuals. However, the absence of normality in the residuals does not render cointegration tests invalid. Thus, the most critical matter in conducting the cointegration analysis is whether the residuals are uncorrelated and homoscedastic. The normality hypothesis test formally tests if the population the sample represents is normally distributed. Thus, the null hypothesis explains that the population is normally distributed, in contradiction to the alternative hypothesis that it is not normally distributed.

5.6.4.3 SERIAL CORRELATION

Other tests include the Lagrange Multiplier (LM) test, which is a multivariate test statistic for residual serial correlation up to the specified lag order. The LM statistic tests the null hypothesis with no serial correlation against an alternative of autocorrelated residuals.

5.6.5 IMPULSE RESPONSE ANALYSIS

The second-last test conducted was the impulse response analysis which shows the sign, magnitude and persistence of real and nominal shocks to the infrastructure investment. It should be noted that the shock to a variable in a VAR affects the variable while the shock also is transmitted to all other endogenous variables in the system through the dynamic structure of the VAR. Brooks (2008) suggests that the impulse response analysis should be used on the VECM, provided that the system is stable while allowing the shock to gradually fade away. The research will use the generalised impulse response approach for impulse response analysis because it is less sensitive when estimating the residual covariance matrix.

5.6.6 VARIANCE DECOMPOSITION

The last analysis is the variance decomposition to measure the proportion of forecast error variance in a variable that is explained by innovations and the other variables. Brooks (2008) suggests that the variance decompositions performed on the VECM provide the ratio of the movements in the dependent variables and this is due to their own shocks as compared to the shocks to other variables. Similar factorisation technique and information used in estimating impulse responses will be applied in the variance decompositions.

CHAPTER SIX: EMPIRICAL FINDINGS

6.1 INTRODUCTION

This chapter presents and interprets the results of the quantitative analysis to address the research objectives stated in chapter one. The empirical result for Angola is presented first, followed by that of DRC and Ghana. The results are presented in the following order: unit root, cointegration, diagnostic test, impulse response functions and forecast error variance decomposition.

6.2 EMPIRICAL RESULTS FOR ANGOLA

6.2.1 PAIR-WISE CORRELATION

The research adopted the pair-wise correlation matrix to establish the exact relationship between the six variables used in the research and this was done for each country included in the study. Results from the pair-wise correlation matrix are presented in Appendix B, Table 7.1.

From the pair-wise correlation results, all variables for the Angolan economy are correlating with the dependent variable D2INF_INV. For Angola, D2INF_INV and GFCFD2 are more highly correlated than other variables. The positive correlation shown by the variables in these economies is aligned with the theory that underpins the research.

6.2.2 UNIT ROOT TESTS

Based on the variables used by the research, the section conducts the graphical examination of the series for each variable before analysis. The examination process is to allow for the detection of any data capturing errors and verification of fundamental breaks that may bias the unit root tests for all three countries.

As explained in the research methodology section in chapter 5, the Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1981) and Phillips-Perron were used to identify the order of integration. ADF and PP tests were run and presented. However, the focus will be on the ADF test results since there was not much significant difference and these are discussed per country. Thus, all the variables for the three countries were tested for stationarity in all deterministic trend assumptions of constant, constant and trend. The research found that all the variables

have unit root in levels but become stationary only after second differencing for Angola and this is discussed in detail below.

Table 1 below shows the results of the Augmented Dickey-Fuller (ADF) test statistic for Angola. The results show that no variable is stationary in levels, meaning they are non-integrated at order zero and therefore not stationary.

Table 1. Unit root test for Angola

Variable	Model Specification	PP			ADF			Order of Integration
		Levels	1st Difference	2nd Difference	Levels	1st Difference	2nd Difference	
CPI	Intercept and trend	5.554	-0.818	-7.446	0.506	-0.854	-7.369	I(2)
EXD	Intercept and trend	-2.425	-3.146	-6.639	-0.843	-2.738	-6.670	I(2)
GDP	Intercept and trend	-0.233	-2.565	-6.609	-2.187	-1.580	-6.682	I(2)
GFCF	Intercept and trend	-0.902	-2.798	-6.557	-2.295	-2.607	-6.557	I(2)
INFRA	Intercept and trend	-1.963	-1.919	-6.613	-3.1600	-1.805	-6.613	I(2)
Critical Value	1 per cent			-4.170			-4.170	
	5 per cent			-3.510			-3.510	

Source: Author's computation using E-views.

Table 1 also shows that all the variables for Angola only attain unit root in levels as the value of the t-statistic is smaller than the critical Mackinnon values for all deterministic trend assumptions. Thus, after second differencing the t-statistics become more substantial or negative than the critical Mackinnon values for the rest of the deterministic trend assumptions. In summary, the research rejects the null hypothesis of the unit root and does not reject the alternative hypothesis of no unit root in the series. All the variables are accordingly integrated into the same order I(2).

6.2.2.2 SELECTION OF OPTIMAL LAG ORDER

The research expects that the optimum lag length will produce homoscedastic and uncorrelated residuals. All lags for Angola are considered and only lag length with robust diagnostics is selected.

Table 3. Optimal Lag Length for Angola

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4462.417	NA	1.560	194.2355	194.4343	194.3100
1	-3985.874	828.7706	4.680	174.6032	175.7958	175.0500
2	-3908.113	118.3327*	4.910*	172.3092*	174.4957*	173.1283*
3	-3897.681	13.60609	1.030	172.9427	176.1229	174.1340

Source: Author's computation using E-views

* indicates lag order selected by the criterion

6.2.2.3 COINTEGRATION

The existence of cointegration of variables means that the variables are integrating of the same order. The existence of cointegration also means the presence of a linear combination of at least one or more variables are integrating at order I(0). The results for the Johansen cointegration test based on trace and maximum eigenvalues test statics are presented in Table 4 and these are discussed to test for the existence of cointegration and the number of cointegration vectors based on Johansen's (1991) recommendations.

Table 4. Johansen cointegration test based on trace and maximum Eigen test: Angola

Hypothesised No. of CE(s)	Max-Eigen				Trace			
	Eigenvalue	Statistic	0.05 Critical Value	Prob.**	Eigenvalue	Statistic	0.05 Critical Value	Prob.**
None *	0.535796	35.30181	33.87687	0.0336	0.535796	94.03369	69.81889	0.0002
At most 1 *	0.445357	27.11383	27.58434	0.0573	0.445357	58.73187	47.85613	0.0034
At most 2 *	0.330783	18.47578	21.13162	0.1131	0.330783	31.61804	29.79707	0.0305
At most 3	0.199377	10.22882	14.26460	0.1973	0.199377	13.14227	15.49471	0.1097
At most 4	0.061372	2.913444	3.841466	0.0878	0.061372	2.913444	3.841466	0.0878
At most 5	0.535796	35.30181	33.87687	0.0336	0.535796	94.03369	69.81889	0.0002

Source: Author's compilation using E-views.

The maximum eigenvalue test in Table 4 reveals that the cointegrating equation exists at a 5 per cent significance level. In particular, there are three cointegrating equations at most since the calculated test statistics are greater than the critical values. Thus, in all cases, the calculated test statistic values were less than the critical value and therefore the null hypothesis of no cointegration was not rejected.

6.2.2.4 VECTOR ERROR CORRECTION MODEL (VECM)

The cointegration tests' results suggest that the research can use the VECM model. The research ran both long and short-run cointegration equations by using VECM.

The time series variables that are cointegrated with error-correlation representative should show a short-run corrections mechanism. The research demonstrates this below by way of exploring the relationship between short-run and long-run cointegration vector dynamics to determine the parameters of the error-correlation term implied by cointegrating vectors for infrastructure investment.

Appendix C 6.2.6 under Angola shows that EXD and CPI have positive long-run relationships with the dependent variable infrastructure investment while GFCF and GDP have negative relationship with the dependent variable. Furthermore, the error correction term is statistically

significant. The model also shows that, in the short run, there is positive relationship between GFCF and EXD with dependent variable while the GDP and CPI have negative relationship with the dependent variable. The variables also indicate that there is significant pressure on the economy to maintain stable interest and inflation rates in the long-run equilibrium whenever there is a disturbance, to gain infrastructure investment.

6.2.2.5 DIAGNOSTIC TEST

The infrastructure investment model for Angola was subjected to comprehensive diagnostics testing. The model was tested for normality, serial correlation, autoregressive conditional heteroscedasticity and stability on the infrastructure investment modelling to validate the parameter evaluation of the outcomes.

The test was also to detect any residuals problem from the estimated model that may make the model inefficient and also the estimated parameters biased. The test was carried out by subjecting the VAR model to a diagnostic test and these results are presented in the appendices. The results assist the research in testing for serial correlation, normality and heteroscedasticity and are based on the null hypothesis that explains that there is no serial correlation for the LM test, there is non-normality for the Jarque-Bera (J-B) test, and there is no heteroscedasticity.

6.2.2.6 HETEROSCEDASTICITY

The results from Appendix D, table E1 show that the test for heteroscedasticity when using the White test with no cross-terms produced a Chi-square of 421.426 with the probability of 0.000. Thus, the null hypothesis could not be rejected since there is no heteroscedasticity and the alternative hypothesis is that there is heteroscedasticity, showing that the residuals are homoscedastic.

6.2.2.7 NORMALITY TEST

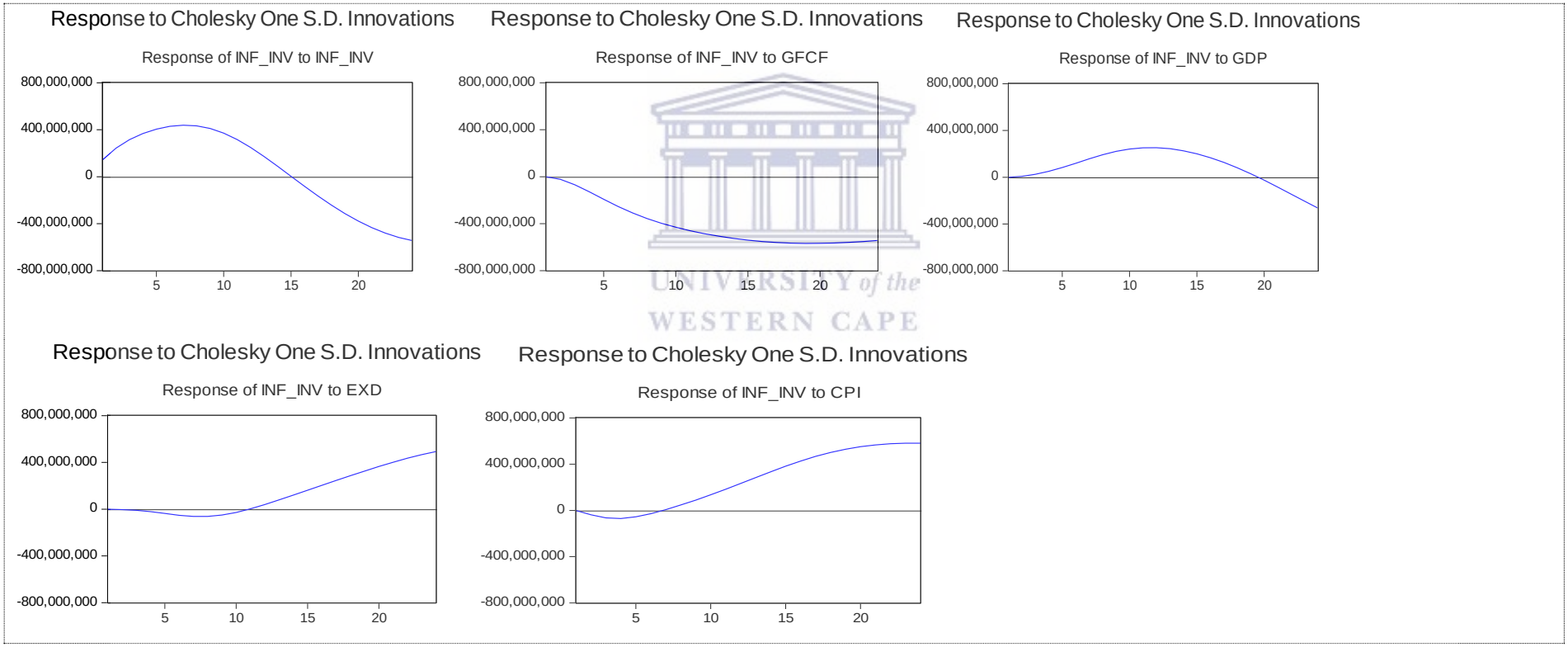
The research also carries out the residual normality test by using the J-B test. The results of the test presented in Appendix E, Table 7.16, for Angola show the J-B statistics and its probability to accept the null hypothesis at the 5 per cent level. The tests were conducted to show that the residuals are normally distributed and other tests included the Lagrange Multiplier (LM) test for the research not to reject the null hypothesis.

6.2.2.8 IMPULSE RESPONSE FUNCTIONS

The generalised impulse response functions trace out the responsiveness of the dependent variable in the VECM to shocks on each of the variables that are included in the model. The research applies a unit shock to the error for each equation and the effects upon the VECM system for 24 periods are noted.

Since the primary objective is to understand the macro and micro-economic factors that impact on infrastructure development within the SSA, the research traces out the responsiveness of the dependent variable, namely infrastructure investment. The impulse response results for the Angola economy are presented in Figure 3 below.

Figure 3: Generalised impulse response functions



Source: Author's compilation using Eviews.

The results for the infrastructure investment in Angola show how capital formation responds to shocks in the macroeconomic variables. Figure 3 shows the response of capital formation to infrastructure investment. The response of infrastructure investment to GDP is positive, reaching its peak around the 12th quarter, and then start declining. This is in line with the economic theory that during the expansion phase of the economy, capital formation tends to increase the amount of infrastructure as the country increases borrowing to expand, but this investment gets to a point where there is not much value added. The opposite applies when there is a recessionary cycle. The negative relationship between the two variables was also related in studies by Prasanna, Thenmozhi and Rana (2014) as well as Abduh (2014).

The response of infrastructure to increase in borrowing (external debt) is positive and has permanent effects. It can be argued that this is consistent with the economic theory that an increase in borrowing will also lead to an increase in infrastructure investment, resulting in better economic performance. The findings are similar to those of Abduh (2014). The impulse response functions for the Angolan economy show the dynamic reaction of infrastructure investment and the impulse response functions have the expected pattern and confirm the results of the short-run relationship analysis.

6.2.2.9 FORECAST ERROR VARIANCE DECOMPOSITION

Table 5 below shows the results of the forecast error variance decomposition for 24 quarters. The forecast error variance decomposition for infrastructure investment is mostly attributed to itself in the first three quarters with capital formation and inflation having an impact from quarter 18 and 24. Thus, capital formation increases its contribution to infrastructure investment, however as the investment in infrastructure is attained so is the increase in inflation in the economy.

Table 5. Variance Decomposition of Infrastructure Investment

Period	S.E.	INF_INV	GFCF	GDP	EXD	CPI
1	1.430	100.000	0.000	0.000	0.000	0.000
6	9.110	79.909	14.869	2.928	0.558	1.735
12	1.760	48.516	36.461	10.283	0.555	4.185
18	2.540	25.514	45.108	8.1141	3.848	17.415
24	3.550	22.678	37.804	5.253	10.277	23.987

Source: Author's compilation using E-views.

6.3 EMPIRICAL RESULTS FOR DRC

6.3.1 UNIT ROOT TEST

Similar to Angola, Table 6 shows the results of the Augmented Dickey-Fuller (ADF) test statistic for the DRC. The results show that no variable is stationary in levels, meaning they are non-integrated at order zero and therefore not stationary. The variables only became stationary after being differenced twice, meaning they are of the order of integration 2.

Table 6. Unit root test for DRC

Variable	Model Specification	PP			ADF			Order of Integration
		Levels	1st Difference	2nd Difference	Levels	1st Difference	2nd Difference	
CPI	Intercept and trend	-0.521	-2.499	-6.256	-1.897	-2.359	-6.256	I(2)
EXD	Intercept and trend	-1.866	-2.815	-6.569	-2.763	-2.626	-5.455	I(2)
GDP	Intercept and trend	-1.879	-1.752	-6.632	-2.455	-1.654	-6.633	I(2)
GFCF	Intercept and trend	-2.158	-2.912	-6.565	-1.273	-2.262	-6.063	I(2)
INFRA	Intercept and trend	-2.295	-3.037	-6.563	-3.746	-2.812	-6.563	I(2)
Critical Value	1 per cent			-4.170			-4.170	
	5 per cent			-3.511			-3.511	

Source: Author's computation using Eviews.

Table 6 also shows that all the variables for the DRC only attain unit root in levels as the value of t-statistic is smaller than the critical Mackinnon values for all deterministic trend assumptions. Thus, after second differencing, the t-statistics become more substantial or negative than the critical Mackinnon values for the rest of the deterministic trends assumptions. The research rejects the null hypothesis of the unit root and accepts the alternative hypothesis of no unit root in the series. All the variables are accordingly integrated into the same order I(2).

6.3.1.2 SELECTION OF OPTIMAL LAG ORDER

The research expects that the optimum lag length will produce homoscedastic and uncorrelated residuals. All lags for the DRC are considered and only lag length with robust diagnostics is selected.

Table 8. Lag length criteria for DRC

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3856.731	NA	5.020	183.8919	184.0988	183.9678
1	-3438.381	717.1703	3.720	165.1610	166.4022	165.6160
2	-3361.594	113.3528*	3.330*	162.6949*	164.9705*	163.5290*
3	-3347.527	17.41643	6.440	163.2156	166.5254	164.4287

Author's computation using E-views

* indicates lag order selected by the criterion.

Based on the information presented in Table 8 for the DRC, lag 2 is selected, therefore the research conducts the Johansen cointegration test under the assumption of a constant series and two lags for the VAR model.

6.3.1.3 COINTEGRATION

The existence of cointegration of variables means that the variables are integrating of the same order. The existence of cointegration also means the presence of a linear combination of at least one or more variables are integrating at the order I(0). The results for the Johansen cointegration test based on trace and maximum eigenvalues test statics are presented in Table 9 and these are discussed to test for the existence of cointegration and the number of cointegration vectors based on Johansen's (1991) recommendations.

Table 9. Johansen cointegration test based on trace and maximum Eigen test: DRC

Hypothesised No. of CE(s)	Max-Eigen				Trace			
	Eigenvalue	Statistic	0.05 Critical Value	Prob.**	Eigenvalue	Statistic	0.05 Critical Value	Prob.**
None *	0.677862	47.57661	33.87687	0.0007	0.677862	101.8359	69.81889	0.0000
At most 1 *	0.395421	21.13536	27.58434	0.2681	0.395421	54.25929	47.85613	0.0111
At most 2 *	0.337419	17.28774	21.13162	0.1589	0.337419	33.12393	29.79707	0.0200
At most 3 *	0.215319	10.18407	14.26460	0.2001	0.215319	15.83619	15.49471	0.0444
At most 4 *	0.125912	5.652122	3.841466	0.0174	0.125912	5.652122	3.841466	0.0174
At most 5 *	0.677862	47.57661	33.87687	0.0007	0.677862	101.8359	69.81889	0.0000

Source: Author's compilation using E-views.

The maximum eigenvalue test in Table 9 reveals that the cointegrating equation exists at a 5 per cent significance level. At most, cointegration vectors are rejected since the trace statistic is roughly more than the critical values at 5 per cent significance. Thus, in all cases, the calculated test statistic values were greater than the critical value and therefore the null hypothesis of no cointegration was rejected.

6.3.1.4 VECTOR ERROR CORRECTION MODEL (VECM)

The cointegration tests' results suggest that the research can use the VECM model. The research will run both long and short-run cointegration equations by using VECM.

The research expects that the time series variables that are cointegrated with error-correlation representative should show a short-run corrections mechanism. The research demonstrates this below by way of exploring the relationship between short-run and long-run cointegration vector dynamics to determine the parameters of the error-correlation term implied by cointegrating vectors for infrastructure investment in the DRC.

Appendix C 6.2.7 under DRC shows that EXD, GDP and CPI have positive long-run relationships with the dependent variable infrastructure investment while GFCF has negative relationship with the dependent variable. The model also shows that the error correction term

is statistically significant. Furthermore, the model shows that, in the short run, EXD has a positive relationship with dependent variable while the GDP, GFCF and CPI have negative relationship with the dependent variable. The variables also indicate that there is significant pressure on the economy to maintain stable interest and inflation rates in the long-run equilibrium whenever there is a disturbance, to gain infrastructure investment.

6.3.1.5 DIAGNOSTIC TEST

The infrastructure investment model for the DRC was subjected to comprehensive diagnostics testing. The model was tested for normality, serial correlation, autoregressive conditional heteroscedasticity and stability on the infrastructure investment modelling to validate the parameter evaluation of the outcomes.

The test was also run to detect any residuals problem from the estimated model that may make the model inefficient and also the estimated parameters biased. The test was carried out by subjecting the VAR model to diagnostic testing and these results are presented in the appendices. The results assisted the research in testing for serial correlation, normality and heteroscedasticity and are based on the null hypothesis that explains that there is no serial correlation for the LM test, there is non-normality for the J-B test, and there is no heteroscedasticity.

6..3.1.6 HETEROSCEDASTICITY

The results from Appendix D, table E2 show that the test for heteroscedasticity when using the White test with no cross-terms produced a Chi-square of 446.3588 with the probability of 0.000. Thus, the null hypothesis could not be rejected since there is no heteroscedasticity and the alternative hypothesis is that there is heteroscedasticity, showing that the residuals are homoscedastic.

6.3.1.7 NORMALITY TEST

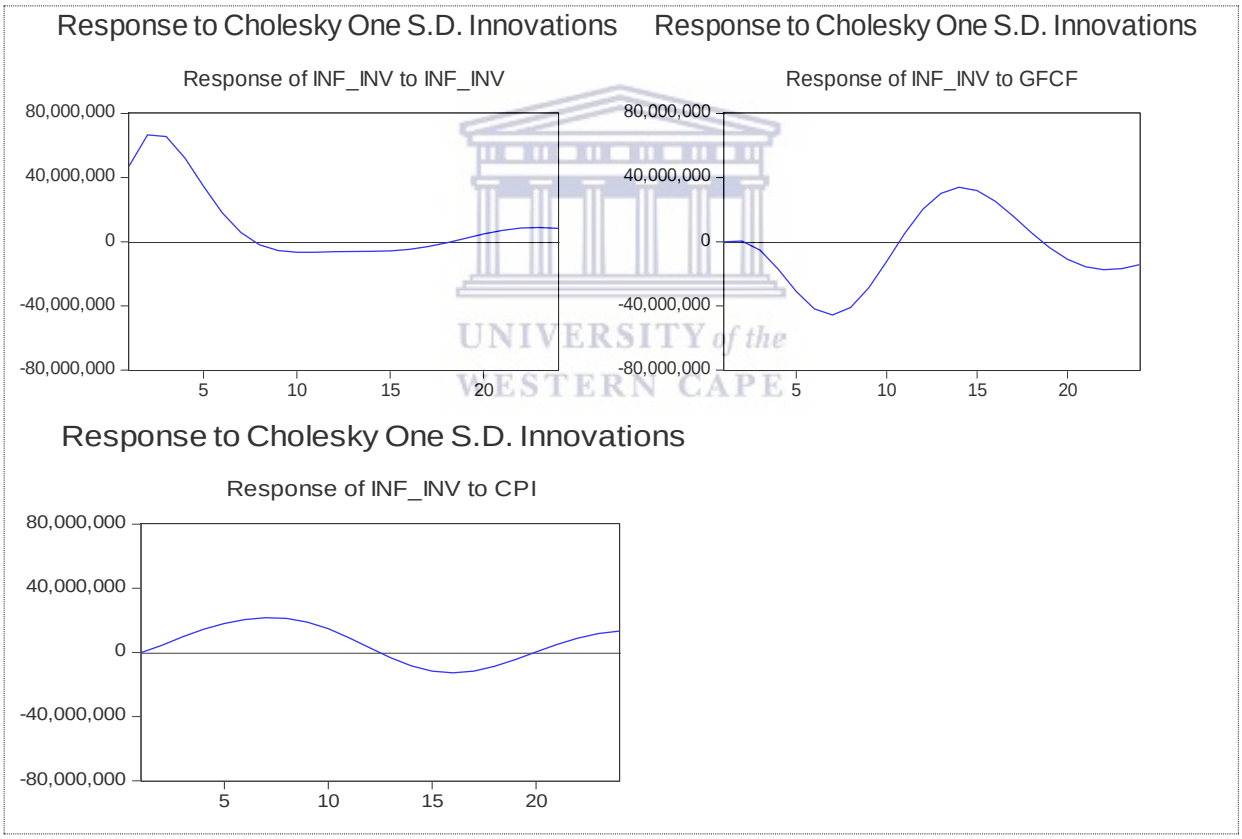
The research also carried out the residual normality test by using the J-B test. The results of the test presented in Table 7.17 in Appendix E for the DRC which show the J-B statistics and its probability to accept the null hypothesis at the 5 per cent level. The tests were run to show that the residuals are normally distributed and other tests included the LM test for the research not to reject the null hypothesis.

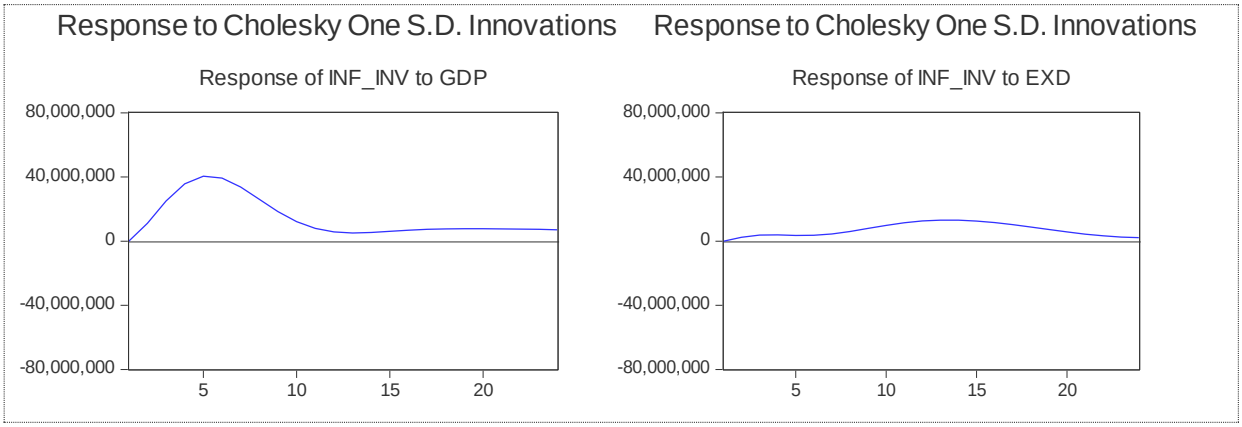
6.3.1.8 IMPULSE RESPONSE FUNCTIONS

The generalised impulse response functions trace out the responsiveness of the dependent variable in the VECM to shocks on each of the variables that are included in the model. The research applies a unit shock to the error for each equation and the effects upon the VECM system for 24 periods are noted.

Since the primary objective is to understand the macro and micro-economic factors that impact on infrastructure development within the SSA, the research traces out the responsiveness of the dependent variable, namely infrastructure investment. The impulse response results for the DRC economy are presented in Figure 4.

Figure 4: Generalised impulse response functions





Source: Author's compilation using E-views.

The results for the infrastructure investment for the DRC show how GDP responds to shocks in the macroeconomic variables and also towards infrastructure investment as indicated by Figure 4 above. The response of infrastructure investment to GDP peaks within 6th period and then gradually slows down but remains positive. This is in line with the economic theory that during the expansion phase of the economy, GDP growth tends to increase the amount of infrastructure as the country increases borrowing to expand but this investment gets to a point where there is not much value added. The opposite applies when there is a recessionary cycle. The negative relationship between the two variables was also be related to studies by Prasanna, Thenmozhi and Rana (2014) as well as Abduh (2014).

The response of infrastructure to shocks in capital formation is positive and permanent effects. This is consistent with the economic theory that an increase in capital formation will also lead to an increase in infrastructure investment, resulting in better economic performance and similar findings were observed by Abduh (2014). The impulse response functions for the DRC economy shows the dynamic reaction of infrastructure investment and have the expected pattern that confirms the results of the short-run relationship analysis.

6.3.1.9 FORECAST ERROR VARIANCE DECOMPOSITION

Table 10 shows the results of the forecast error variance decomposition for 24 quarters. The forecast error variance decomposition for infrastructure investment is attributed to itself in the first quarter until 18th quarter when capital formation and GDP start picking up. The contribution of GDP and capital formation continue until 24th quarter with 19,2 and 31,5

percentage contribution respectively. Thus, the more investment in infrastructure, the more the likelihood that the GDP and capital formation will continue to grow.

Table 10. Variance Decomposition of Infrastructure Investment

Period	S.E.	INF_INV	GFCF	GDP	EXD	CPI
1	46969284	100.000	0.000	0.000	0.000	0.000
6	1.570	61.825	12.364	21.209	0.2483	4.354
12	1.860	44.651	23.913	22.082	1.6441	7.709
18	2.000	38.571	30.406	19.531	3.4255	8.066
24	2.060	37.117	31.464	19.234	3.5316	8.653

Source: Author's compilation using E-views.

6.4 EMPIRICAL RESULTS FOR GHANA

6.4.1 UNIT ROOT TEST

Similar to the DRC, Table 11 shows the results of the Augmented Dickey-Fuller (ADF) test statistic for Ghana. The results show that no variable is stationary in levels, meaning they are non-integrated at order zero and therefore not stationary. The variables only became stationary after being differenced twice, meaning they are of the order of integration 2.

Table 11. Unit root test for Ghana

Variable	Model Specification	PP			ADF			Order of Integration
		Levels	1st Difference	2nd Difference			Levels	1st Difference
CPI	Intercept and trend	1.146	-1.777	-6.803	-1.151	-1.758	-6.802	I(2)
EXD	Intercept and trend	-4.894	-2.515	-7.055	-1.739	-1.235	-8.261	I(2)
GDP	Intercept and trend	-1.963	-1.919	-6.613	-3.160	-1.805	-6.613	I(2)
GFCF	Intercept and trend	-1.533	-2.492	-6.587	-2.472	-2.302	-6.587	I(2)
INFRA	Intercept and trend	-2.248	-3.148	-6.648	-2.543	--3.065	-6.648	I(2)
Critical Value	1 per cent			-4.170			-4.186	
	5 per cent			-3.511			-3.518	

Source: Author's computation using E-views 9.5 Econometric Software.

As it was the case with Angola and the DRC, table 11 also shows that all the variables for Ghana only attain unit root in levels as the value of t-statistic is smaller than the critical Mackinnon values for all deterministic trend assumptions. Thus, after second differencing, the t-statistics become more substantial or negative than the critical Mackinnon values for the rest of the deterministic trends assumptions. In summary, the research rejects the null hypothesis of the unit root and accepts the alternative hypothesis of no unit root in the series. All the variables are accordingly integrated into the same order I(2).

6.4.1.2 SELECTION OF OPTIMAL LAG ORDER

The research expects that the optimum lag length will produce homoscedastic and uncorrelated residuals. All lags for Ghana are considered and only lag length with robust diagnostics is selected.

Table 13. Lag length criteria for Ghana

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4333.733	NA	5.800	188.6406	188.8393	188.7150
1	-3866.164	813.1637	2.570	169.3984	170.5910	169.8452
2	-3784.128	124.8369*	2.240*	166.9186*	169.1050*	167.7377*
3	-3768.366	20.55970	3.710	167.3202	170.5005	168.5116

Source: Author's compilation from E-views.

* indicates lag order selected by the criterion.

Based on the information presented in Table 13 for Ghana, lag 2 is selected, therefore the research conducts the Johansen cointegration test under the assumption of a constant series and two lags for the VAR model.

6.4.1.3 COINTEGRATION

The maximum eigenvalue test in Table 14 reveals that the cointegrating equation exists at a 5 per cent significance level. At most, cointegration vectors are rejected since the trace statistic is roughly more than the critical values at 5 per cent significance. Thus, in all cases, the calculated test statistic values were less than the critical value and therefore the null hypothesis of no cointegration was not rejected.

Table 14. Johansen cointegration test based on trace and maximum Eigen test: Ghana

Hypothesised No. of CE(s)	Max-Eigen				Trace			
	Eigenvalue	Statistic	0.05 Critical Value	Prob.**	Eigenvalue	Statistic	0.05 Critical Value	Prob.**
None *	0.629190	45.63497	33.87687	0.0013	0.629190	111.1397	69.81889	0.0000
At most 1 *	0.440036	26.67458	27.58434	0.0650	0.440036	65.50472	47.85613	0.0005
At most 2 *	0.390956	22.80976	21.13162	0.0288	0.390956	38.83014	29.79707	0.0035
At most 3 *	0.177228	8.973511	14.26460	0.2884	0.177228	16.02038	15.49471	0.0417
At most 4	0.142036	7.046868	3.841466	0.0079	0.142036	7.046868	3.841466	0.0079
At most 5	0.629190	45.63497	33.87687	0.0013	0.629190	111.1397	69.81889	0.0000

Source: Author's compilation using E-views.

6.4.1.4 VECTOR ERROR CORRECTION MODEL (VECM)

The cointegration tests' results suggest that the research can use the VECM model. The research will run both long and short-run cointegration equations by using VECM.

The research expects that the time series variables that are cointegrated with error-correlation representative should show a short-run corrections mechanism. The research demonstrates this below by way of exploring the relationship between short-run and long-run cointegration vector dynamics to determine the parameters of the error-correlation term implied by cointegrating vectors for infrastructure investment in Ghana.

Appendix C 6.2.8 under Ghana shows that GFCF and CPI have positive long-run relationships with the dependent variable infrastructure investment while EXD and GDP have negative relationship with the dependent variable. The model also shows that the error correction term is statistically significant. Furthermore, the model shows that, in the short run is positive relationship between GFCF, CPI and EXD with the dependent variable while the GDP has negative relationship with the dependent variable. The variables also indicate that there is significant pressure on the economy to maintain stable interest and inflation rates in the long-run equilibrium whenever there is a disturbance, to gain infrastructure investment.

6.4.1.5 DIAGNOSTIC TEST

The infrastructure investment model for Ghana was subjected to comprehensive diagnostics testing. The model was tested for normality, serial correlation, autoregressive conditional heteroscedasticity and stability on the infrastructure investment modelling to validate the parameter evaluation of the outcomes.

The test was also run to detect any residuals problem from the estimated model that may make the model inefficient and also the estimated parameters biased. The test was carried out by subjecting the VAR model to diagnostic testing and these results are presented in the appendices. The results assist the research in testing for serial correlation, normality and heteroscedasticity and are based on the null hypothesis that explains that there is no serial correlation for the LM test, there is non-normality for the J-B test, and there is no heteroscedasticity.

6.4.1.6 HETEROSCEDASTICITY

The results from Appendix D, table E3 show that the test for heteroscedasticity when using the White test with no cross-terms produced a Chi-square of 272.0829 with the probability of 0.9912. Thus, the null hypothesis could not be rejected since there is no heteroscedasticity and the alternative hypothesis is that there is heteroscedasticity, showing that the residuals are homoscedastic.

6.4.1.7 NORMALITY TEST

The research also carries out the residual normality test by using the J-B test. The results of the test presented in Table 7.18 in Appendix E for Ghana which show the J-B statistics and its probability to accept the null hypothesis at the 5 per cent level. The tests were run to show that the residuals are normally distributed and other tests included the LM test for the research not to reject the null hypothesis.

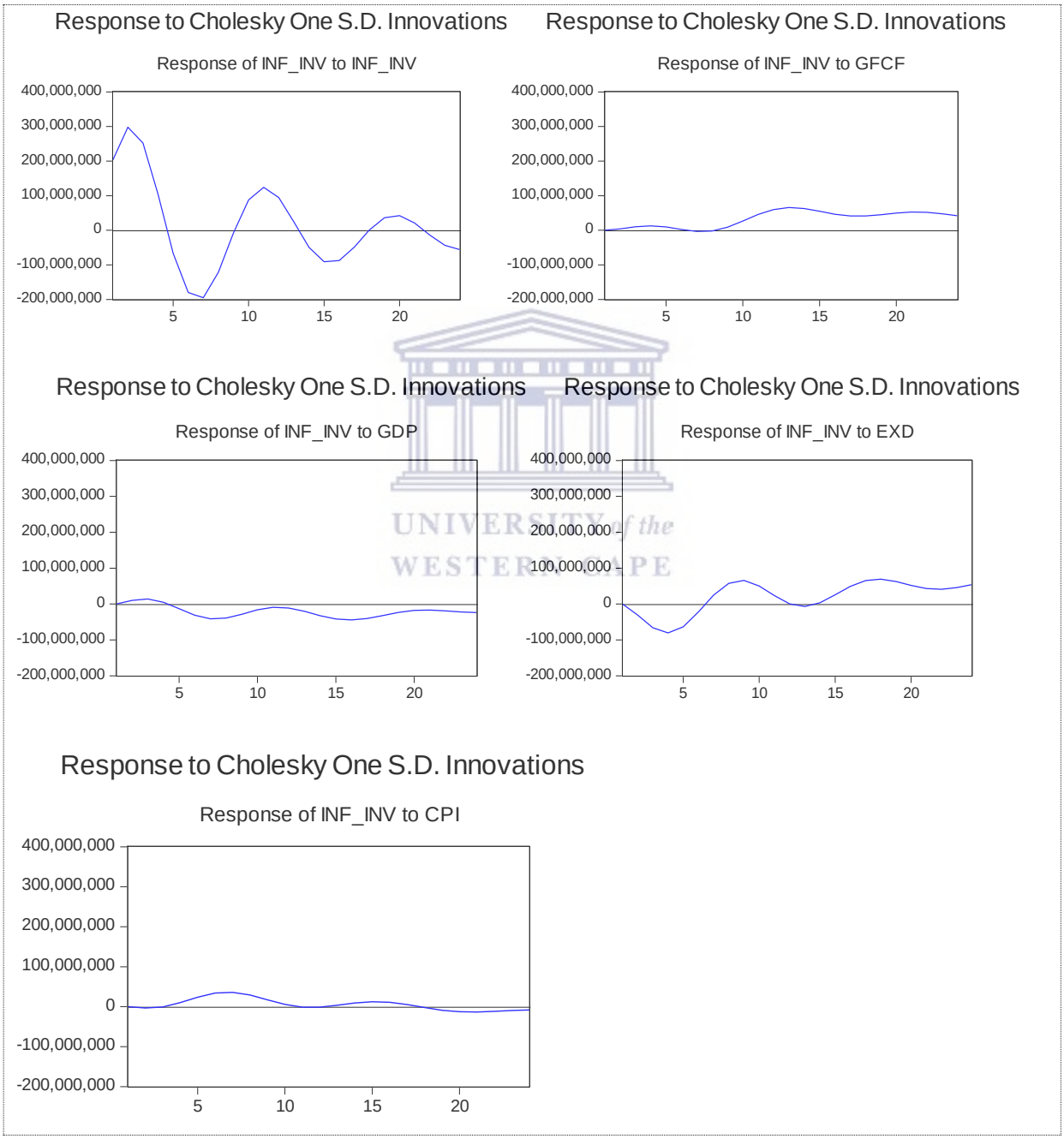
6.4.1.8 IMPULSE RESPONSE FUNCTIONS

The generalised impulse response functions trace out the responsiveness of the dependent variable in the VECM to shocks on each of the variables that are included in the model. The

research applies a unit shock to the error for each equation and the effects upon the VECM system for 24 periods are noted.

Since the primary objective is to understand the macro and micro-economic factors that impact infrastructure development within the SSA, the research traces out the responsiveness of the dependent variable, namely infrastructure investment. The impulse response results for Ghana's economy are presented in Figure 5.

Figure 5: Generalised impulse response functions



Source: Author's compilation using E-views.

The results for the infrastructure investment for Ghana show how capital formation responds to shocks in the macroeconomic variables and also towards infrastructure investment as indicated by Figure 5 above. The response of infrastructure investment to capital formation or investment flows peaks at 12th intervals and gradually remains positive. This is in line with the economic theory that during the expansion phase of the economy, capital formation tends to increase the amount of infrastructure as the country increases borrowing to expand but this investment gets to a point where there is not much value added. The opposite applies when there is a recessionary cycle. The negative relationship between the two variables was also be related to studies by Prasanna, Thenmozhi and Rana (2014) as well as Abduh (2014).

The response of infrastructure to shocks in capital formation is positive and has permanent effects. It can be argued that this is consistent with the economic theory that an increase in capital formation will also lead to an increase in infrastructure investment, resulting in better economic performance and similar findings were observed by Abduh (2014). The impulse response functions for Ghana's economy show the dynamic reaction of infrastructure investment and have the expected pattern that confirms the results of the short-run relationship analysis.

6.4.1.9 FORECAST ERROR VARIANCE DECOMPOSITION

Table 15 shows the results of the forecast error variance decomposition for 24 quarters. The forecast error variance decomposition for infrastructure investment is mostly attributed to itself. However, capital formation and GDP contributions start picking from period 12 and continues until period 24 although moderately. Thus, GDP and fixed capital formation play an important role in infrastructure investment or infrastructure investment plays an important role in GDP growth and capital formation.

Table 15. Variance Decomposition of Infrastructure Investment

Period	S.E.	INF_INV	GFCF	GDP	EXD	CPI
1	2.020	100.000	0.000	0.000	0.000	0.000
6	4.960	92.873	3.2887	2.8827	0.2697	0.685
12	6.040	88.081	3.4745	4.8796	0.6680	2.896
18	6.270	85.709	5.3881	5.1325	0.7042	3.066

24	6.370	84.784	5.2976	6.0596	0.7909	3.067

Source: Author's compilation using E-views.

CHAPTER SEVEN: CASE STUDY RESEARCH FINDINGS

7.1 INTRODUCTION

The case study findings for the research focus on infrastructure services such as transportation, energy and ICT for the SSA region. These infrastructure services are important as they are the backbone of economic activities and trade. The chapter includes a discussion of the economic outlook of the selected economies, special economic zones and mega-infrastructure projects. The case studies of the three economies analysed similar factors to ascertain if there were particular patterns in the selected countries' infrastructure services that would assist in identifying issues that could be used to answer the research question and address the objectives of the study.

The case study findings augment the findings of the quantitative analysis method employed, where a Vector Error Correction Model was used and presented in Chapter 6. Although the quantitative econometric model used yearly data (2005–2017), the case studies are not similarly limited as many of the important events happened outside the 13-year period. Thus, aspects of the economic history of the countries selected are also highlighted to contextualise the importance of infrastructure investment and the roles played by infrastructure services.

7.1.1 ANGOLA ECONOMIC OUTLOOK

During the colonial era, no major infrastructure investment was undertaken and the end of colonialism did not change the infrastructure spending pattern in the country due to limited resources and the protracted civil war that began in 1975 and ended in 2002. Carciotto (2014) states that the internal migration instigated by the civil war put pressure on existing infrastructure in urban areas with Luanda's population increasing from less than 500 000 to a height of over 5 million people. Angola was deprived of public infrastructure services because resources were directed to finance the civil war and infrastructure frequently destroyed or damaged in military actions. Although there is no reliable data for the period, the civil war also kept FDI low, denying the country the opportunity to fully exploit its natural resources in agriculture, mining, oil and water.

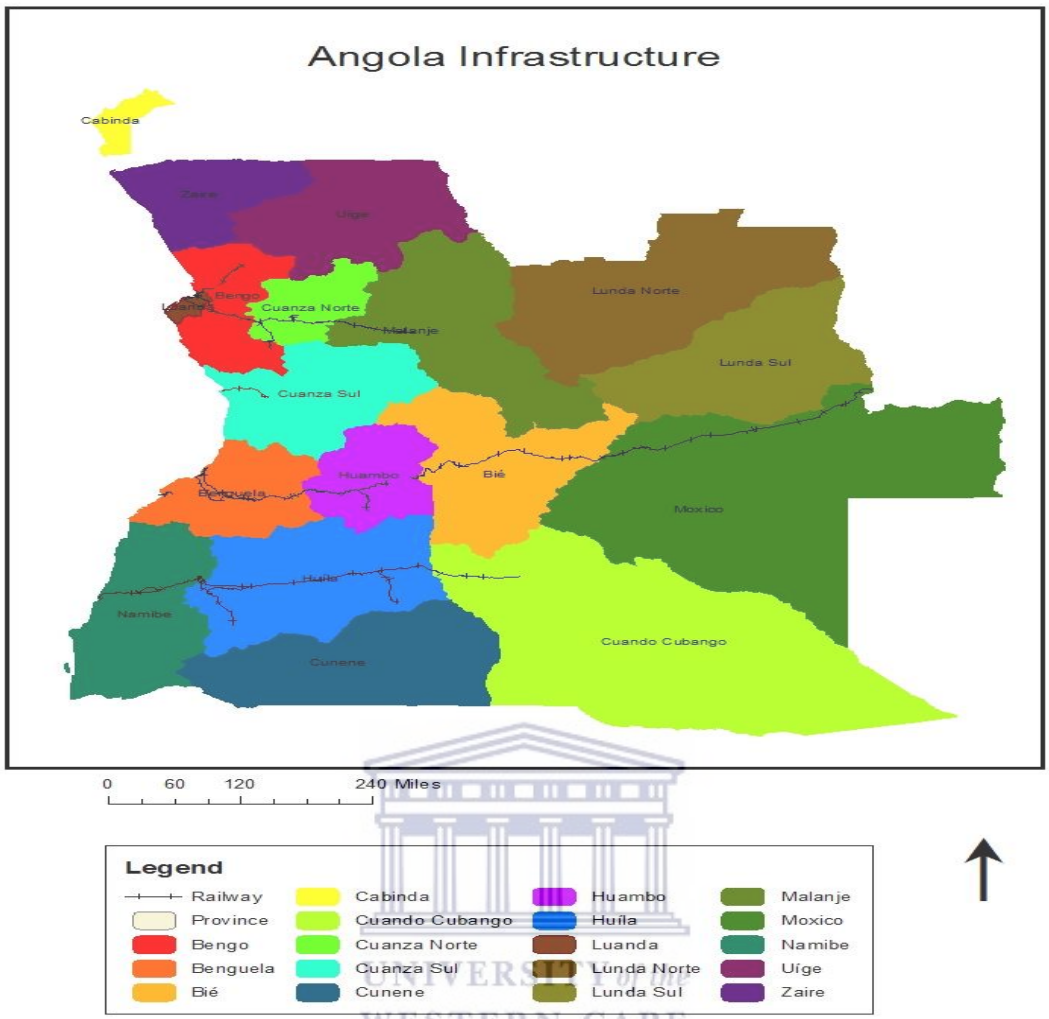
Post-civil war, the country has experienced good economic growth although the standard of living for Angolans remains low with a skewed distribution of wealth according to Banerjee, Deaton and Duflo (2016) and Hamilton, Helliwell, and Woolcock (2016). The cost of living is high, with only a small section of the population, particularly the politically connected elite, having benefitted from better economic growth. The lack of infrastructure development has negatively affected the country's economic and social development as explained in the sections that follow.

7.1.2 INFRASTRUCTURE SERVICES IN ANGOLA

After the end of the civil war, Angola started slowly rebuilding its public infrastructure. The reconstruction is being undertaken with the assistance of mainly Chinese investment, especially in the construction of rail and road infrastructure to connect mainly mining towns while other infrastructure such as rail connects the hinterland of Angola to the sea port in the west.

The road infrastructure connects Luanda and Windhoek in Namibia (1,580 km). Angola also has a rail infrastructure network that connects the country to Zambia and the DRC giving the landlocked countries access to Angola's Atlantic Ocean ports and enabling them to import and export goods via Angola. This network is shown on the infrastructure routes below.

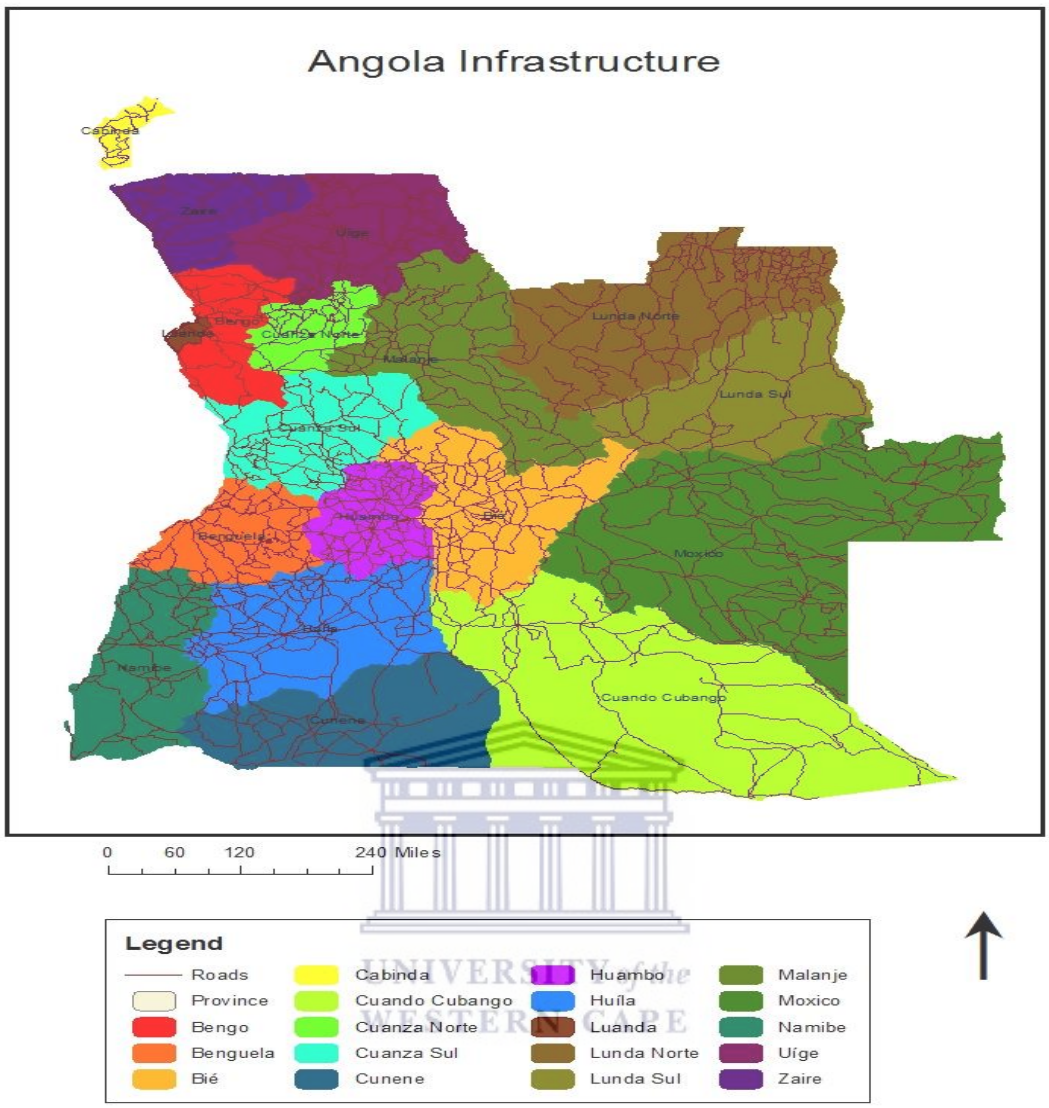
Figure 6: Angola Rail Infrastructure



Source: Author's GIS Mapping (2019).

Figure 6 above shows that the rail infrastructure is not widely spread in Angola and the lack of rail infrastructure is a barrier to trade and economic efficiency for a country that is largely rural but with vast potential in the agriculture and mining sectors. Similarly, Figure 7 below shows that the road networks in Angola require development with no major routes joining the provinces. The Angolan road network is largely composed of gravel roads and, while there are concerted efforts to upgrade the road networks after years of war, the process is protracted due to the country's dependence on foreign skills and oil revenue to finance upgrading and new construction.

Figure 7: Angola road infrastructure



Source: Author's GIS Mapping (2019).

Although the country is strategically located, Angola's main economic sectors have not yet reached their full potential within the regional economy since most of the infrastructure is still underdeveloped. As mentioned, Angola is endowed with mineral resources with good rainfall. The government largely relied on oil as a source of revenue while the mining activities were in the hands of UNITA, which financed a large part of its operations through the illicit sale of conflict diamonds. In recent years, the country has been able to access all its resources to finance the reconstruction programme, although the mining sector has not been fully exploited. The mining and oil sectors contribute most of the country's GDP while industrial and manufacturing activity is lagging, although there has been a push to develop it, reflected in the

table below. Table 16 also shows the contribution of the agriculture and services sectors to economic growth in Angola, which further emphasises the dominance in the GDP of oil and mining.

Table 16. Percentage Real Growth Rate Comparison

GDP growth rate (per cent)	2004	2010	2017	Average Annual
Composition by Sector				
Manufacturing Industry	13.5	10.7	-1.0	7.7
Agriculture	8	5.4	-4.5	2.97
Services	9	4.7	-4.6	2.7
ANGOLA (GDP)	10.2	5.2	-2.5	4.3
SOUTHERN AFRICA REGION	5.3	4.4	2.3	4
SUB-SAHARAN AFRICA	4.13	2.561	0.356	2.35

Source: OECD and SADC Selected Economic and Social Indicators and World Bank (2018c).

Angola experienced an increase in oil production after the war, resulting in an average growth rate of over 15 per cent between 2003 and 2008 according to Da Rocha (2012:2). The growth rate was supported by high oil prices during the period and also post-war stability in Angola. This stability allowed the displaced population to resettle. For example, the post-war population of Luanda declined considerably and presently numbers about 2,6 million. A boom in the construction and agricultural sectors also followed the war. The construction industry was given a boost when foreign countries committed funding to rebuild infrastructure in Angola. China concluded agreements with Angola for the construction of infrastructure in Luanda in exchange for oil and gas.

Chuhan-Pole et al. (2018) state that government revenues are largely dependent on oil, making the economy vulnerable to oil price fluctuation which contributed to Angolan oil revenues declining at an average of 51 per cent between 2014 and 2017. Despite the recent slowing of economic growth in Angola due to a slump in the global oil price, which has affected most of the construction projects adversely and increased the accumulation of foreign debt, the country remains committed to rebuilding the infrastructure.

Nevertheless, according to Chuhan-Pole et al. (2018), Capital (2019) and Makate, Mahonye and Mandishara (2018), total government expenditure fell 44.8 per cent between 2014 and 2017, leading to a budget deficit of 5.7 per cent of GDP. The budget deficit was in the main not dominated by capital expenditure but related to compensations to the social sector, employees and goods and services. As a result of Angola's attempts to finance the deficits, public debt increased from 65.4 per cent to 71.5 per cent between 2015 and 2016 (Makate et al., 2018). Angola's economy has failed to meet the SADC's specific economic indicators for inflation, deficits and public debt as indicated in Table 17. Indeed, Angola has never met the inflation targets set by the SADC.

Table 17: Primary Macroeconomic Convergence Indicators

	2015	2016	2017
Inflation (3–7 per cent)	14.3	41.1	29.8
Fiscal Deficit (3 per cent of GDP)	4.9	5.4	5.4
Public Debt (60 per cent of GDP)	64.2	75.3	64.6
GDP (7 per cent)	0.9	-2.6	-2.5

Source: SADC economic targets indicators and IMF economic data (2018).

The IMF economic outlook data (2018) shows that the country's public debt remains above 60 per cent of the GDP with no signs that this may be reversed in the short to medium term. The increase in Angola public debt is mainly a consequence of skewed economic activities overly reliant on oil revenue.

This dependency leaves the economy highly vulnerable to fluctuation in the international oil price and demand since, as a member of the Organisation of the Petroleum Exporting Countries (OPEC), the country cannot increase prices or produce more than the production target set by OPEC. Angola has had to borrow more whenever the oil price declined to close the budget deficit and support government spending, including on capital projects for the construction of roads, rail and urban renewal infrastructure. The struggle to balance the demand for infrastructure investment and social investment with Angola's economic performance is exacerbated by the limited resources, corruption and poor governance as outlined below.

7.1.3 PRIMARY ECONOMY

The primary economy in Angola is dominated by oil and gas, the main sources of revenue for the country, although the country is also well endowed in mineral reserves, arable land, forestry and fishing. Sectors such as agriculture and fishing remain predominantly subsistence-based while mining and forestry suffer the effects of neglect and underdevelopment. The World Bank (2018a) forecasted the value of primary products to remain unsteady based on the continuous contraction of the agricultural sector that reached a low of 4 per cent in 2017 and low demand for primary goods such as diamonds. The World Bank (2018a) argues that the country has not exploited more than 40 per cent of its mineral resources and therefore there is huge potential to grow the primary economy. The lack of growth in the agricultural sector compared to the mining sector is exacerbated by the absence of public infrastructure and lack of investment in road, rail and telecommunication infrastructure in rural areas. Table 18 shows the GDP growth rate and the value added by the primary economy to GDP in Angola for the 2007–2017 period.

Table 18. GDP Growth Rate and the Percentage of Primary Economy Value Added

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	14.01	11.17	0.86	4.86	3.47	8.54	4.95	4.82	0.94	-2.58	-0.15
Agriculture, value added (per cent of GDP)	5.24	4.81	6.62	6.18	5.85	6.07	6.51	7.55	9.12	9.83	10.02
Natural resources rents (per cent of GDP)	47.48	56.61	31.75	39.00	39.89	35.68	30.47	23.38	10.80	10.75	16.35

Source: World Bank (2018a).

The underdevelopment in public infrastructure has also resulted in Angola's failure to exploit adequately its vast mineral deposits that are often located in rural and remote areas. Angola's main exploitable primary products are listed in Table 19:

Table 19. Sub-sector Classifications and Related Products

Sub-sector	Product(s)
Mining	Diamonds, iron, manganese, copper, gold, phosphates, granite, marble, uranium, quartz, lead, zinc, wolfram, tin, fluorite, sulphur, feldspar, kaolin, mica, asphalt, gypsum, oil and talc
Agriculture	Fishing, livestock, coffee, maize, sisal, bananas, tobacco, sugarcane, cassava, timber

Source: World Bank. (2018a).

The primary sector is responsible for over 70 per cent of the country's revenue due to the influence of oil which contributes over 50 per cent of the revenue in the country. Angola's agricultural fundamentals – fertile land, abundant water, a global market for food crops and biofuel – are highly conducive to commercial farming but very few commercial activities exist despite the agricultural sector being the main employer in Angola, mainly through subsistence farming. Part of the problem relates to lack of expertise in industrial farming and agro-processing but the lack of infrastructure in transportation and storage also has a large role in preventing access to potential markets and Angola from becoming a large-scale exporter of agricultural products.

While the agricultural sector is the core employer in Angola in terms of numbers, the mining sector is at the core of Angola's economic development given the revenue it generates for the country, which has funded much of the public infrastructure rebuilt after years of civil war. The revenue from the mining sector has allowed the country to implement major infrastructure projects, especially in Luanda, in addition to the oil for infrastructure programme with China. However, few projects have taken place outside Luanda, especially in rural areas. Escobal and Ponce (2003) explain the importance of initiatives to develop rural infrastructure and how this can enhance income in rural areas and assist the development of the agricultural sector.
In essence, Angola has not supported the primary economy enough with public infrastructure services and the investments in the oil and mining sectors have not impacted significantly on public infrastructure provision in the rural areas of the country.

7.1.4 SECONDARY ECONOMY

The secondary economy is largely dominated by energy generation within the manufacturing sector with very little industrial activity taking place in Angola outside of oil and mining. Energy generation plays a significant role in influencing the GDP in Angola as shown in Table 20 below.

Table 20. GDP Growth Rate and the Percentage of Manufacturing Value Added

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	14,01	11,17	0,86	4,86	3,47	8,54	4,95	4,82	0,94	-2,58	-0,15
Manufacturing	3,40	3,46	5,11	4,54	4,17	4,40	4,83	4,76	5,69	6,75	6,58

Source: World Bank.

7.1.5 TERTIARY ECONOMY

The tertiary economy in Angola consists mainly of the banking and telecommunication sectors. The performance of the tertiary economy in Angola is robust compared to most economies in SSA, with the banking sector being the third-largest in SSA after Nigeria and South Africa (National Bank of Angola, 2017; World Bank, 2017). The World Bank further forecasts Angolan credit growth to moderate although positive in the short term with the development of the services sector less supported due to the country's dependence on oil revenues.

Table 21. GDP Growth Rate and the Percentage of Services Economy Value Added

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	14.01	11.17	0.86	4.86	3.47	8.54	4.95	4.82	0.94	-2.58	-0.15
Services	5.60	12.92	8.97	6.64	10.52	5.66	7.74	10.08	-4.84	-5.24	1.48

Source: World Bank.

Table 21 above indicates that the services sector's contribution to GDP averaged 5.41 per cent over the 2007–2017 period, although in recent years (2015–2017), the sector has been struggling. The services sector performance is largely linked to the performance of natural resources such as oil and diamonds which have underperformed in the three years ending 2017.

The lack of competition in the services sector has also become challenging. For instance, Angola has nearly thirty licensed banks but five banks control over 80 per cent of the market share in Angola, being Banco Angolano de Investimentos (BAI), Banco Economico, Banco de Fomento Angola (BFA), Banco BIC Angola (BIC) and Banco de Poupança e Crédito S.A.R.L. These banks have had a long history in Angola as they became more established after the end of the civil war. The robust performance of Angola's banking sector has not translated significantly into better GDP for the country. The banking sector has also not played a significant role in the financing of public infrastructure despite the opportunities to participate in the development of infrastructure in Angola, other than the investment in energy infrastructure in 2009.

Restructuring the economy of Angola is predicated on identifying sub-sectors within the primary economy that can transition into the secondary and tertiary economies. The identified

sub-sectors would also help in informing the planning and structure of the special economic zones that Angola could embark on in addition to the current Special Economic Zones (SEZ) discussed below.

7.1.6 SPECIAL ECONOMIC ZONES, INDUSTRIAL PARKS AND PORTS

The notion of a special economic zone (SEZ) is to concentrate resources to stimulate economic diversification or development in specific industries, attracting investment through special funding vehicles, relaxing regulations and providing tax and other incentives, particularly to encourage FDI. A functional SEZ, Luanda-Bengo SEZ (ZEELB), was built on the outskirts of Luanda with the assistance of Chinese investment and is aimed at rationalising resources and stimulating diversification in the economy, which is currently oil and diamond dependent. At its full capacity, the economic zone will process mineral resources such as aluminium to reduce the country's dependency on imports. The ZEELB has largely been financed through credit lines from China although the amount has not been disclosed. The credit line from China carried conditions – including Chinese companies' rights to supply infrastructure such as electricity, road access, customs clearance, supply labour and administrative support – and tax incentives. The government of Angola has only developed three SEZs, the ZEELB outside the capital city, Luanda, and the ports of Dande and Namibe, as depicted in Table 22.

Table 22. Economic Zones

Zones	Activities
Port of Dande	Transport logistics and food industries.
Namibe Port Concession	Transport logistics and food industries.
Luanda-Bengo SEZ	Agro-processing, heavy and manufacturing and others.

Source: National Bank of Angola.

The investment upgrade of the ports infrastructure as part of the SEZs is aimed at increasing sea freight volumes that will facilitate transportation of goods, including shipping containers for neighbouring countries such as the DRC, and also for Angola.

The construction of the Angolan SEZs, which included supplying engineering, metal containers, electroplating and metal pavilions, manufacturing and agribusiness among others, benefitted Chinese investors more than Angolans since almost all were sourced from China. However, the SEZs in Angola are expected to positively influence the developmental trajectory of Angola's economy beyond oil and mining sector. The lack of an adequate and reliable power

supply in Angola is making it difficult for companies to be attracted to operate in the SEZs. The SEZs are also threatened by the risk of corruption, which is already characteristic of the ports, and has led the government to consider running the SEZs in partnership with private sector shareholders.

7.1.7 MEGA-INFRASTRUCTURE PROJECTS IN ANGOLA

Angola has a few mega-projects that are in various stages of development. Table 23 below outlines the major projects in Angola, which are mainly in transportation infrastructure services. The main projects for Angola include the SEZs.

Table 23. Major Projects in Angola

Project Investment	Project Status Comment
Port of Dande SEZ	Planned
Namibe Port Concession SEZ	Under construction
Luanda-Bengo (ZEELB) SEZ	Under construction, operational
Caculo Cabaca hydropower	Constructed

Source: World Bank.

The mega-projects that Angola has proposed or are under construction are concentrated in Luanda and do not address the infrastructure challenges facing the country enough. The slump in the oil price has adversely affected the construction of the Namibe and ZEELB projects as they are dependent on oil revenue for funding their public infrastructure services.

7.1.8 INFRASTRUCTURE SERVICES

Tjønneland (2011:4) states that "infrastructure has remained a major focus for the main regional organisation in Southern Africa including Angola". Infrastructure service development within Angola supports the development of the SSA region since it facilitates cross-border commerce. In addition, cross-border partnership projects in energy, water and transport increase social and economic stability for the SSA region, as explained below.

7.1.8.1 ENERGY INFRASTRUCTURE

According to Tjønneland (2011:5), 48 countries in Sub Saharan Africa in 2011 had a power generation capacity of 68 gigawatts or just 25 per cent of the region's need. As a result, the

region had a deficit of over 70 per cent power supply while the supplied power remains expensive in comparison with other regions across the world.
Based on the Tjønneland (2011) studies, Angola has not been an exception as the country has not invested much in energy infrastructure. The current investment in energy infrastructure service remains insufficient for Angola considering the energy deficit facing the country after the civil war. Angola continues to import energy from neighbouring states to reduce the deficit although this remains inadequate considering the demand.

The lack of energy supply was explained by the government as the reason for the country to enter into partnerships with the private investors to invest in energy infrastructure during the period 2003 to 2009. Gonçalves (2017) explains the period as "the mini golden age of Angolan growth where the country experienced some of its highest real GDP growth in history".

Infrastructure investment during the "golden age" was staggered in phases of 3-year gaps with the first investment made in 2003 followed by further investment in 2006 and the last investment in 2009 in energy infrastructure services (Caculo Cabaca hydropower), an account made by the World Bank (2013). After 2009, more investments were undertaken without following similar pattern due to the country securing credit from China, although the new investments were less transparent with little information being shared with the public.

The new investment from China is also targeting the natural gas which Angola has some reserves. Given these endowments, Angola has been striving to further invest in power generation to lift the current power production, however, the country lacks capacity and resources to adequately undertake the investment.

According to the World Bank (2016) data as indicated on Table 24 below, Angola had 830 MW capacity in 2002, a mere drop to the country's need where less than 15 per cent of the population has access to power. In 2014, the capacity was around 2 230 MW, a significant increase in capacity although this is not enough to meet Angola energy needs.

Table 24. Angola Energy Generation Capacity

	2002	2008	2012	2014	2015	2017
Capacity installed (MW)	830	1,200	1,917	2,861	3,561	7,879
Electricity produced (GWh)	1,295	4,133	7,710	12,618	17,018*	34,346*

Source: Empresa Nacional de Electricidade and World Bank.

Angola has planned to increase its production capacity on power generation to 7,879 MW in 2017 based on the country's National Development Plan, as indicated on the table above. However, the report by Muzima (2018:1) shows that Angola power generation capacity expanded from 830 MW in 2002 to 5,400 MW in 2017. The increase in energy production only meets the needs of less than 30 per cent of Angola economy and less than 6 per cent of the rural population having access to electricity.

Angola National Development Plan had an ambition of increasing energy production four-fold, although this has not been met. The increase in capacity shows that progress has been made in the power generation with more capacity being added to the grid and over 3,500 MW was added to the grid in 2017.

Jensen (2018:10) estimates the cost of the extra capacity to be US$7 billion. Jensen (2018) blames the shortfall in targeted capacity to the delay in Caculo Cabaca hydropower which should be producing over 2,000 MW power once it is fully commissioned. Although the country has made progress on the generation side, Angola does not have enough transmission and distribution infrastructure capacity.

It is a fact that Angola investment in power generation and infrastructure development has only started to pick tremendously from 2002 until 2009. However, the increase in investments in power infrastructure has not changed into widespread access to electricity especially the rural masses. Pushak and Foster (2011:11) explain that the "inadequate power supply in Angola is a huge impediment for private sector activity".

As a result, companies in Angola rely on own generation capacity for its energy needs to compensate for intermittent and unreliable grid supply. The number of companies and household, especially outside of Luanda, where power is not guaranteed remain high while self-generation capacity such as generator has become a norm.

For the period 2007-2017, manufacturing value add to the GDP averaged 4.88 per cent while access to electricity by the rural population averaged 12 per cent according to the World Bank data (2018c). The access to electricity by the urban population over the same period was 63.5 per cent.

Despite the increase in demand for energy, the World Bank data (2018c) data on Table 25 below also shows that the country's last investment in energy infrastructure with the assistance of the private sector was in 2009. The investment in energy remains a concern for investors considering the demand in both rural and urban areas in Angola.

Table 25. Energy Investment

	2003	2006	2009
Investment in energy with private participation (US$ in mil)	45	9,4	120

Source: World Bank.

Table 25 above also shows that less than US$200 million were invested in the expansion of energy infrastructure since the end of civil war in Angola. Given the inadequate amount of energy in Angola with less than 70 per cent of the urban population having access to energy with less than 12 per cent of the rural population having access to energy, Angola remains in dire needs for investment in energy infrastructure. The economy continues to lag due to insufficient energy supply and lack of investment in the sector.

Pushak and Foster (2011:12) blame the poor access and erratic power supply on "the fragmented nature of Angola's transmission system as well as deficiencies that exist in transmission and distribution infrastructure". According to Pushak and Foster (2011), "Angola has three major electricity systems that are not interconnected and each operating independently".

These transmission systems are categorised as north, south, and central systems with each of them having their own networks infrastructure that is linked to generation sources to load centres. Jensen (2018) contends that the increase in production without addressing the transmission infrastructure will not yield any value for the country.

Jensen (2018:11) argues that "the investment in hydroelectric dams holds the potential to lower power costs in the medium term". However, it is unknown whether the capital investment in power infrastructure in Angola offers value for the economy considering the amount of investment the country has made and still not meet 30 per cent of energy needs.

Muzima (2018:2) explains that despite the challenges facing Angola power infrastructure, Angola remains on track in increasing its energy capacity. The country plans to augment the energy needs by investing in renewable energy such as solar although they have not estimated the cost for renewable energy.

Angola is targeting at least 500 MW from renewable energy, however, this could be undermined by the deficiency in transmission and distribution infrastructure grids. Thus, Angola lacks a coordinated energy distribution grid to transmit electricity across the country and this includes road and rail infrastructure as discussed in details below.

7.1.8.2 ROAD AND RAIL INFRASTRUCTURE

The road and rail infrastructure for Angola remain a challenge since the civil war destroyed most of it. The challenge that Angola faces on transportation infrastructure is however not unique to the country. Tjønneland (2011:5) characterises the transport infrastructure in Africa as inefficient and ineffective.

Furthermore, Tjønneland (2011) argues that there is virtually no connection between various transportation modes in Sub Saharan Africa including in Angola. As a result, this makes economies such as Angola to struggle in coordinating trades. For instance, Angolan ports are among the most insufficient ports in the SSA region as they are not adequately equipped to handle imports and exports of good. Once the goods are out of the ports, rail and roads transportation also struggle to transit them due to poorly maintained infrastructure.

The country is, however, modernising its transportation infrastructure with Pushak and Foster (2011), suggesting that Angola after the war increased its public spending on roads infrastructure at an average of US$2,8 billion over the period of five years. During the period 2005 and 2009, Angola had the highest spending on road infrastructure in Africa. The spending

was necessitated by the poor and inadequate road networks at primary, secondary and tertiary road infrastructure across Angola.

Pushak and Foster (2011:18) argue that "the inadequate condition of the roads caused by years of destruction and under maintenance contributes to the low level of investment". As a result, rural areas continue to have very little investment especial in infrastructure while over 40 per cent of the country's roads are rural and in poor condition.

According to Pushak and Foster (2011:18) "Angola had only 17 per cent of classified roads as urban and were paved in 2010". To date, these roads are also in a dire state as they require maintenance due to a number of factors such as over-utilisation due to very low road density. In some cases, the country's road network lacks bridges to connect them, making travelling by road from one province to the other difficult.

Based on the account on the state of roads in Angola, the quality of the road network is below standard with no better corridors to facilitate regional trade with the neighbouring states. The lack of road infrastructure puts more pressure on economic growth in the region including Angola. Access to the Angolan ports by the neighbouring economies such as the DRC also gets limited.

Angola has acknowledged that road infrastructure has created an economic bottleneck for the country as explained by Muzima (2018) on the progress that Angola has made to unlock the economy. This progress according to Muzima (2018:9) includes the construction of Lombe, Luau, Menongue, Soyo and Caala roads infrastructure.

Muzima (2018:9) estimates that "the country road network is 76,000 km and 18,000 km are paved or 24 per cent of the road is paved compared to 17 per cent in 2010". Of the 76,000 km road network, Muzima (2018) explains that "12,300 km are primary roads, 27,200 km secondary roads, and 36,500 km tertiary roads". This means that only 29 km/1,000 km^2 making Angola road density one of the lowest in the SADC region (29 km/1,000 km^2 versus 92 km/1,000 km^2).

Tjønneland (2011:5) suggests that "only 40 per cent of rural Africans live within 2 km of an all-season road, compared to some 65 per cent in other developing regions". Improving rural road infrastructure in Sub-Saharan Africa, in particular, in Angola, is critical to reviving the economy.

Pushak and Foster (2011:21) also explain that the insufficient transportation infrastructure in Angola acts as a "bottleneck for Angola's economy". Thus, poor road infrastructure and transport logistics continue to affect Angola's overall economic growth including trades. The transportation infrastructure has made it difficult to export or import goods, especially for companies outside Luanda.

Despite the reconstruction and development programme, transport infrastructure in Angola remains a challenge. Tjønneland (2011) and Jensen (2018) argue that the underdevelopment of transport infrastructure is due to inadequate capacity, a lack of transparency, and low levels of skilled labour, corruption and deranged infrastructure planning.

According to Jensen (2018:3), Angola lacks proper oversight to manage public funds. The country also lacks the capacity to budget and to plan. As a result, more emphasis is placed on one infrastructure investment (road) at the expense of other infrastructure.

Jensen (2018) contends that Angola lost an opportunity to modernise its transport infrastructure between the period 2006 to 2014, as it was characterised by rapid economic growth and expansionary fiscal policy. The rapid growth was at the back of high oil price and an increase in oil production. The country also enjoyed credit line from foreign investors such as China.

The argument made by Jensen (2018) is also supported by the World Bank data (2016) which shows that Angola has spent around a third of its oil revenue on infrastructure investment although this is not reflective of the infrastructure the country has built. For instance, Jensen (2018) argues that some of the investments were done off-budget, making them difficult to trace as there is no data to support it.

The emphasis on investing in road infrastructure at the expense of other infrastructure has also made it difficult for the rail network to enjoy any significant investment in Angola, although

the country has a cross-border rail network that runs between Angola and the Democratic Republic of Congo. The rail network acts as a conduit for goods from the sea port to inland ports and also the Democratic Republic of Congo.

The rail network in Angola still resembles the civil war infrastructure since very little investment was made after the war. For instance, post the civil war, Angola has not added much rail infrastructure other than rehabilitating the existing infrastructure. As a result, the rail infrastructure network remains disconnected despite the Afdb, ADB and EBRD (2018) reporting that over US$3 billion was invested between 2010 and 2017 in rail in Angola.

With the developed of infrastructure, Angola as a member of the Southern Africa Development Community, could easily diversify its economy and increase regional trade. PwC (2013:26) report ascertains that "Angola's regional integration could play an important role in making the country an important supplier of goods to its landlocked neighbouring economies".

Angola can also benefit from the two major trade routes, also known as trans-African corridors, by investing their development to increase trades in the region. Concern has however been raised that, the quality of infrastructure that forms the corridor route on the Angolan side is of sub-standard. As a result of poor road infrastructure construction, Angola may lose out due to inefficient roads and thus affect other projects such as energy, or ICT infrastructure. The poor quality of road infrastructure will further make it difficult for Angola to integrate its economy in the region and thus dampen the economic ambitions of the AU on free trade across Africa.

7.1.8.3 ICT INFRASTRUCTURE

The Information and Communication Technologies (ICT) sector in Angola only gained traction in early 2000 after the end of civil war. The recent report (2017) by the Telecommunication, Information and Communication department in Angola paints a picture of a growing sector. The report suggests that the growth is mainly attributed to public and private investment in ICT infrastructure including the changes in regulation.

The boom in the ICT sector in Angola can easily be linked to the boom in the oil sector since most ICT investors made major investment around the period of oil price boom and just after the end of civil war. On the back of oil and gas sector, the country has licensed two mobile

operators (Movicel and Unitel) and four fixed-line operators (Mercury, Nexus, Mundo Startel and Wezacom) and the sector has not reached saturation point, mainly due to lack of accessibility for rural consumers.

Furthermore, Angola has low internet penetration with demand for mobile internet (broadband) on the rise while services for fixed services is on the decline. ICT infrastructure investment should be considered as among the future drivers of economic growth in Angola. For instance, Informa on Africa Telecoms outlook (2018), suggests that Angola mobile penetration rate is less than 80 per cent with only 20 per cent internet penetration. Therefore, the country still has room for further growth.

The internet connectivity in Angola is further limited by the lack of fibre infrastructure which Africa Telecoms outlook (2018) according to Informa, estimates it to be less than 1 per cent for the household. The lack of ICT infrastructure such as limited fibre has further alienated the economy from reaching its full potential and also in attracting investors in the sector. As a result, the rural economy remains disconnected from the rest of the economy as there is lack of both communication (ICT) and transportation infrastructure while in urban areas have limited and unaffordable ICT access, mainly concentrated in the capital city, Luanda.

Another challenge facing the ICT investment in Angola is the obsolete technology, which mobile communication companies are still using and thus limits the competition and development of the sector. Pushak and Foster (2011) explain the obsolete by comparing the technology used by the country's only two mobile operators.

In their analysis of this technology, Pushak and Foster (2011:34) suggest that one of the reason Angola's ICT sector is not competitive, particularly mobile, is that "the two operators providing service use two different technologies (CDMA4 in the case of Movicel and GSM5 in the case of Unitel)". The use of different technologies makes it more costly for subscribers to switch networks because of the need to purchase new equipment.

The country has poor data collection on official data on internet usage. As a result, it is difficult for the sector to build ICT infrastructure informed by the demand. Despite the lack of data and information, investors in ICT are investing in new cable connection that will link Africa Coast to Europe (ACE) cable and the West Africa Cable System (WACS) which also lands in Angola.

Once these cables are completed and functional, Angola ICT infrastructure may bring down the costs of internet usage through increased competition.

Angola still spends a substantial amount of its public budget on infrastructure compared to its peers in Sub-Saharan Africa. Muzima (2018) found that Angola spent an average of 6 per cent of the GDP on infrastructure for the period 2009-2015, which remain three times the amount spent by other countries in the Sub-Saharan region.

In summary, Angola infrastructure remains inadequate and it is poorly maintained. The economy is struggling to develop infrastructure such as transportation to meeting its economic commitment although GDP has been growing better than most economies in SSA due to the oil boom. The infrastructure development programme in Angola is largely driven with the assistance of Chinese investors with very little investment in the development of local capacity. Angola as a coastal country is positioned well to benefit from regional economic growth. The country can easily take advantage of its access to the shore and act as a trade conduit for the landlocked economies. However, the country has not yet realised its strength as it lacks adequate infrastructure services.

7.2.1 THE DRC ECONOMIC OUTLOOK

The DRC has an abundance of natural resources and yet, after a post-independence history of military dictatorship and almost constant war, unstable government and corruption, most of its people are poverty-stricken. The Central Intelligence Agency (CIA, 2018) found that slow political reform, corruption, poor governance, inefficiency and patronage were at the centre of the country's challenges. Furthermore, the DRC government is burdened with external debt and lacks administrative control of many areas in provinces where much of the exploitation of natural resources occurs illegally and therefore does not contribute to the fiscus. These challenges have made it difficult for the DRC to develop infrastructure as have also kept most international investors out of the DRC economy despite good investment opportunities, mainly in mineral resources. Although the DRC also has a huge stock of arable land, forests and an abundance of water resources, the World Bank (2017) data shows that the mainstay of the DRC economy is the mining sector through the export of copper, cobalt, gold, diamonds, coltan, zinc, tin and tungsten.

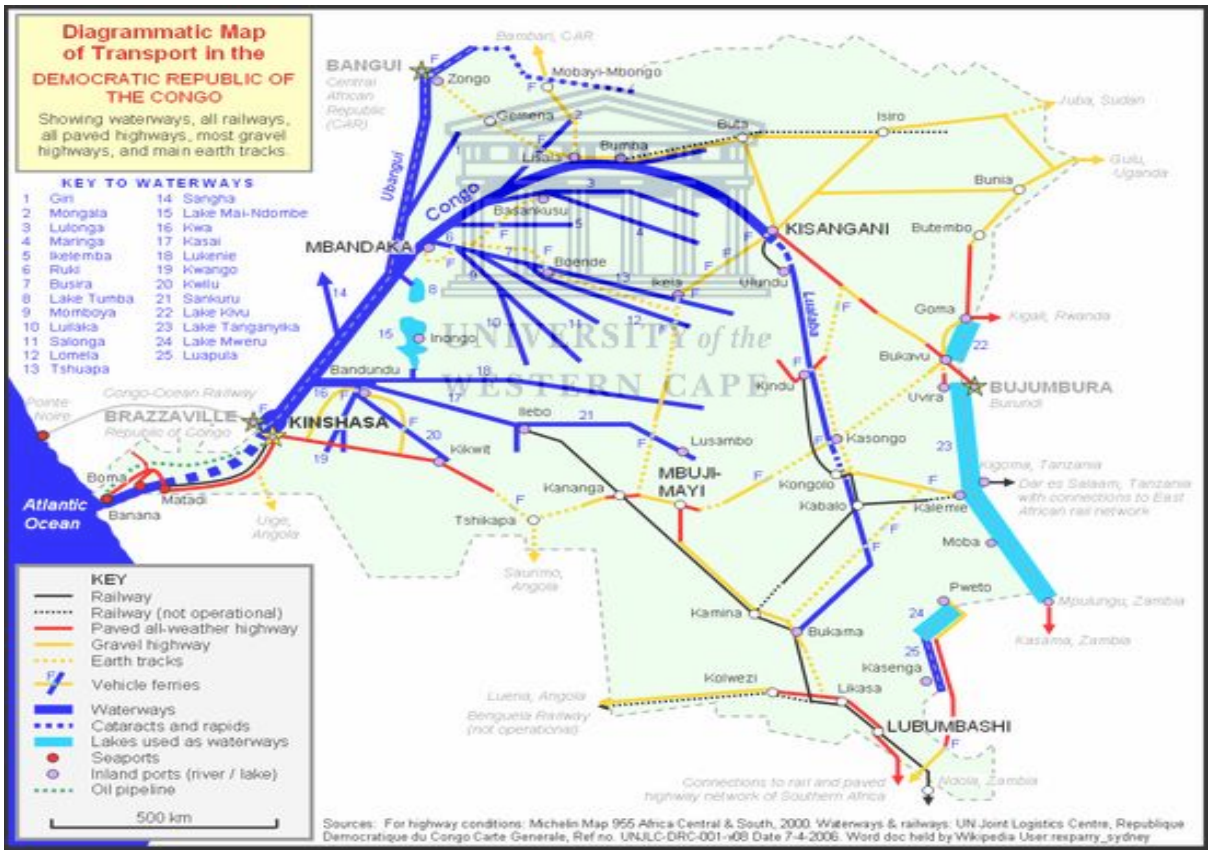
Despite the economy being driven by mining sector activities, very few infrastructure services exist to assist the mining sector. Some of the mining activities are informal and artisanal run and much of it is illegal or operates in dangerous conditions. Securing investments and protecting investors is made difficult by the vast size of the DRC which shares borders with nine countries. The size of the country, the second-largest country in Africa, adds to the complexity and difficulty of establishing an efficient, stable national government, especially given that most Congolese have experienced little rule of law in practice in their lifetimes. As a result, the country is struggling to provide basic services such as transportation, energy or communication for its population. Although DRC has theoretical access to the sea at Matadi and Boma, these are shallow draught harbours and cannot handle large cargo ships. The only port in the 37 km DRC coastline territory between Angola and the Cabinda enclave which can be developed into a deep water harbour is Banana port, from which DRC currently exports crude oil. It engaged global developer DP World in 2018 in a public-private partnership with to establish a greenfield deep water port at Banana. All other goods transported by sea are exported and imported through Mombasa (Kenya), Dar es Salaam (Tanzania), Durban (South Africa) and Luanda.

Figure 8: The Democratic Republic of Congo

Source: World Atlas.

Despite the presence of peacekeepers from the UN and the AU, DRC remains exposed to violence from dozens of armed rebel groups who continue to attack the population and the government in weakly governed areas throughout the country. This deters both national investment in infrastructure and FDI generally. Years of political instability in the DRC has made it difficult for the country to invest in and to develop transportation infrastructure. The country has one of the most highly disintegrated transport systems in Africa. Rivers are used as waterways and this remains a popular way to access the capital, Kinshasa, from provinces such as Kisangani and Bumba. Mining equipment is ferried through the river channel which is also used to transport goods for the agricultural, industrial and services sectors. The Congo River system is dangerous as there is no maintenance of the river channel despite it being the cheaper mode of transport in the DRC.

Figure 9: Diagrammatic Structure of Transport Infrastructure in the DRC



Source: Central Intelligence Agency (CIA).

The Congo River plays an important role in connecting various transportation nodal points that contribute to economic trade and growth in the DRC economy, although there is no data that shows the share the Congo River itself contributes to growth. The river is used for

hydroelectricity power generation and is a proposed site for one of the largest hydroelectricity plants in the world, the Grand Inga hydropower scheme, also known as Inga 3 (described in detail below). The current power generation from the Congo River can be argued to be contributing towards the annual growth rate in the DRC although this is not adequate, given the demand for power in the country.

The country has shown signs of growth according to World Bank Data and Makate et al. (2018). On SADC Selected Economic and Social Indicators, as indicated by Table 26 below, DRC even outperformed SADC and SSA over the periods 2004, 2010 and 2017.

Table 26. Percentage Real Growth Rate Comparison

GDP growth rate (per cent)	**2004**	**2010**	**2017**	**Average Annual**
DRC SUB-SECTORS				
Industrial	5.75	28.67	7.71	14.04
Agriculture	1.6	3.6	1.57	2.26
Services	9.4	7.83	6.1	7.78
DRC (GDP)	6.7	7.2	3.7	5.9
SOUTHERN AFRICA REGION	5.3	4.4	2.3	4
SUB-SAHARAN AFRICA	4.13	2.561	0.356	2.35

Source: World Bank Data and SADC Selected Economic and Social Indicators (2018).

The lack of infrastructure such as roads, rail, and electricity in the DRC has led to the deteriorating economic outlook, compounded by poor governance, political instability and corruption. Table 27 provides an overview of the economic performance indicators of the DRC.

Table 27. Primary Macroeconomic Convergence Indicators

	2015	2016	2017
Inflation (3–7 per cent)	4.2	18.2	35.7
Fiscal Deficit (3 per cent of GDP)	-0.8	-1.2	0.1
Public Debt (60 per cent of GDP)	16.3	15.7	18.6
GDP (7 per cent)	6.9	2.4	3.7

Source: United Nations Economic and Social Council.

The primary macroeconomic indicator targets for the DRC set by the SADC shows that the GDP growth has declined, while public debt increased over the same period. The deteriorating economic outlook has also worsened the inflation outlook in the country thus making it less

attractive for some investors. The decline in economic growth in the DRC is across all main economic sectors as discussed below.

7.2.2 PRIMARY ECONOMY

The primary economy of the DRC comprises the mining and agriculture sectors. These sectors are the main formal employer in the country, although the majority of the workforce are employed in the informal sector. In recent years, the primary sector has experienced the best growth rate mostly due to a boom in natural resources and the discovery of oil and gas. Table 28 shows the main components of the primary sector in the DRC.

Table 28. Primary sector percentage growth rate (2007–2017)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	6,30	6,20	2,9	7,10	6,90	13,40	2,40	7,20	7,70	2,40	3,70
Agriculture	2,76	2,77	2,78	3,61	3,57	3,45	4,25	4,74	4,66	3,26	1,57
Mining	2,50	11,4	-12,5	8,80	8,55	-3,32	10,72	9,59	8,09	12,46	8,37

Source: World Bank data and Chambre des Mines Federation des Entreprises du Congo and Reuters.

The data from Table 28 above, shows that, while the agricultural sector grew consistently averaging 3.4 per cent in the period, the mining sector was more robust for the 2007–2017 period and averaged 5.9 per cent growth, with a sharp decline in 2009 due to the global economic crisis.

7.2.2.1 MINING SECTOR

The mining sector remains the dominant sector for the country's GDP and strongly influences economic growth in the country. Kivu and Katanga provinces contribute almost all the mining revenue in DRC and experienced better economic growth due to the mining activities compared to non-mining provinces. Herderschee, Kaiser and Samba (2012:32) suggest that "the mining sector in Katanga contributed more than 50 per cent to GDP in 2010". These provinces are also at the centre of conflicts and also experience the highest incidence of illegal mining through which rebel movements finance their operations. Herderschee et al. (2012) argue that the mineral riches of the eastern provinces "have played an important role in continuing armed conflict at the expense of economic development".

These provinces have among the best copper reserves in the world (United States Geological Survey, 2017) and among the purest ore, mainly in Katanga. Past over-reliance on copper exports made the DRC economy vulnerable to price fluctuation and even the more recent collapse of copper and gold prices impacted on economic growth and plans to develop public infrastructure. The collapse of the copper price and gold caused the closure of some mines, such as Glencore closing their Kamoto mine in 2015 (Southern African–German Chamber of Commerce and Industry, 2018). Although the disinvestment has been counteracted by the Chinese investment, the Sicomines copper mine project was delayed but remains under construction at Kolwezi in Lualaba Province. The research study envisages that some remaining mining technology companies are likely to disinvest if the Chinese remain active in the mining sector since Chinese investors prefer using their technology rather than sourcing technology suppliers elsewhere.

The poor growth according to the KPMG Global Mining Institute (2014) is likely to pass and commodity prices were expected to rebound in the medium term, although the Institute (KPMG, 2014:2) noted that "despite the mining sector facing significant growth challenges due to uncertainty in the DRC such as the conflict in the east of the country (key mining region), and severely inadequate infrastructure such as electricity supply and transportation, this challenge will not be permanent". The Institute acknowledged that the mining investment by multinational investors did not address the challenges of social and economic challenges in the DRC and therefore could also be sources of social instability. This contention appears to apply to mineral-rich provinces such as Kivu where, despite the province's contribution towards GDP, there is a poverty rate of 85 per cent.

Table 29. Minerals Endowment in the Eastern DRC

Sub-sector	Product(s)
Mining	copper, cobalt, cassiterite, coltan, wolframite, gold, diamond, and zinc, crude oil and gas

Source: World Bank.

The mineral wealth in Eastern DRC has not helped the DRC to address the development of public infrastructure in the province, nor to create jobs. Chuhan-Pole et al. (2018:2) calculate that "more than 70 per cent of the youth in the DRC have no jobs and of the 9 000 university graduates that the country produces each year, fewer than 100 graduates find employment". As a result of high unemployment and lack of other economic opportunities, unemployed youth

opt for survivalist strategies such as joining armed groups involved in conflicts or trying to engage in informal sector activities.

7.2.2.2 AGRICULTURAL SECTOR

Political instability and armed conflict have made it difficult for the DRC to develop its agricultural sector despite the rich soil and good climate. According to the World Bank (2017), around 10 per cent of the land in the DRC is cultivated. A study on the agricultural sector by Herderschee et al. (2012:35) found that subsistence farming contributes over 40 per cent of the GDP and employs 60 per cent of the workforce in the agricultural sector. The research suggests that commercial agriculture is in its infancy, although efforts were made to develop agro-industrial park such as Bukanga Lonzo, located 200 km from the capital Kinshasa, which was developed in 2014 with the assistance of South African investors. The main products currently produced are beans and maize, although data was not available on the volume produced. Bukanga Lonzo remains challenged as efforts to expand the park were stymied by inadequate transportation infrastructure development in the area and logistics and retail networks. Chuhan-Pole et al. (2018:4) suggest that "the agriculture in the DRC has great potential for growth but it is weakly exploited". The planned construction of roads infrastructure in agricultural areas will give farmers access to the market and improve food security, especially if political stability can be improved in the DRC.

7.2.3 SECONDARY ECONOMY

The secondary economy in the DRC is largely dominated by the manufacturing sector while the energy sector in the DRC remains flat and can be argued to be on the decline based on energy per capita. The World Bank (2018c) data shows that less than 15 per cent of the population has access to power.

The inadequate energy investment in the DRC has been cited as one of the reasons for lack of development by Farquharson, Jaramillo and Samaras (2018) in their analysis of electricity outages in SSA. Investors in mining have blamed lack of electricity supply as the reason for not reaching full production capacity. Companies that intend to invest in the secondary sector are being discouraged by the lack of electricity infrastructure, especially outside the major cities and provinces in the DRC. Despite the challenge in electricity supply, the manufacturing

sector remains robust with Table 30 showing steady value added to the GDP for the 2007–2017 period. Table 30 also shows the average GDP growth rate over this period.

Table 30. GDP Growth Rate and the Percentage of Secondary Economy Value Added

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	6.26	6.23	2.86	7.11	6.87	7.09	8.48	9.47	6.92	2.40	3.70
Manufacturing	17.01	14.92	18.88	16.22	15.36	15.36	15.39	15.55	17.13	18.26	19.67

Source: World Bank.

Slow growth in the secondary economy and the effect of inadequate energy supply has led the country to consider the introduction of non-hydro renewable energy such as solar energy. The data from the World Bank (2016) shows that renewable energy remains less than 1 per cent of the energy production since its introduction in 2012 while the bulk of the energy produced is generated by hydroelectrical plants. Table 28 below shows the various sources of energy for the 2007–2015 period in the DRC.

Table 31. The DRC Energy Sources

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Power from hydroelectric sources	98.90	98.72	98.91	98.91	98.89	99.66	99.67	99.77	99.71
Power from oil, gas and coal sources	1.10	1.28	1.09	1.09	1.11	0.12	0.11	0.12	0.18
Power from renewable sources, excl. hydro	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.10	0.11

Source: World Bank.

The lack of energy in the DRC has had a negative effect on growth, especially in the mining sector. The country has not invested enough in energy infrastructure mainly due to development being skewed towards Kinshasa and past and present warfare. Because the DRC cannot supply its energy demands, the country's manufacturing sector relies on generators for energy. The manufacturing sector remains robust despite the unreliable energy supply in the country with a positive average growth rate of 9.36 per cent over the 2007–2017 period.

Table 32. Manufacturing and Energy Consumption Growth Rate (2007–2017)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	6.3	6.2	2.9	7.1	6.9	13.4	2.4	7.2	7.7	2.4	3.7
Manufacturing	4.47	4.45	1.57	28.67	15.66	8.96	10.45	14.63	5.91	0.50	7.71
Energy	3.4	-3.8	5.5	-2	3.2	3.9	4.3	-7.3	1.64*	3.64*	1.6*

Sources: World Bank data, Chambre des Mines and Federation des Entreprises du Congo.

Officially, the DRC continues to boost the manufacturing sector by banning the export of raw ores and concentrates. The moratorium on raw ore and concentrates export is intended to encourage mining beneficiation and industry. However, the lack of investment in the energy infrastructure has forced the mining companies to undermine the moratorium to survive.

7.2.4 TERTIARY ECONOMY

Despite the country having more than 20 financial institutions, the contribution to GDP of tertiary sector institutions such as banking, insurance and other financial institutions appears low, although there is little data available on the sector. According to Herderschee et al. (2012:88–89), "the absence of a well-developed financial sector has had severe economic costs for the DRC" as the country relies on foreign donors and institutions to raise finance. The DRC's economic growth remains constrained by unknown economic and social costs. For instance, the country has been unable to mobilise and save resources for developmental purposes. The country also lacks auditing skills to understand its basic needs to allocate resources adequately. Herderschee et al. (2012:89) confirm these capacity challenges, arguing that "the DRC has no capacity to monitor investments and to exert pressure corporate governance or control over easing of exchange of goods and services". The challenge as explained by Herderschee et al. (2012) has further deferred the development of tertiary economy in the DRC which underperforms compared to the primary and secondary economies. Table 33 below shows that the services sector during the 2007–2017 period averaged -0.88 per cent growth rate while the GDP growth rate averaged 6.13 per cent over the same period. The tertiary economy is highly dependent on banking sector performance in the DRC, as in Angola, and has been struggling due to its dependency on commodities.

Table 33. GDP Growth Rate and the Percentage of Tertiary Economy Value Added

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	6.26	6.23	2.86	7.11	6.87	7.09	8.48	9.47	6.92	2.40	3.70
Services	11.71	9.61	3.99	-4.55	1.03	6.61	7.83	6.84	9.07	4.50	2.94

Source: World Bank.

It is worth noting that the data on DRC trades is mainly collected by outside parties, and often only estimates or no data at all are available since the country infrastructure remains disintegrated. Thus, data collected by the third parties may be missing information in certain sectors.

7.2.5 SPECIAL ECONOMIC ZONES, INDUSTRIAL PARKS AND PORTS

The DRC has no special economic zones but intends developing five regional SEZs, namely Kinshasa-Inga-Matadi-Banana, Ilebo-Tshikapa-Kananga-Mbuji Mayi, Kolwezi-Likasi-Lubumbshi-Sakania, Uvira-Bukavu-Goma-Beni-Bunia and Kisangani-Bumba-Mbandaka. Investment in public infrastructure has only commenced in two of the five SEZs. Table 34 below outlines the foci of the proposed SEZs.

Table 34. Proposed Economic Zones

Zones	Activities
West Kinshasa-Inga-Matadi-Banana	Hydropower, production of oil and bauxite, manufacturing industries around the sea ports of Matadi, Boma and Banana.
Centre Ilebo-Tshikapa-Kananga-Mbuji Mayi	Transport logistics and food industries.
South Kolwezi-Likasi-Lubumbashi-Sakania	Heavy and manufacturing industries focussed on copper, cobalt and others.
East Uvira-Bukavu-Goma-Beni-Bunia	Food and manufacturing industries.
North-West Kisangani-Bumba-Mbandaka	Wood industries and agri-business.

Source: Invest in DRC.

Kinshasa-Inga-Matadi-Banana and Kolwezi-Likasi-Lubumbashi-Sakania are the main focus for SEZ infrastructure investments in the DRC. As a result, foreign investments have been focusing on energy, ICT, roads and railways, given their immediate demand in the DRC. The proposed Inga hydroelectricity project continues to attract investors given the abundance of rivers in the DRC.

7.2.6 MEGA PROJECTS IN THE DRC

The DRC has few mega-projects and these are mainly in energy and mining sectors, the main project being the Grand Inga hydropower project. Inga is managed by a consortium of three entities and has a power output of 4,800 MW. The DRC intends to expand Inga to produce an estimated power output of 39,000 MW which the World Bank (2016) estimates will cost US$12 billion. However, the estimated cost has already been overtaken by delays in the construction of the project due to political instability and lack of private investment.

There are also smaller planned power generation projects financed by China and the EU. Lastly, there are mega-projects planned or under construction in mining, as well as mines run

by the private sector on a concessionary basis (e.g. Ivanhoe Mining, Zijin Mining) for the government.

Table 35. Energy Infrastructure Projects

Project Investment	Amount USD Bln	Project Status Comment
Inga III hydropower station (Public-Private Partnership; PPP)	12	Planned
Sicomines copper and cobalt mine	3	Under construction
Kamoa-Kupfervorkommen	2,5	Planned
Hydropower station Rusisi 3	0,45	Planned
Hydropower station Zongo 2	0,365	Under construction

Source: Southern African–German Chamber of Commerce and Industry, 2019.

7.2.6.1 ENERGY INFRASTRUCTURE

Over the 2013 to 2017 period, the energy sector attracted an average of US$1,65 billion for investment in energy infrastructure such as generation, transmission and distribution, an amount that remains inadequate given the demand for energy generation. The main beneficiary was hydro-power generation and this includes the feasibility study of the Grand Inga hydroelectricity project at a revised estimated cost of US$13,8 billion. The Congo River is the world's second-largest in terms of flow (42,000m^3/s), after the Amazon, and the second-longest river in Africa (4,700 km), after the Nile River. The Congo River has large waterfalls suitable for hydropower projects. According to the International Rivers website, the Congo River has the largest waterfall in the world (Inga falls) by volume and is 4 km wide. The Inga dams are located in western DRC, 50 km upstream of the mouth of the Congo River, and 225 km south-west of Kinshasa. The Grand Inga project will more than address the power deficit in the economy since the output is estimated to be 39,000 MW. The challenge facing the Inga project remains finance since few investors have the appetite to invest in the DRC infrastructure considering the country risks associated with corruption, governance and political instability. Table 36 below shows that China and the European Union have shown keen interest in the DRC energy sector with an investment of US$500 million in the 2013–2014 financial year.

Table 36. Energy Infrastructure Projects and Funding Structure

Year	Funder	Project	Amount (Mil US$)
2013	Multilateral	Electricity Generation	71.71
2013	Multilateral	Hydro generation	37
2013/2014	China	Electricity Generation	500
2013/2014	EU	Electricity Generation	500
2014	Multilateral	Hydro generation	73.1
2017	Multilateral	Transmission and distribution	145
2017	Multilateral	Electricity Generation	27
2007	Multilateral	Electricity Generation	296.7

Sources: World Bank and Infrastructure Investor (2018).

7.2.6.2 ROAD AND RAIL INFRASTRUCTURE

The DRC road and rail infrastructure are still based on the expectations and requirements of its former colonial rulers whose focus was on extracting commodities as cheaply as possible, which entailed primarily using the river systems to transport goods. This, and the devastation of war, are the main reasons for the inadequate and limited infrastructure that has continued to deteriorate due to poor maintenance, lack of governance and accountability and political instability across the country. Poor governance and accountability also reflected the operation of river transport between Brazzaville and Kinshasa which the government had run as a monopoly. Private sector companies are now rendering better services than the state-owned transport. The lack of efficiency in the transport infrastructure was highlighted by Herderschee et al. (2012:57) who found that "only four out of ten provincial capitals are linked by road networks that lead to the capital, Kinshasa, while less than 10 per cent of the population had access to electricity". Herderschee et al. (2012) also argue that lack of infrastructure not only created economic bottlenecks but also created political challenges since the government struggles to govern some parts of the country which are inaccessible. The future of the DRC is dependent on the country investing in rail and road infrastructure, given the increasing population and vastness of the landscape. This would strengthen the role and authority of the central government while enabling inter-provincial trade as well as improve trade with the neighbouring states (Foster and Benitez, 2011; Korecki, 2018). The lack of infrastructure investment is illustrated in Table 37 below, which shows the investments in the DRC for the 2013–2017 period in road and rail infrastructure.

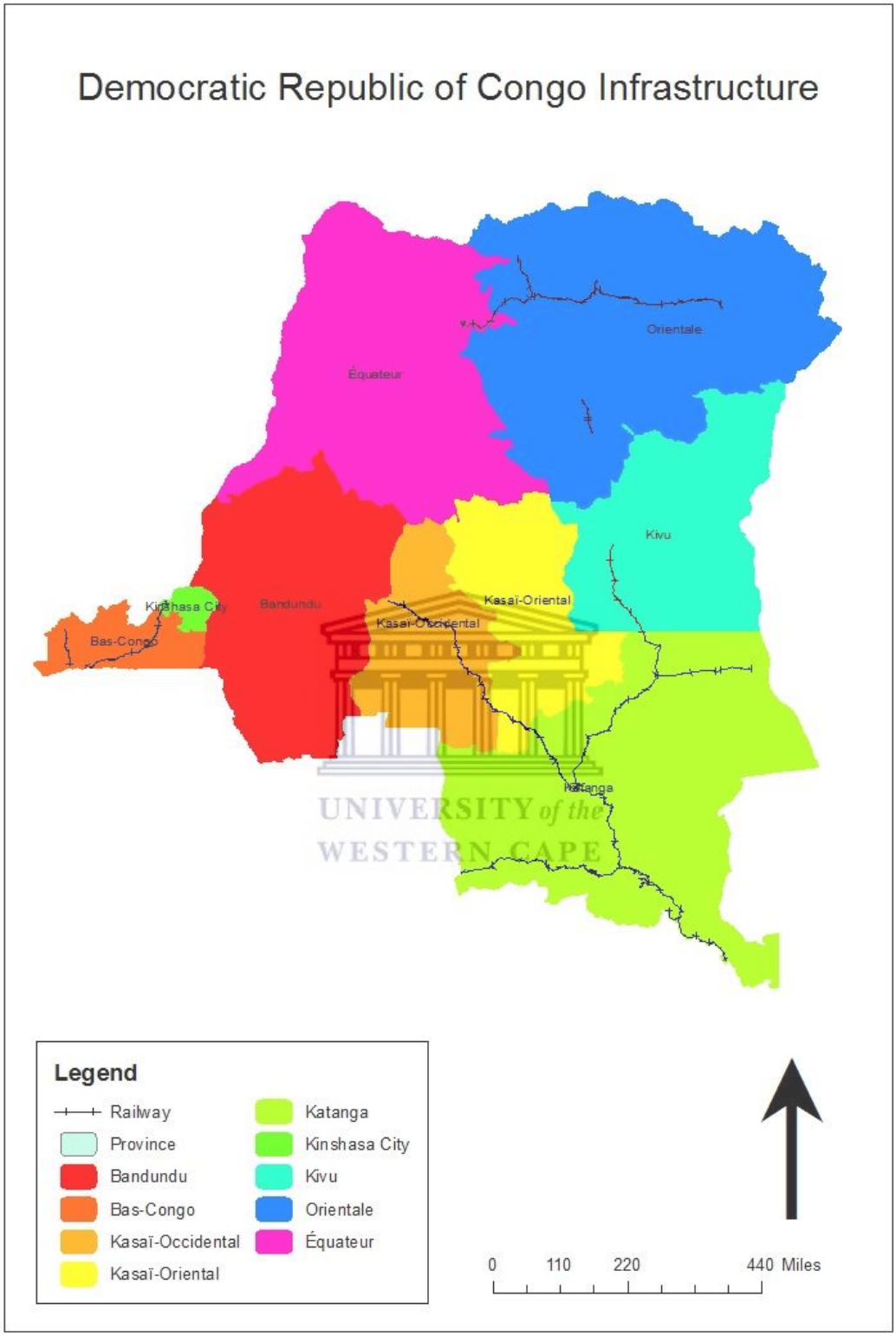
Table 37. Infrastructure Projects and Funding Structure

Period	Funder	Project	Amount (mil US$)
2013	Multilateral	Roads	290
2013	Multilateral	Roads	101
2013	Multilateral	Roads	56.12
2008-2014	China	Roads and Rail	478
2016	Multilateral	Roads	125
2017	China	Rail	1,200

Sources: World Bank and Infrastructure Investor (2018).

Table 37 above indicates that investments totalling US$2,25 billion were made for the development of rail and road infrastructure networks in the DRC from 2013 to 2017 (and a Chinese commitment that began in 2008). Some of the committed investment in infrastructure is in the form of a special arrangement between investors and the government of the DRC for payment in kind. For instance, Chinese investors have been building roads and railways under the minerals for infrastructure development programme in the DRC. Clowes (2018) posits that the DRC has failed to account for the rail and road infrastructure loan from China. The inference by Clowes (2018) was made after Chinese-built infrastructure was appraised at a value of US$478 million compared to the US$1,63 billion that Chinese investors received for the construction of roads and railways in the DRC. Allegations of corruption and poor governance in the DRC have contributed to the slow delivery of infrastructure in all the provinces. This is compounded by the lack of capacity to safeguard the country's resources under the minerals resources for infrastructure development programme. Figure 10 below illustrates the infrastructure setup of the DRC and the challenges facing the development of infrastructure.

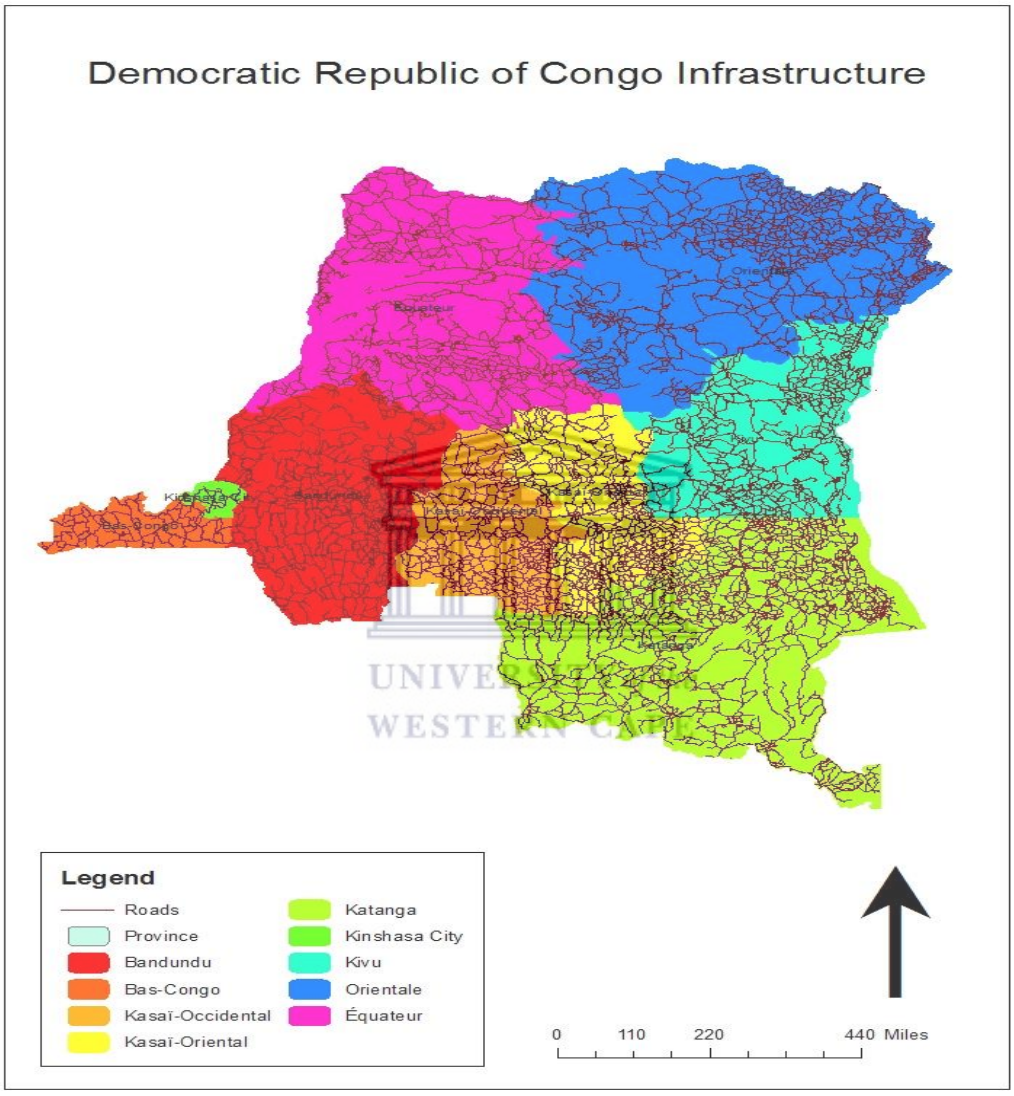
Figure 10: The DRC rail infrastructure



Source: Author's GIS mapping (2019).

Figure 10 above depicts the rail infrastructure in the DRC, which is not widely and is, therefore, a barrier to development and economic efficiency for a largely rural country with poorly developed alternative transport, as illustrated in Figure 11, which shows that the road networks in the DRC are not coordinated with no major roads connecting some provinces.

Figure 11: The DRC road infrastructure



Source: Author's GIS mapping (2019).

According to the African Development Bank (2015), only 5 per cent of the national road networks is tarred and a large proportion of roads are in a state of disrepair due to years of neglect and war. The DRC has only two main highways that connect the major economic hubs, namely the East-West road linking the port of Matadi to Lubumbashi via Kinshasa, and the

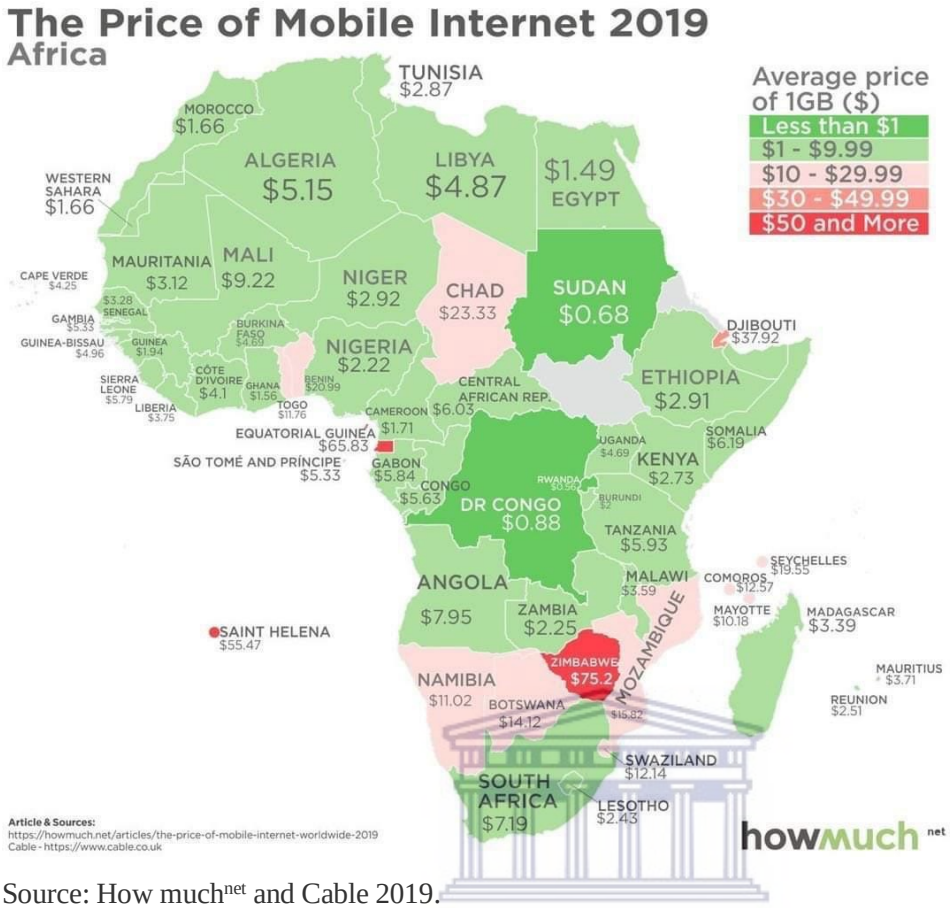
North-South road linking Lubumbashi to Goma, Bukavu and Kisangani. There are no efforts to upgrade the DRC road networks, largely composed of gravel roads, since warfare continues and rebels can easily target work crews in remote areas. Given the DRC country's size, it is difficult to estimate how much resources the country needs to resolve the road and rail infrastructure backlog.

7.2.6.3 ICT INFRASTRUCTURE

The DRC has little information that it shares on ICT infrastructure investment and development and it is difficult to obtain the information. Since the fixed-line infrastructure is almost dysfunctional, the DRC telecommunications and ICT infrastructure is currently dominated by six mobile telecom network service providers: Celtel, Tigo, Congo Chine Telecoms, Africell, Helios and Vodacom-Congolese Wireless Network.

Figure 12 below compares the cost of mobile internet across Africa with the DRC being among the lowest; however, accessing the internet service is not guaranteed. The country has been on the drive to increase internet usage since there is low market penetration of internet in the country. This is exacerbated by the lack of ICT infrastructure in the DRC which is challenged by the vast area that needs to be covered.

Figure 12: Price comparison of mobile internet, in US$



Source: How much[net] and Cable 2019.

Information on the cost of ICT infrastructure proved difficult to obtain as service providers are not disclosing their infrastructure spending. Vodacom used to post capital expenditure annually but has also stopped. The only information available on ICT infrastructure spending in the DRC was in 2010 as indicated below in Table 38. The study was therefore unable to compile analyses reflecting recent revenues relative to costs to assess the true cost of ICT infrastructure in the DRC. However, based on the previous information on infrastructure spend and the fact that Vodacom is the market leader in the mobile telecom space in DRC (51 per cent), Table 39 below outlines the infrastructure development spend by Vodacom in the absence of infrastructure spending by other ICT companies in the DRC, for the 2010–2017 period.

Table 38. ICT Infrastructure Spending

	2004	2005	2006	2007	2008	2009
ICT Infrastructure in USD Mil	54	42	74	320	335	151

Source: World Bank; Grail Research and Monitor Analysis.

Table 39. Infrastructure Investment Growth Rate (per cent) by Vodacom-DRC

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
11.1	-3.0	37.4	-21.0	-9.9	23.0	9.5	12.8	11.2	38.2	-12.4	3.8

Source: Absa Capital.

The investment growth rate on ICT infrastructure by Vodacom DRC averaged 8.4 per cent over the period of 11 years. Vodacom DRC, as a leader in the mobile network space, may reflect the investment attitude of other mobile networks in ICT. Despite the lack of infrastructure investment information about the other mobile networks, based on the Vodacom investment in infrastructure in DRC, the study assumes that other industry players were active in developing their own infrastructure and expended similar proportions or amounts of investments in infrastructure development over the same period. The assumption is based on the fact that the mobile network is driven by the network infrastructure coverage which influences the number of subscriptions or market share. The annual value of the investments made by Vodacom DRC is reflected in Table 40 below and its total spending for the 2005–2017 period was US$125 million. The table shows that Vodacom DRC periodically accelerated investments in infrastructure with sharp jumps in several years, presumably improving coverage to target greater market share, as the increase shown in 2014–2015 accompanied a recorded 38.2 per cent growth rate in infrastructure.

Table 40. Infrastructure Investment for 2005–2017

Year	Funder	Project	Amount (mil. US$)
2005	Vodacom-DRC	Infrastructure development	6,32
2006	Vodacom-DRC	Infrastructure development	7,02
2007	Vodacom-DRC	Infrastructure development	6,81
2008	Vodacom-DRC	Infrastructure development	9,36
2009	Vodacom-DRC	Infrastructure development	7,39
2010	Vodacom-DRC	Infrastructure development	6,66
2011	Vodacom-DRC	Infrastructure development	8,19
2012	Vodacom-DRC	Infrastructure development	8,97
2013*	Vodacom-DRC	Infrastructure development	10,12
2014*	Vodacom-DRC	Infrastructure development	11,25
2015*	Vodacom-DRC	Infrastructure development	15,55
2016*	Vodacom-DRC	Infrastructure development	13,62
2017*	Vodacom-DRC	Infrastructure development	14,14

Source: Absa Capital and *estimate based on historical spending.

The telecom industry in the DRC is on the rise given the almost non-existence of a fixed-line telecom industry in the country. Although the growth of the telecom industry is not unique to the DRC, it is worth noting that, given the country's lack of infrastructure, mobile telecom has had a noticeably positive effect on the economy of the DRC. Herderschee et al. (2012:63) suggest that "the telecommunication industry generated a turnover of US$850 million in 2008". The total revenue per service provider during that period was Zain (US$380 million), Vodacom (US$330 million) and Tigo (US$80 million), with the balance split between Congo China Telecom, Standard Telecom and Supercel. The contribution to the DRC fiscus by the mobile operators in 2008, according to Herderschee et al. (2012), was not less than US$160 million.

The DRC does not have a working national communication framework and, despite the private investment in ICT infrastructure, the country lags behind the other countries in SSA on ICT infrastructure. While ICT is growing rapidly, the growth is still limited to urban centres.

A limited national fibre optic backbone only began rolling out in the DRC in 2013 with Chinese support, but because broadband is limited pricing is high, contributing to the slow proliferation of information and communication technologies in the DRC in both urban and rural areas. According to Herderschee et al. (2012:64), the principal internet service providers in the DRC "operate in the big cities (Kinshasa, Mbuji-Mayi and Lubumbashi, in particular) and in the

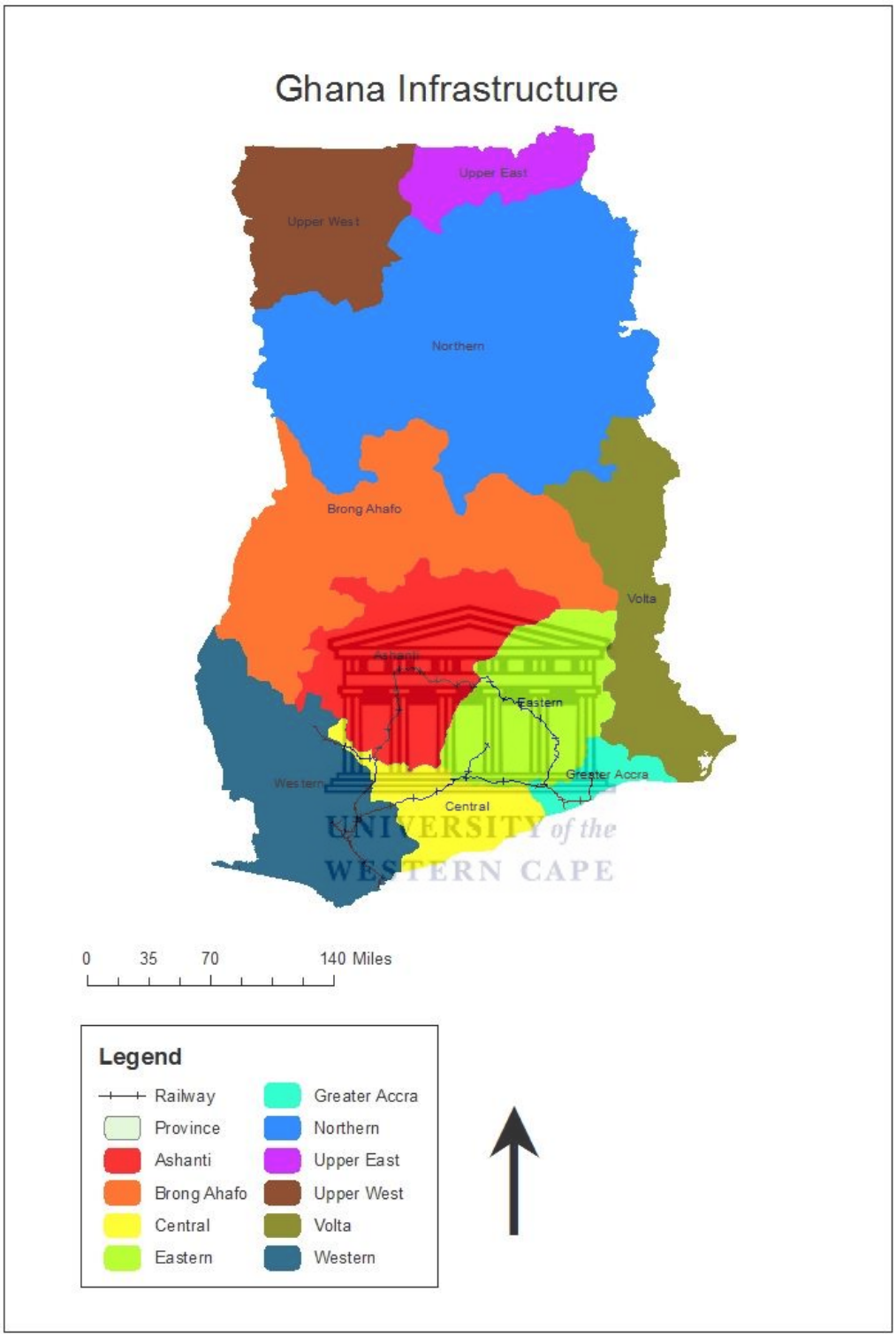
mining sites". These service providers are mostly focused on business customers with tariffs as high as US$100 a month for a connection of 64 kilobytes per second due to the limited international bandwidth access provided by satellite. The high cost of ICT in the DRC has been highlighted as a challenge for the economy and the government has been under pressure to regulate the price but lacks capacity. In response to the high cost of ICT, a public-private partnership is under way with China International Telecommunication to develop a satellite and terrestrial wireless-based network across the DRC at a cost of US274 million. The construction of a fibre optic backbone that will link the DRC capital from the coast has also been proposed. Until there is better broadband internet access across the country the ICT infrastructure in DRC is too slow and unreliable to contribute significantly to the economic growth of the DRC.

7.3.1 GHANA'S ECONOMIC OUTLOOK

Ghana's economy is relatively diverse with better public infrastructure services and higher GDP growth than neighbouring economies such as Togo, Burkina Faso and Cote d'Ivoire (African Centre for Economic Transformation, 2016). Sithole (2012) has described Ghana as a beacon of hope in West Africa and Deloitte (2017:5) described Ghana as a beacon of hope for democracy and stability. Aside from economic diversification, Ghana is regarded as a stable democracy, making Ghana comparatively attractive to investors in the region. However, Ghana's public sector spending, debt financing and power shortages have posed challenges for the country and to macroeconomic prospects for enhancing growth.

On the other hand, the country's governance is well established, especially in the management of the oil and gas sector, which has challenged most other African economies rich in natural resources. Figure 13 depicts Ghana's geographical location. It is noteworthy that all the country's neighbours had suffered political and economic instability in stark contrast to Ghana's past two decades.

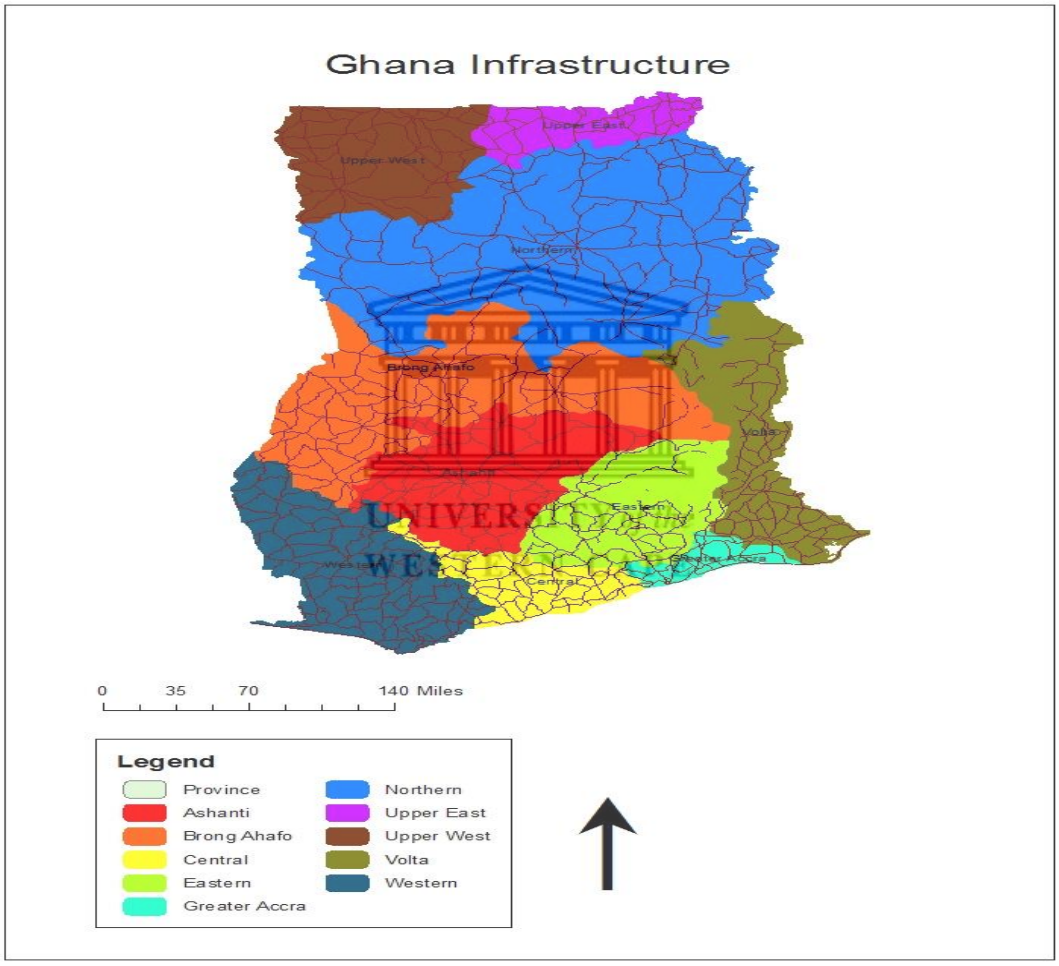
Figure 13. Ghana Infrastructure



Source: Author's GIS mapping (2019).

Figure 13 also shows that the rail infrastructure is not widely spread in Ghana. The lack of infrastructure services remains a barrier to development and economic efficiency for a country that is largely rural with vast growth potential in the agriculture and mining sectors. Similarly, the graph below (Figure 14) shows that the road networks in Ghana are not coordinated with no major roads connecting provinces. It is worth noting that the road network is largely used to connect the economies of neighbouring states with Ghana and is used to transport goods to and from these states.

Figure 14: Ghana's road infrastructure



Source: Author's GIS mapping (2019).

World Bank economic data (2017) shows that, despite a turbulent 2016, Ghana's economic performance improved significantly in 2017. The country's fiscal deficit decreased from 9.3 per cent in 2016 to 6 per cent deficit of GDP in 2017, underpinned by the various economic programmes, including the development of Special Economic Zones and the better

performance of the mining and crude oil sectors which led to improving the balance of payments after unimpressive results in the previous years. According to Deloitte (2017:7), Ghana outperformed most West African economies in 2016 due to better than expected oil and gas prices and on the back of Ghana's increasing manufacturing sector, including the mining sector. While the manufacturing sector is still developing state, it enjoyed better growth than agriculture, which remains the biggest employer but underperformed. Table 41 below illustrates the performance of three sub-sectors of the economy between 2004 and 2017 in Ghana.

Table 41. Percentage Real Growth Rate Comparison

GDP growth rate (per cent)	2004	2010	2017	Annual Average
GHANA SUB-SECTORS				
Agriculture	7.5	5.3	8.4	7.07
Industry	4.6	6.9	16.7	9.4
Trade	6.2	9.8	4.3	6.77
GHANA (GDP)	6.3	7.9	8.5	7.57
WEST AFRICA REGION	6.27	9.73	3.15	6.38
SUB-SAHARAN AFRICA	4.13	2.561	0.356	2.35

Source: World Bank Development indicators, Bank of Ghana and African Development Bank (2018).

Table 41 above covers three main economic sectors in Ghana. The focus of the study was on main economic sectors of agriculture, industry and services, which broadly mirror the primary, secondary and tertiary economies respectively. The World Bank (2018c) data shows that, between 2004 and 2017, the services sector contributed over 50 per cent of the total GDP, followed by agriculture, with the industry sector performing the least, as discussed in detail below.

7.3.2 PRIMARY ECONOMY

The primary economy in Ghana consists of the mining and agriculture industries. The primary economy in Ghana is the main employer and accounts for over 50 per cent of the workforce in the country. Table 42 below shows the performance of each sector that comprises the primary economy.

Table 42: Primary sector percentage growth rate (2007–2017)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agriculture	-1.7	7.4	7.2	5.3	0.8	2.3	5.7	4.6	2.8	3	8.4
Mining	6.9	2.4	6.8	18.8	20.7	19	14.8	3.85	-2.6	-12	63.55

Source: Ghana Statistical Services (2018).

Table 42 above shows a spike for 2010 and this was due to the Ghana Statistics Services' decision to start accounting for oil and gas separately from the other mining commodities in 2010, given its potential distorting effect on the mining industry. This effect is also manifested by the tremendous growth rate in mining between 2010 and 2013 where the sector recorded an average growth rate of 18.3 per cent reflecting unstable commodity price fluctuation. Table 43 below is a summary of the composition of mining and agricultural products. The abundant natural resource in the mining industry in Ghana is gold, while in agriculture, the country is a significant grower of cocoa.

Table 43. Sub-sector composition

Sub-sector	Product(s)
Agriculture	cocoa, other crops, livestock, forestry, fishing and logging
Mining	gold, diamond, manganese, aluminium, bauxite, crude oil and gas

Source: Ghana Statistical Services (2018).

The revenue from oil was almost equal to the total contribution to GDP of all other mining activities in 2015 at US$396 million, giving it an export share of 18.7 per cent (Ghana Statistics Services, 2016). The main reason for the increase in oil revenue was the higher oil price while the price of gold underperformed over the same period. The oil and gas industry in 2015 contributed 4 per cent to GDP, according to Rustad, Le Billon and Lujala (2017). According to Ghana Statistical Services (2016), in 2015 the activities from the agricultural industry contributed the following percentage to the GDP: cocoa (2.1 per cent), crops (14.6 per cent), livestock (1.2 per cent), forestry and logging (2.2 per cent) and fishing (1.1 per cent). Cocoa is an important product as it is also produced by the small-scale farmers who then aggregate their productions for bulk-buying commercial merchants. Over the 2007–2017 period, Ghana Statistical Services (2018) data shows that the agricultural sector has had an average growth of 4.16 per cent year on year. Ghana's economy is heavily dependent on agriculture and mining

to provide the main export products. For instance, mineral resources assisted the economy to move from 0.4 per cent GDP growth in 1980 to 8.4 per cent in 2017. Over the 1980–2017 period, inflation in Ghana dropped from 50 per cent to 12.4 per cent (World Bank, 2018c).

7.3.3 SECONDARY ECONOMY

The secondary economy in Ghana is dominated by the industry sector. The country has been on a drive to strengthen the industrial sector to diversify the economy. In 2017, the secondary economy experienced an average growth of 6.9 per cent, mainly due to the growth in the ICT, energy and water services after the country embarked on the special economic zone (SEZ) programme. Table 44 shows the relative growth rates of the sub-sectors of the secondary economy in the 2007–2017 period.

Table 44. Growth rate performance of the secondary economy, 2007–2017

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Manufacturing	-1.2	3.7	-1.3	7.6	17	2	-0.5	-0.8	2.2	2.7	3.7
Construction	23.1	39	0	9.3	2.5	17.2	16.4	8.6	0	2.2	4.6
Energy	-17	19.4	7.5	12.3	-0.8	11.1	16.3	0.3	-10	11.7	6.3
Water and sewage	1.2	0.8	7.7	5.3	2.9	2.2	-1.6	-1.1	20	-3.2	6.8
ICT	4.1	19.5	3.9	24.5	17	41.5	24.3	38.4	21.6	21.7	13.2

Source: Ghana Statistical Services (2018).

Table 45 outlines the constituents of the secondary sector in Ghana including the growth rate. Although the SEZs aim to increase production capacity for the secondary economy, the manufacturing sector in Ghana has not been growing fast enough to realise spinoffs from the SEZs in accordance with the industrialisation policy adopted in early 2000, although it is expected that this will transpire soon.

Table 45. Sub-sector composition

Sub-sector	Product(s)
Manufacturing	Agro-processing, light and heavy machinery manufacturing
Construction	Road, dams, port, rail and building
Energy	Electricity generation, transmission and distribution (infrastructure)
Water and sewage	Pipe networks (Infrastructure)
ICT	Cell phones, towers, transmission network (Infrastructure)

Source: Ghana Statistical Services (2018).

Investment in the manufacturing industry, although not adequate, has not slowed and the country continues to experience a surge in light and heavy manufacturing, such as cars and machinery manufacturing, that was unveiled in 2014. Ghana also assembles mobile phones and does agro-processing for agricultural products in the special economic industrial parks. It is worth noting that the mobile phone in Ghana has reached market saturation of 127 per cent per user in 2017.

7.3.4 TERTIARY ECONOMY

The tertiary economy has the highest number of sub-sectors and is the second-best performing sector in Ghana. Table 46 below gives a detailed account of the composition of each sub-sector.

Table 46. Sub-sector composition

Sub-sector	Product(s)
Trade	Mechanics and General trading
Hospitality	Hotels, Restaurants and Accommodation
Storage	Warehousing and Transportation
Financial and Insurance	Banking, Policies and Investment
Real Estate	Commercial and Residential, Admin and Sales
Education	Training
Health Care	Medical health care
Public Admin, Defence and Social Security	Police, Defence and Public service
Community and Personal activities	Social stability

Source: Ghana Statistical Services (2018).

The top sub-sectors of the tertiary economy in Ghana were financial and insurance, health care, education, trade and community and personal activities, with financial and insurance being the best performer while the least performer was hospitality. The top products in the sub-sectors of the tertiary economy in Ghana consist of banking, policies and investment, medical health care, training, mechanics and general trading, and social stability.

For the 2007–2017 period, the sector averaged growth of 7.23 per cent year on year. Table 47 below outlines the performance of each sub-sectors of the tertiary economy in the 2007–2017 period.

Table 47. Composition of the tertiary economy growth rate

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Trade	5.4	9.5	5.4	13.3	11	11.3	14.5	1.6	9.7	3.1	2.8
Hospitality	2.5	9.1	-3.8	2.7	3.6	5.7	24.6	-1.2	1.5	0.9	1.1
Storage	9.2	3.8	4.4	8	11	9.2	-0.5	0.3	3	2.2	0.4
Financial and Insurance	18.4	10.8	9.3	16.7	1	21.9	23.2	22.9	3.5	3.6	0.5
Real Estate	3.2	0	0.2	13.9	14	18.3	-18	-1.5	7.7	3.8	5.2
Education	10	13	12.4	5.3	3.8	6.7	6.9	7.1	7.9	8.3	9.9
Health Care	3.8	4.4	15.2	11.2	5	10.9	7.8	-1.7	15.7	16.8	14.4
Public Admin, Defence and Social Security	11.3	12.7	11.7	3.4	7.4	4.2	8.4	-4.7	1.4	2.2	1.5
Community and Personal activities	8,9	9,2	7,5	10,8	12,9	4,2	36,5	-1,6	-6,4	-5,2	-3,8

Source: Ghana Statistical Services (2018).

The main contributor to the tertiary sector and overall economic growth is the financial and insurance sub-sector with an average growth rate of 11.98 per cent for the 2007–2017 period. Health care is the second-best performer at 9.41 per cent over the same period while the least performer, hospitality, had an average growth rate of 4.24 per cent.

The three economic sectors in Ghana have played different roles in the economy and this is noticeable in the GDP performance. The planning in these sectors has led to better economic prospects for Ghana compared to other economies in the region. The growth was also boosted by the 100% debt relief cancelling the remainder of Ghana's debts owing to the IMF in 2005. As a result, the country has directed resources towards the development of SEZ infrastructure and general public infrastructure. Ghana has a better public infrastructure in the region with a strong appetite for investment by the private sector, especially in infrastructure development. The drive by the private sector for infrastructure investment is also influenced by Ghana's political and social stability and promising manufacturing sector. Furthermore, investors are also attracted to investing in Ghana on the basis of an economy that is relatively stable and is coming from the lower base and yet performing in SSA. Other than infrastructure investment

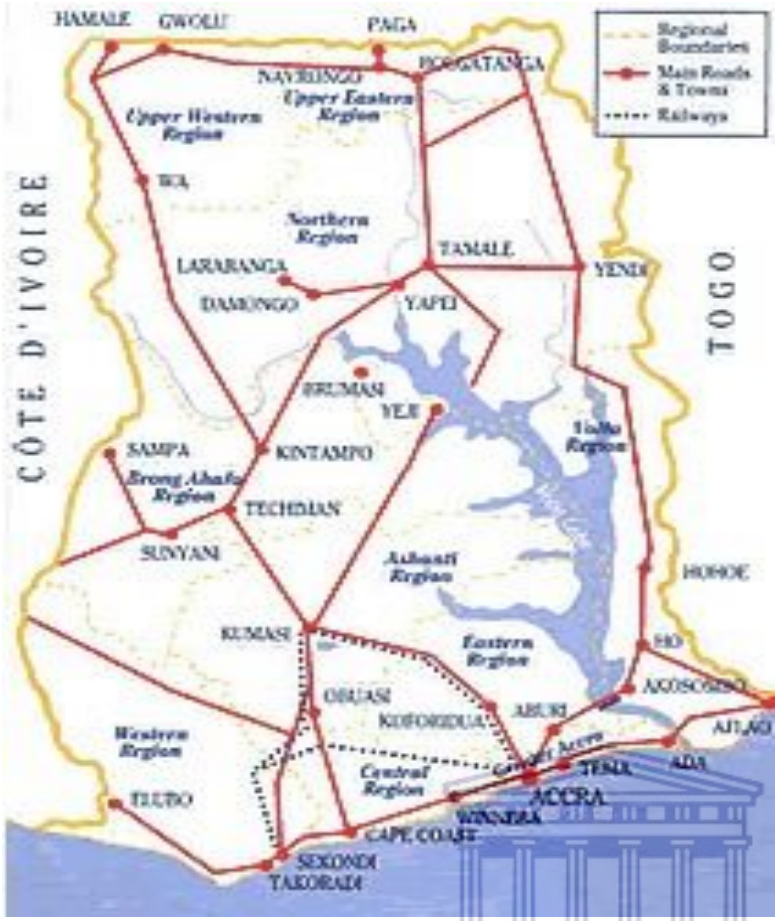
by the private sector, Ghana also attracts investment in gold, cocoa, crude oil and gas and these are the country's main exports. Although the manufacturing sector and service sector are slowly taking shape with motor manufacturing, the country has not built enough capacity and public infrastructure to support and to compete on a global scale in the manufacturing of goods and services.

7.3.5 SPECIAL ECONOMIC ZONES, INDUSTRIAL PARKS AND PORTS

Ghana has embarked on developing SEZs to address the lack of capacity and public infrastructure services such as energy, ICT and transportation. The approach will enable Ghana to orientate the economy towards export by investing in public infrastructure that supports economic growth. The SEZs are strategically placed with access to the sea and linked through other public infrastructure. Inadequate postcolonial public infrastructure that no longer supported the economic activities of the country led to the country starting to plan SEZs and industrial parks around early 2000.

As a result, the country's public infrastructure, including the sea ports, is being reconfigured. Tyson (2018) found in her research that Ghana had looked at various models to finance SEZs including partnership investments between the private and public sectors. The development of SEZs have been good vehicles for private infrastructure investment and have also facilitated trade within Ghana and other economies. The SEZs have led to better performance in sectors such as the services and industry sector. The infrastructure around the SEZs has also improved including the transportation infrastructure such as shipping, road, rail, port terminals, and related ICT and energy. The map below indicates the locations of SEZs in Ghana.

Figure 15: Ghana SEZ



Source: Ghana Department of Transport (2018).

It can be argued that the Ghana SEZs are aligned along the concept of an export-orientated economy based on their locations. These SEZs are separated into Export Processing Zones, Free Zones, Free Trade Zones, Industrial Parks and Free Ports. The focus for these zones is to promote urban enterprise to position and build the economy towards export. Companies are offered tax breaks, including tax holidays and certain exemptions from import duties, as long as they meet the requirement of exporting 70% of what they produce.

7.3.5.1 EXPORT PROCESSING ZONES

One of the export processing zones is enclaved in the western region of Ghana and is designated as the Sekondi Export Processing Zone (EPZ). The proximity of the Sekondi EPZ to the country's second-largest seaport is ideal for heavy industrial activities as it is linked with modern road infrastructure. According to Tyson (2018), the Sekondi EPZ is a partnership between Chinese Investment Company and the government of Ghana, where the Chinese

company is responsible for the development of infrastructure and also financing. The development has attracted multinational companies, especially in industrial minerals processing. Although these companies have not fully taken advantage of the zone, the establishment promises better economic prospects for the country, including an increase in FDI.

Shama EPZ, the dedicated petroleum and petrochemical zone located in Shama Ahanta, is strategically located for the petrochemical sector as it is located on seafront land in the western region of Ghana. According to Huang, Neequaye, Banahene, Van and Fynn (2018) and Ghana Free Zones Authority (GFZA, 2018), the government provides investment support for refinery, distribution, transit and supply chain support for chemical production as well as for manufacturing of by-products like plastics and gels for export. The country also has free zones for agricultural products under land banks also located in Shama Ahanta East in the western region.

The role of the government in partnering with the private sector in the investment and development of free processing zones remains limited to the provision of serviced land for "logistics and haulage contractors, manufacturing of chemical inputs and accessories for the petroleum industry". GFZA (2018) argues that the partnership between government and the private sector will also help Ghana in skills development and capacity building especially in public infrastructure development and the trade export market.

Another EPZ is located in Tema, a new seaside city located less than 25 km from Accra. The zone caters for manufacturing, service and commercial export activities. Infrastructure in place are roads, drains system, water supply, ICT and electricity connections. The zone is linked to the sea port and the airport through road infrastructure.

The Ashanti Technology Park is located in the main industrial park in the Ashanti region in Ejisu and focuses on the export market. The industrial park includes an ICT cyber village, cocoa processing, light and heavy industrial manufacturing, biotechnology development and warehousing. The park also processes products such as cocoa beans, gold, timber and wood and leatherware. The park infrastructure was developed as a joint venture with the private sector (Chinese investors). The EPZ still offers numerous opportunities for investors,

especially in the Ashanti Technology Park. These opportunities include the investment in clean water and distribution, electricity from thermal and bio-mass plants, ICT infrastructure development, accessories manufacturing, data processing and call centre operations (GFZA, 2018). Tema EPZ offers facilities for manufacturing, services and commercial export activities (see Tema port discussion below).

7.3.5.2 PORTS INFRASTRUCTURE IN GHANA

Ghana's major ports are Kotoka, Accra, Tema, Kumasi and Sekondi-Takoradi. Kotoka is a major international airport in Accra capital. The airport has three passenger terminals with each servicing domestic, regional and international flights. The seaport of Accra, the capital city, is mainly used by the fishing industry for export purposes. The port also caters for other goods including the wood and furniture industry. Tema port lies on the Gulf of Guinea and has good deep water berths that accommodate oil tanker berthing, as well as a dockyard, warehouses and transit sheds. The Tema port infrastructure is connected to the hinterlands through networks of roads that serve to transport goods to and from landlocked countries to the north of Ghana.

Ackah, Adjasi and Turkson (2016) state it is used by industrial and commercial companies that import and export goods including petrochemicals, cement, food, metals and textiles. The port handles over 80 per cent of Ghana's national imports and exports and is the main export port for cocoa. As a result of the port's importance to Ghana's economy, the country's port authority is adamant that more resources are needed to improve and expand port infrastructure, although the amount has not been quantified. The expansion is aimed at meeting the rising cargo traffic since it also handles the cargo for landlocked countries.

The other important port is Takoradi, located 230 km from the capital Accra, with its twin city Sekondi. The port is mainly used for the timber, energy and technology industries. Takoradi services mining centres such as Tamale and therefore has had good investment in the past due to the mining sector activities. Takoradi handles the bulk of timber, bauxite and manganese exports as well as exporting cocoa. Takoradi is an international port of trade for landlocked countries such as Mali, Burkina Faso and Niger. According to the Ghana Statistical Services (2006 and 2011), the port handles a third of Ghana's sea traffic and acts as an import hub for 20 per cent of Ghana's goods. The port had a major upgrade after 2004 with US$250 million

invested in the infrastructure and a further US$700 million in 2009 to accommodate offshore oil and gas production.

7.3.6 PORT UNDER DEVELOPMENT IN GHANA

7.3.6.1 BOANKRA INLAND PORT

According to GFZA (2018), the country and the private sector are to establish the Boankra Inland Port near Kumasi in the Ashanti region. The port will be linked with the ports of Tema and Takoradi, the interior and the landlocked countries of Burkina Faso, Mali and Niger through rail and roads infrastructure. Once operational, the port will ease congestion at seaports and facilitate cargo transition for neighbouring landlocked countries. According to GFZA (2018), the port offers:

Reduced "transport cost of international cargo to importers and exporters from the middle and northern parts of Ghana, including the Sahel sub-region; increased exportation of produce such as cola nuts, shea butter, cocoa and cocoa products, wood and wood products; promotion of the establishment of export processing zones in the vicinity of the inland port; assist in the provision of up-to-date infrastructure to meet current developments and technological changes in the shipping industry".

The port will also facilitate trade between Ghana and the neighbouring economies in the region. The proposed port boosts completed infrastructure services such as electricity, water and telephone facilities and the construction of an access road connecting the port to the Kumasi-Konongo highway. The cost of infrastructure services provision for Boankra Inland Port and the envisaged completion date for the project are unknown due to the inadequate offtake agreement between the government and the private investors.

7.3.7 THE SPECIAL ECONOMIC ZONES AND TRADE

The 2017 trade statistics for Ghana show that, despite the investment in SEZ infrastructure, the country has not yet realised the returns as it is still a net importer of goods and services. Ghana's main trading partners are Switzerland, China, the United Arab Emirates and the United Kingdom. The trade statistics show that gold, cocoa beans, crude oil, timber, aluminium, tuna fish, manganese ore and diamonds are the main export products for Ghana while Ghana imports finished goods such as machinery and processed goods. Despite Ghana being a net importer of

goods, data from the Bank of Ghana (2017) shows that the country has made considerable progress with consistent increases in exported goods since 2003. On average, the increase was 35 per cent for the 2003–2016 period on exported goods and services as a percentage of GDP.

The Ghana Statistical Services (2017) show that the top trading exports destinations for Ghana in 2016 were Switzerland (US$1,87 billion) United Arab Emirates (US$1,43 billion), China (US$942 million), India (US$1,56 billion) and Vietnam (US$549 million). During the same period, Ghana imported substantial amounts of goods from these countries. For instance, Ghana's imported goods from China in 2016 worth US$1,96 billion, the UK (US$1,11 billion), the USA (US$882 million, India (US$528 million) and Belgium (US$577 million). Based on the trade data from the Ghana Statistical Services (2017), it is evident that Ghana has inadequate trading activities on the continent although this can be explained by the types of goods that Ghana imports from the rest of the world. Another reason for the lack of trading activities with the rest of Africa is that Ghana's immediate neighbours Burkina Faso, Togo, Benin and Nigeria have no trading advantage relative to each other as they produce largely similar products and compete for the same markets.

The development of SEZs in Ghana, once completed, will likely have a positive effect on trade in the region. The existing zones and the proposed zones are considered to be at the centre of attracting private investment. The key to the success of SEZs is the infrastructure investment and development required that enables economic efficiency and competitiveness. Ghana is focusing on investing in specific infrastructure that complements its SEZs.

7.3.8 INVESTMENTS IN PUBLIC INFRASTRUCTURE IN GHANA

The Ghanaian economy has not been successful in generating steady growth over the past 10 years relative to its trading partners, such as China. This has been blamed on inadequate public infrastructure that hampers economic growth in the country. The existing infrastructure services require substantial support from the private sector since the country lacks resources to maintain and expand this infrastructure. Private investors in Ghana are predominately foreign multinational companies whose interests may not resonate with the country's long-term plan. Table 48 below indicates Public-Private Partnerships (PPPs) involvement in Ghanaian public infrastructure, by location, type and cost, since 2000. Each type is discussed in detail in the sections that follow.

Table 48. Infrastructure type, location and cost

Funder	Location	Project type		Mil. US$	
		Energy	Transport	Energy	Transport
PPP	LNG terminal in Tema	Energy		350	
PPP	Benin/Ghana/Nigeria/Togo pipeline	Energy		590	
PPP	Container terminal in Tema		Transport		10
PPP	Container import terminal in Tema		Transport		550
PPP	Tema motorway		Transport		500
PPP	Dry bulk terminal		Transport		357
PPP	Inland port in Kumasi		Transport		119,5
PPP	Road		Transport		105
PPP	Ghana Rail		Transport		1380
PPP	Tema port expansion		Transport		1500
PPP	Port of Takoradi		Transport		1000
Private	Nzema	Energy		324	
Private	Nkwanta	Energy		525	

Source: PPP market intelligence. 2018.

7.3.9 ENERGY INFRASTRUCTURE

Ghana never had energy security since it mostly relied on hydroelectric energy plants that were built during the colonial era. Despite the challenge, the country built SEZs without initially investing adequately in energy. Given the amount of energy that the SEZs require, Ghana is embarking on investing in energy infrastructure to expand its energy mix to include solar, wind and biomass energy.

The current main source of energy in Ghana is still hydroelectricity. This energy infrastructure is located south-east of Ghana and is known as the Akosombo hydroelectric or Volta dam, the largest energy infrastructure project in Ghana which produces 6,495 Gigawatt hours of electricity daily. The Volta dam is operated by the government through the parastatal, the Electricity Company of Ghana. The Volta dam was built in 1961 to supply electricity to the mining sector, such as aluminium and gold mines. The funding for Volta was undertaken by the International Bank for Reconstruction and Development for the World Bank, and the

governments of the United States, Ghana and the United Kingdom. The concern has been expressed that the biggest source of energy in Ghana is dependent on rainfall patterns and thus increase the risk to the energy security of the country.

The energy mix that Ghana is investing in includes solar energy. The country aims to generate 6 per cent of its energy needs from solar energy, a target that has not been met (Ghana Statistical Services, 2012). The solar energy project is earmarked for development in Nzema by multinational companies from Germany and China. The estimated cost of the solar energy project is US$324 million. Although there was a delay in delivering the project, the government is still committed to the project given the success rate and demand for reliable energy in Ghana, especially in the SEZs. The country's climate also favours the probability of success of solar energy projects.

Wind energy projects are situated in Nkwanta, the Accra Plains, and the Kwahu and Gambaga mountains. The country's energy company estimates that available wind energy is around 600 Gigawatts hours per year. A new wind energy project in Ayitepa is under construction and the cost is estimated to be US$525 million (PPP market intelligence, 2018). The project is to be operated by NEK Umwelttechnik Ghana and Atlantic International for 25 years. According to the Electricity Company of Ghana, the Ayitepa wind farm will supply 225 MW to the grid. The construction of the Ayitepa project started in 2017.

Ghana is exploring investing in biomass energy to encourage rural economic development in line with the country's policy on the energy mix. Although this has not gained enough traction, a concern could be raised that the biomass energy project may undermine food security for the country if not properly monitored and managed. The concern is based on the fact that over 50 per cent of the working population depend on agriculture for employment, especially in the cocoa plantations. However, assuming that there will be no adverse effect on food security, biomass energy production could augment other energy supplies since the country does not produce adequate energy for domestic consumption.

Ghana also has limited reserves of crude oil and gas. Investment in the hydrocarbon energy sector continues to be considered with scepticism since Ghana does not have refinery facilities. As a result, the country imports refined petroleum products for domestic consumption.

Investment in the energy sector will increase with the development of SEZs, provided the government secures funding or a partnership to develop the zones (PPP market intelligence, 2018). The country has invested in energy infrastructure projects such as the Tema LNG terminal and the Benin/Ghana/Nigeria/Togo pipeline. The estimated cost for the Tema LNG terminal is US$350 million while the Benin/Ghana/Nigeria/Togo pipeline is estimated to be US$590 million. These projects do not entirely address Ghana's energy security. For instance, the investment in energy will benefit the urban areas since most of the developments are taking place in the urban areas where SEZs are envisaged, including the investment and development of other infrastructure such as ICT and transportation, as discussed below. The rural communities will thus still not have a guaranteed energy supply and the rural economy will remain agriculture-based.

7.3.10 TELECOMMUNICATION INFRASTRUCTURE

The ICT sector remains an important economic enabler for economies in SSA, including Ghana. The private ICT companies have been vigorously competing throughout the continent given the growth potential that the telecommunication sector offers for mobile and data. Ghana has three dominant companies in the ICT sector – MTN, Vodafone and Tigo-Airtel. These three companies are responsible for most of the telecommunication infrastructure investment in the country with MTN reaching a market share of 47 per cent in 2017. The investment in telecommunication or ICT infrastructure has played an important role in transforming the economy of Ghana. Telecommunications in rural areas enable farmers to determine fair prices for their products and also determine the right time to sell their produce. The introduction of ICT services has enabled transactions through mobile money for communities that are located away from the cities where there is limited access to banks. The mobile infrastructure has transformed the informal and formal market in Ghana since more services are accessed through mobile technology, including insurance, banking, government services and social networking. The development of SEZs in Ghana will stimulate the Ghana ICT infrastructure to expand since their success in business communication and transactions, including connecting foreign investors with their countries of origin, will depend on fast and reliable connectivity infrastructure. The mobile telecommunication companies in Ghana are investing substantially in the development of fibre optic network infrastructure in and around the major economic zones, although the amount invested remains unknown. The investment in fibre infrastructure shows that the country is serious about transforming its economy through ICT. Ghana already

hosts the biggest ICT and mobile manufacturing company in SSA. A recent study by the Internet Society (2019) found that internet usage in Ghana had increased from 3 per cent in 2011 to 33.6 per cent, although this is still below Africa's average usage of 35.9 per cent. The increase was supported by growth in mobile telephone use (68.9 per cent), mobile modem (65 per cent), ISDN dial-up (23.8 per cent) wireless broadband (18.7 per cent) and ADSL (0.5 per cent). However, internet access remains inadequate in rural areas where coverage is sparse. Although progress has been made in ICT, Ghana continues to struggle with building ICT technology centres in Accra to develop innovation and entrepreneurship and propel the economy into research and development in ICT for the 4th Industrial Revolution.

In 2012, when Ghana had a population of 25,73 million, Baylon and Antwi-Boasiako (2016) reported that there were only 165 licensed internet service providers in Ghana in 2010 with only 29 providers running on fibre optic infrastructure. While the population increased by over three million population between 2012 and 2017, the country did not experience a major increase in internet access. Baylon and Antwi-Boasiako (2016) state that 176 operators were authorised as VSAT suppliers with 99 authorised as internet operators for the public and 25 for private and public data and packet-switched networks. MTN is the biggest mobile company in Ghana with almost half of the market share followed by Tigo/Airtel. While the fixed line is almost on its way to extinction in Ghana, mobile use continues to rise with more infrastructure investment taking place, although the amount of investment per company in the mobile sector is unknown. For example, in 2017, mobile subscription stood at 35,98 million (127 per cent penetration) while the mobile data subscription was 21,58 million (76.2 per cent penetration). The growth is unlikely to be sustained without Ghana participating in the 4th Industrial Revolution. Increasing investment in ICT infrastructure services will, once ICT infrastructure services are in place, propel the economy onto a new trajectory of competitive advantage in the region and also encourage investment in other infrastructure services.

7.3.11 TRANSPORT INFRASTRUCTURE

Transportation infrastructure is at the centre of all economic development including in Ghana. Without functional transportation networks, economies tend to grow slower when compared to other economies with integrated infrastructures. For instance, Ghana's Ministry of Transport has proposed investment in the construction of roads and bridges that will connect SEZs to other transportation networks as part of the ongoing economic transformation programme. The

investment in this infrastructure will connect key economic areas where most people are employed (agriculture) and SEZs. Ghana expects to construct 99 steel bridges and several roads in the central and northern part of the country in the coming 10 years. Furthermore, the Ghana Ministry of Transport (2015) proposes revamping the railway network, mostly in the Western, Ashanti, Eastern and Greater Accra regions to reduce transportation congestion and facilitate trade.

Work on the development of the Western railway line (Kojokrom-Kumasi with branch lines to Dunkwa-Awaso-Nyinahin) as well as the 85 km railway line from the Tema Port to link the Volta Lake via the Akosombo Port is under way, although the completion time is unknown (PPP market intelligence, 2018). The cost of the project is estimated to be US$1,38 billion on completion (PPP market intelligence, 2018). It is also planned to connect the Eastern railway line with Boankra Inland port. Feasibility studies for the project have been completed and the project is envisaged to be a public-private sector partnership, although the government had not procured a strategic investment partner for the project at the time of this study. Once completed, the rail network will also connect with the other networks to service SEZs and neighbouring economies.

Table 49 below shows some of the investments undertaken by the government of Ghana with the private sector. The investments were spread over six years with a focus on developing and supporting the SEZs. The country invested over US$5,5 billion in transportation infrastructure between 2012 to 2018, as indicated below.

Table 49. Infrastructure type, location and cost

Location	Project Type	Amount in mil US$
Container terminal in Tema	Transport	10
Container import terminal in Tema	Transport	550
Tema motorway	Transport	500
Dry bulk terminal	Transport	357
Inland Port in Kumasi	Transport	119,5
Road	Transport	105
Ghana Rail	Transport	1,380
Tema port expansion	Transport	1,500
Port of Takoradi	Transport	1,000

Source: PPP market intelligence and the African Development Bank.

The US$5,5 billion investment includes a container terminal in Tema which cost Ghana US$560 million to develop and a further US$1,5 billion to expand the ports other than Tema such as Takoradi. Takoradi received an investment of up to US$1 billion through a public-private partnership for expansion of the port. Table 49 above shows that Ghana invested an estimated US$357 million in dry bulk terminal infrastructure and an estimated US$119,5 million the development of an inland port in Kumasi. The dry bulk terminals allow the ports to handle different types of cargo for export and import.

Attracting infrastructure investment in Ghana has been made easier as the country enjoys political stability which creates a level of certainty for private investors, especially in capital infrastructure investment projects. However, Ghana has not attracted enough private investment because of the country's proximity to unstable economies in the region, a phenomenon that will take a while to overcome.

The process of industrialisation and modernisation of infrastructure started in early 2000 and was informed by the identified challenges facing the country's economic growth (Kwakye and Fouracre, 1998). Transportation infrastructure was found to be at the centre of the challenges and addressing it was seen as more urgent to unlock economic growth in the country, an argument also raised by Mensah, Domfeh, Ahenkan and Bawole (2013) in their analysis of policy and institutional perspectives on local economic development in Africa, including

Ghana. There has been some progress in addressing transportation infrastructure challenges in Ghana, especially congested roads and rehabilitation of some major road networks.

The progress made in transportation infrastructure investment in Ghana will help the country to exports more value-added goods and change the dominance of raw materials, food products, minerals, oil and wood for export. The development of SEZs and the transformed transportation infrastructure will enable Ghana to boost its exports market while reducing the import of high value-added manufactured goods that can be developed and produced locally through the industrialisation programme. Ghana is well-positioned to benefit from regional economic growth by collaborating with neighbouring economies on infrastructure investment. For instance, Bawku, as an economic zone, is linked by road with the coastal ports and other zones and is situated in the north-east of Ghana, only 5 km from Burkina Faso and 20 km from Togo. The zone has a high potential to create economic opportunities for the economies in the region.

7.4 COMPARATIVE SUMMARY OF THE CASE STUDIES AND EMPIRICAL ANALYSIS

The economic setup of the countries that are included in the case studies can be summarised as consisting of primary, secondary and tertiary sectors. Based on the case study analysis, the primary economy is more dominant and contributes more to the GDP growth of the three countries. For instance, agriculture and mining activities are at the centre of driving the primary economy in Ghana, Angola as well as the DRC. The three economies have oil and other natural resources at varying stages of exploitation. The research used case studies analysis to identify challenges and opportunities in infrastructure services. Furthermore, the research augmented the analysis through a quantitative approach by analysing factors that influence infrastructure investment and development in SSA. For instance, the case studies show that risks such as poor governance and political uncertainty play important roles for investors in SSA.

Similarly, the empirical model shows that there is a correlation associated with infrastructure investment and risk. The correlation matrix of the Vector Error Correction Model also shows that there is a positive association between infrastructure investment and the GDP and capital formation in all three sampled economies. Thus, an increase in capital formation or GDP could stimulate the level of infrastructure investment in these economies.

The case studies also highlighted the rate of economic growth in all three countries. Economic growth can reflect the monetary stability of a country where interest rates play an important role, i.e. the empirical analysis shows that lower interest rates could influence infrastructure investment while higher rates could have the opposite effect. The three countries are dependent on primary sector activity such as mining and the agricultural and there are concerted efforts to transform their economies into industrial-driven economies.

The case studies show that the transformation of the economy from a primary base can be aided by diversifying and integrating agricultural activities with industrial manufacturing and processing through special economic zones. The transformation, according to the empirical analysis outcome through factors such as capital formation, shows a positive relationship with infrastructure development, which should benefit the economy through better trade and efficiency. Thus, the investment in agro-processing will benefit the rural infrastructure which remains underdeveloped in the three countries. The remaining challenge is the investors' perceived risks of investing in rural infrastructure. It may be ambitious or unrealistic to expect investors to start taking advantage of these investment opportunities in public infrastructure without the country governments or the SSA region as a whole addressing and mitigating risks. In the case study countries, this was attempted through public-private partnerships of various types.

CHAPTER EIGHT: CONCLUSION

8.1 SUMMARY OF FINDINGS

Investment in infrastructure plays an important role in a developmental state. However, for an economy to acquire infrastructure services, there should be a substantial commitment to invest in it. Understanding the factors that influence the commitment to invest, especially in infrastructure services, is important for policy makers and private investors. This includes understanding factors that may lead to infrastructure investment in the economy and policy recommendations on how SSA can handle these factors to influence investment and trade flows.

The research study addressed the existing body of theoretical literature concerning the infrastructure investment in SSA region and growth. In the literature review on investment and economic growth theories, two general trends of thought were distinguished and discussed. The first trend is supported by scholars who contend that a positive association exists between investment (including infrastructure) and economic growth. The second trend suggests a negative association. Although the two views were found to be balanced, the first was more credible as the results from the case studies and the quantitative analysis suggest that infrastructure investment is an instrument for growth but is limited by other factors. Therefore there is a need to address these factors.

Since the research was conducted using the case studies approach as well as the quantitative method, it has the unique strength to deal with a variety of evidence. Thus, the evidence for the case studies was gathered from qualitative analysis while quantitative methods were based on data analysis. The quantitative and qualitative evidence were then triangulated to integrate the information and data to answer the key research objectives.

The research undertook to provide a brief historical background of infrastructure investment in Africa to identify the main factors that influence infrastructure investment and economic growth. The historical backgrounds of the three countries i.e. Angola, the DRC and Ghana, were detailed as part of the case study. Furthermore, the research outlined a detailed profile of the key economic sectors of each of the three countries to identify key factors that influence

the sectors. The roles of key economic sectors and their relations to economic growth were regarded as critical due to the sectors' reliance on infrastructure investment growth. For instance, the three economies are still dominated by primary economic activities which rely on transportation infrastructure. The study found that transportation infrastructure in these countries remain inadequate and therefore negatively impacted economic growth and investment.

It was also found that, despite the infrastructure investment backlog and inadequate economic growth, there has been very little investment in the development of infrastructure services such as transportation and energy. However, several achievements in ICT infrastructure have been made with the assistance of private investment, especially in mobile networks, although more still need to be done. For instance, all the three countries have reached deep mobile network penetration which has facilitated businesses to trade in rural areas and thus aids economic growth.

Economic growth factors that influence infrastructure were discussed in relation to the impact they have on investment. The analysis of these factors and how they influence infrastructure services were anchored on various studies on the relationship between growth and investment. In the case study discussions, it became evident that infrastructure investment is influenced by various factors, including those analysed in this study.

The research found that infrastructure is a viable instrument for attracting FDI inflows into the host countries. The finding is in line with the theoretical and empirical evidence which advocate that infrastructure investment may result in economic benefits to economies when factors that affect infrastructure development are addressed. The assessment from the case studies also shows that, despite opportunities, the infrastructure backlog is a challenge in SSA, due to several factors that need to be addressed if the region is to pursue integrated economic growth through infrastructure development. The case studies show that the challenges facing the region in infrastructure investment include the cost of borrowing and poor governance. As a result of poor governance, the study found that the quality of infrastructure in Angola and the DRC is compromised. Poor governance and corruption were also found to influence the investment attitudes of private investors in public infrastructure services in all three countries and the region.

The research shows that aspects of the colonial infrastructure services influenced or still play a role in the case study countries. For example, colonial-era infrastructure services mainly served the urban population, despite the majority of the population living in rural areas, and the postcolonial backlog this caused in rural infrastructure in SSA persists.

It was shown that SSA countries have similar experiences of public infrastructure investment, such as not having enough transportation infrastructure or the lack of an adequate power supply. Since the existing infrastructures were mainly built to serve urban populations, the consequence of this poor spatial planning is the lack of development in the periphery, where natural resources are exploited without much benefit to rural development.

The study found that successful investment is dependent on good governance. Without good governance in place, countries struggle to attract investment in infrastructure development. Good governance enables countries to manage and optimise limited resources for development. The implementation of sound economic policies combined with good governance leads to growth in infrastructure development.

It was observed that economies with good planning, organising and controlling characteristics that facilitate trade and growth such as infrastructure services can satisfy their social and administrative needs. Conversely, the research demonstrated that countries in SSA that were included in the study lack these characteristics, and therefore struggle to plan and implement the development of basic public infrastructure. The lack of planning skills in SSA also contributes to the poor management of public finances and consequent underfunding of general public infrastructure services. As a result, public infrastructure continues to deteriorate with an adverse effect on investment in the region.

The research infers that the region struggles to appeal to investors despite opportunities to invest, due to the lack of coordinated infrastructure services. Although the opportunities to invest in public infrastructure abound in SSA, the region has not attracted enough investment, despite the introduction and development of special economic zones in countries such as Ghana, Angola and the DRC. As a result, SSA economies find it difficult to be competitive in global trade and also struggles to trade efficiently within the region due to the lack of infrastructure services.

There is generally no clear plan in place to invest in transportation infrastructure such as railways to connect countries in the region. The continued dependence on a decaying road network infrastructure for trade tends to concentrate economic activities in urban areas since the road infrastructure in SSA mainly link and serve the urban areas. The research concludes that the rural road infrastructure in the SSA region remains moribund despite the agricultural sector being the major player in these economies, with the majority of the population residing in rural areas and working in agriculture.

Furthermore, the natural advantages of agriculture in the case study countries and elsewhere in SSA, of an abundance of arable land and water and conducive climates, would enable the sector to contribute more to economic growth, were it not for the lack of infrastructure investment in distribution logistics, including roads, railways and power. The constraints of infrastructure development on electricity generation also make it difficult for the region to industrialise and the inability to guarantee the electricity supply adds to the risk for the investors.

Political instability in the region has played an adverse role historically in infrastructure investment and investors still consider the region to be risky for credit extension. The notion of risk in the region has confined investments to the primary sector, mainly in mining activities where the minerals can easily be exported. Investing in public infrastructure or in the tertiary economy requires more commitment of resources over the long term, which requires investors with more appetite for risk, especially if a country is seen as unstable or lacking good governance.

The study notes that China seems less risk-averse than western investors and has pursued partnerships in many of the economies in the region to exploit the infrastructure services opportunities in exchange of minerals. However, the public infrastructure built by China under the natural resources exchange programme in countries such as Tanzania, Zambia, Kenya, Angola and the DRC may turn out to be more expensive due to the lack of capacity to negotiate with China or to monitor and evaluate the results of the investment programmes. Furthermore, China has been accused of turning a blind eye to corruption due to its ‘no interference’ stance in the countries it invests in.

While the case studies explained the infrastructure investment factors qualitatively, the study undertook to explain similar factors quantitatively. The study ran three separate VECM for three economies and compared their results. The first part of each model was to run stationarity tests by using the Dickey-Fuller and Philips-Perron tests. The Dickey-Fuller and Philips-Perron tests revealed that the data series are non-stationary at levels and are only stationary when second differenced. Other econometric tests, including the cointegration, multicollinearity, autocorrelation and heteroscedasticity, were conducted.

The VECM from the three economies showed that infrastructure investment is influenced by risk since risk was common in the selected economies. Thus, risk plays a unique role in investment and this includes the cost of borrowing. Despite its endowment in natural resources, this study confirms that investment in natural resources has not translated into high growth in infrastructure development in SSA. This shows that investment decisions are based on risk assessment and not investment opportunities alone. The results emphasise the importance of addressing risks to attract more investment to SSA.

The three economies show that the response of infrastructure investment to capital formation or investment flows was positive. This is in line with economic theory that argues that during the expansion phase of the economy, capital formation tends to increase the amount of infrastructure as the country increases borrowing to expand, but this investment gets to a point where there is not much value added. The quantitative analysis shows the dynamic reaction of infrastructure investment and the impulse response functions have the expected pattern and confirm the results of the short-run relationship analysis.

The research concludes that, despite the clear positive relationship between infrastructure investment and economic growth, the investment in infrastructure services in SSA is politically contested and exacerbated by the scramble for SSA's riches in natural resources by foreign investors, the legacy of colonialism, corruption and lack of governance. The combination of these factors is having an adverse effect on the development of infrastructure in the region.

8.2 POLICY RECOMMENDATIONS

Infrastructure investment is highly dependent on factors that were identified by the case study and quantitative analysis. These factors are good governance, an anti-corruption approach,

financial risk management, technical skills development and management of macroeconomic factors. Without these factors, infrastructure investment cannot be realised to bring about desirable economic benefits. These factors should be considered a focal point for the states, regions and policy makers in the SSA region in directing policies.

The case study and the quantitative analysis for the three economies have demonstrated that there is a positive association between infrastructure investment and risks. Based on the positive association between the two, the research recommends that policy makers in the region should focus more on addressing macroeconomic factors, poor governance and corruption to increase investment and economic growth for the region.

Furthermore, for the region to successfully attract private sector investment, SSA should devise policies that encourage a conducive investment environment with a focus on infrastructure services. This requires policy makers in the region to establish central policy coordination points that facilitate infrastructure investments in roads, bridges, electricity, water, energy, seaports and communication networks in SSA.

The case studies show that regional infrastructure is uncoordinated with very little benefit for regional trade. For example, the transportation infrastructure plays a role in the inefficiencies in these economies, including the high cost of road transportation in the region exacerbated by the absence of significant rail networks. Policy makers should focus on developing infrastructure nodal points and networks to promote regional trade.

There is also a need for the SSA region to formulate macro-economic policies that promote economic stability for the whole region. Coordinated fiscal and monetary policies for the region should be in place that are informed by the infrastructure needs for SSA, which will assist the region to attain economic growth through regional trade.

As demonstrated in the quantitative analysis and findings for the three economies, the research recommends that the SSA region should consider developing policies that are orientated towards reducing external debt since the debt can be used by investors to measure financial risk appetite for the region. SSA can propose export-led trade strategies that emphasise regional

trade, to improve the regional balance of payments and result in improved risk conditions for investment and lower costs of credit for the economies in the region.

High perceptions of risk were explained in the quantitative analysis. To reduce the perception of risk in the region, which is detrimental to attracting investment and therefore affects economic growth, there is a need to develop a predictable political atmosphere in SSA. Instability in the DRC is a particular challenge for the public and also private investors. The research recommends that the region should consider focusing on improving good governance and ensuring that there is protection of property rights, and that corruption and bureaucratic uncertainty are addressed.

The case study has shown that the SSA region is well endowed with natural resources and remains significant in the global market. To begin dealing with the disadvantages of SSA countries' in individually negotiating trade agreements with developed economies, and more recently China, SSA should develop a natural resources trade policy and association similar to OPEC to protect common regional interests and address the pillaging of Africa's natural resources. In particular, the scramble for mineral resources which is a source of conflict in many parts of SSA should be addressed through policy changes if Africa intends to develop infrastructure services from her rich mineral resources. This should also include addressing risk reduction by dealing with the conflict, corruption and bad governance in the region that enable the pillaging and inhibit investment and development.

Countries in the SSA region should have a coordinated response to the role of foreign powers, companies and individuals in destabilising the region for their economic benefits, especially in mining and natural resources. Destabilisation includes sponsoring political conflict and divisions to create instability, rent-seeking and other forms of corruption, participating directly in the illegal pillaging of natural resources or indirectly by encouraging the destruction of existing infrastructure, undermining the rule of law and enabling criminal syndicates and black markets.

Foreign interests could not undermine SSA economies without the cooperation of corrupt political leaders and government officials. Political leadership should be held to the highest standards of accountability. The region should cooperate to ensure that corrupt politicians and

foreign sponsors are brought to book. This should include greater coordination between the investigative and judicial agencies of the countries and more aggressive oversight by elected representatives.

Lastly, rather than work in country silos, the region should consider agreeing to and enforcing minimum standards for infrastructure such as roads, rail and ICT, as well as to cooperate in joint ventures and shared technology for energy generation and distribution. This will create synergies, economies of scale and seamless integration of regional infrastructure services and facilitate trade and economic growth benefits across the region.

8.3 LIMITATIONS AND AREAS FOR FURTHER RESEARCH

The research only considers three countries (Angola, the DRC and Ghana) from the SSA region for both the case study and quantitative analysis, selected on the basis of colonial history and geographical location. Each was representative of a different colonial experience, i.e. Angola represented Lusophone countries, DRC Francophone countries and Ghana Anglophone countries. A follow-up study could include more countries from the region or focus on only countries of one colonial experience.

The selected countries have challenges of data not being available. Where data was available, it only started around the middle of 2000 with some parts of the data being missing. For further studies, should complete data be available, follow-up research could encompass more countries in the SSA region.

The data unavailability also limited the number of variables included as explanatory variables for analysis. For instance, variables such as human capital development and privatisation could not be considered due to considerable missing data. The absence of the variables mentioned above would most probably result in the challenges of omitted variable bias.

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APPENDICES

APPENDIX A

6.20 ANGOLA

CPI
ADF INTERCEPT ONLY

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.598398	0.9993
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.971950	0.9998
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-28.87076	0.0001
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	0.505704	0.9990

Test critical values:	1% level	-4.165756
	5% level	-3.508508
	10% level	-3.184230

*MacKinnon (1996) one-sided p-values.
Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.854186	0.9527
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.369953	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		5.234888	1.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.597887	0.9882
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.987167	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		5.554337	1.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.818567	0.9564
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.445664	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

EXD
ADF INTERCEPT ONLY

Null Hypothesis: EXD has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.325768	0.9775
Test critical values:	1% level	-3.565430	
	5% level	-2.919952	
	10% level	-2.597905	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.764788	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.398464	0.0001
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: EXD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.843485	0.9532
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.738993	0.2270
Test critical values:	1% level	-4.186481	

	5% level	-3.518090
	10% level	-3.189732

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.670843	0.0000
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: EXD has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.554425	0.9992
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	3.21E+17
HAC corrected variance (Bartlett kernel)	6.90E+17

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.144390	0.0300
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-6.648867	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: EXD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.425767	0.3623
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.146114	0.1079
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.639291	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

GDP
ADF INTERCEPT ONLY

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.013542	0.2802
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	

	10% level	-2.600658

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.655288	0.4469
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.49714	0.0000
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND INTERCEPT

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.187275	0.2135
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.580278	0.4846
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.681627	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.286230	0.0211
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	4.18E+17
HAC corrected variance (Bartlett kernel)	1.51E+18

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.656775	0.4462
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.65E+17
HAC corrected variance (Bartlett kernel)	1.81E+17

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-6.681627	0.0000

Test critical values:	1% level	-3.581152
	5% level	-2.926622
	10% level	-2.601424

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.233065	0.9904
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.565420	0.2972
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.609871	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

GFCF
ADF INTERCEPT ONLY

Null Hypothesis: GFCF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.893545	0.3327
Test critical values:	1% level	-3.565430	

	5% level	-2.919952
	10% level	-2.597905

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.063237	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.832832	0.0000
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: GFCF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.295061	0.4282
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.607147	0.2791
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.557554	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: GFCF has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.045160	0.2673
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.474386	0.1281
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.633363	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: GFCF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.901974	0.9473
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.798280	0.2051
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.557554	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

INF_INV
ADF INTERCEPT ONLY

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.208741	0.9704
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.730293	0.4098
Test critical values:	1% level	-3.577723	

	5% level	-2.925169
	10% level	-2.600658

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-22.61896	0.0001
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.160010	0.1050
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.804964	0.6865
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.613538	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.446465	0.9830
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.849989	0.3525
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.675653	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.963006	0.6061
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-1.919986	0.6284
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.613538	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

6.21 DRC

DRC
CPI
ADF INTERCEPT ONLY

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.829318	0.3618
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.901678	0.3285
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.327972	0.0000
Test critical values:	1% level	-3.596616	

	5% level	-2.933158
	10% level	-2.604867

*MacKinnon (1996) one-sided p-values.

ADF CPI INTERCEPT AND TREND

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.897308	0.6386
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.359914	0.3944
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.256529	0.0000
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

*MacKinnon (1996) one-sided p-values.

CPI PP
INTERCEPT ONLY

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.141616	0.2300
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.022616	0.2764
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.327972	0.0000
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.521156	0.9788
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.499299	0.3270
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.256529	0.0000
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

*MacKinnon (1996) one-sided p-values.

EXD
ADF WITH INTERCEPT ONLY

Null Hypothesis: EXD has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.547105	0.5013
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.662148	0.0883
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.475506	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: EXD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-2.763532	0.2175
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.626343	0.2711
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.455593	0.0003
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

PP
INTERCEPT ONLY

Null Hypothesis: EXD has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.908739	0.7771
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.850775	0.0590
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.633729	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: EXD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.866644	0.6561
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.814792	0.1994
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.569705	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

GDP
ADF INTERCEPT ONLY

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.291189	0.9183
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.808138	0.3722
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.637072	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.455516	0.3478
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-1.653998	0.7557
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.632982	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.092473	0.9969
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.878998	0.3391
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.637072	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.879662	0.6495
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.752368	0.7116
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.632905	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

GFCF
ADF INTERCEPT ONLY

Null Hypothesis: GFCF has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.495376	0.5254
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root

Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.947454	0.3080
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.100559	0.0000
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: GFCF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 9 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.273032	0.8799
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 8 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.262039	0.4437
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.062976	0.0001

Test critical values:	1% level	-4.211868
	5% level	-3.529758
	10% level	-3.196411

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: GFCF has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.201631	0.6664
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.946835	0.0476
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.634206	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP WITH INTERCEPT AND TREND

Null Hypothesis: GFCF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.158266	0.5012
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.912713	0.1679
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.565614	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

INF_INV
ADF INTERCEPT ONLY

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.695384	0.0073
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.848003	0.0594
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.634334	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.746475	0.0288
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.811807	0.2005
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.563104	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-2.260235	0.1887
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.
Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.070151	0.0358
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.634334	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP WITH INTERCEPT AND TREND

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.294706	0.4286
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.036948	0.1335
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.563104	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

6.23 GHANA

ADF INTERCEPT ONLY

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.895927	0.9946
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.799755	0.8099
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.879780	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.151637	0.9087
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.758989	0.7085
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.801985	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		6.216167	1.0000
Test critical values:	1% level	-3.574446	

	5% level	-2.923780
	10% level	-2.599925

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.790135	0.8126
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.882160	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.145710	0.9999
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.776795	0.7001

Test critical values:	1% level	-4.165756
	5% level	-3.508508
	10% level	-3.184230

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(CPI,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.803128	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

EXD

ADF INTERCEPT ONLY

Null Hypothesis: EXD has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.835930	0.3587
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.767759	0.3910
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.040627	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: EXD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.739636	0.7160
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.235165	0.8902
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.260678	0.0000
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: EXD has a unit root

Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.754177	0.9922
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.279672	0.0215
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.700411	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: EXD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.894728	0.0013
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.515314	0.3197
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(EXD,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.055512	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

GDP

ADF INTERCEPT ONLY

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.225847	0.9715
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.734943	0.4075
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.675653	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.160010	0.1050
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.804964	0.6865
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.613538	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.446465	0.9830
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.
Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.849989	0.3525
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.675653	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.963006	0.6061

Test critical values:	1% level	-4.161144
	5% level	-3.506374
	10% level	-3.183002

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.919986	0.6284
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.613538	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

GFCF

ADF INTERCEPT ONLY

Null Hypothesis: GFCF has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.577937	0.4858
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.309096	0.1734
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.646973	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: GFCF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.472047	0.3399
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.302548	0.4243
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.586786	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: GFCF has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.038023	0.7322
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.500933	0.1217
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.646973	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: GFCF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.532842	0.8041
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.491775	0.3306
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GFCF,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.586786	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

INF_INV

ADF INTERCEPT ONLY

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		1.612309	0.9993
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.330287	0.9117
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-22.00381	0.0001
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

ADF INTERCEPT AND TREND

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.038910	0.9998
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.551603	0.7954
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-21.90580	0.0000
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT ONLY

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.247952	0.1927
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.147804	0.0298
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.647999	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

PP INTERCEPT AND TREND

Null Hypothesis: INF_INV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.543432	0.3070
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.065216	0.1264
Test critical values:	1% level	-4.165756	
	5% level	-3.508508	
	10% level	-3.184230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(INF_INV,2) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.648058	0.0000
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

APPENDIX B

7.2.1.1 ANGOLA

	INF_INV	GFCF	GDP	EXD	CPI
INF_INV	1	0.7685	0.9621	0.9677	0.9237
GFCF	0.7681	1	0.8843	0.6628	0.5303
GDP	0.9621	0.8843	1	0.9102	0.8293
EXD	0.9677	0.6628	0.9102	1	0.9691
CPI	0.923	0.5303	0.8293	0.9691	1

7.2.3 DRC

	INF_INV	GFCF	GDP	EXD	CPI
INF_INV	1	-0.2818	-0.2156	0.4542	-0.1931
GFCF	-0.2818	1	0.8904	-0.9096	0.8956
GDP	-0.2156	0.8904	1	-0.8232	0.9301
EXD	0.4542	-0.9096	-0.823	1	-0.8625
CPI	-0.1931	0.8956	0.9301	-0.8625	1

7.2.1.3 GHANA

	INF_INV	GFCF	GDP	EXD	CPI
INF_INV	1	0.5508	0.5605	0.6218	0.6766
GFCF	0.5508	1	0.8864	0.9144	0.8269
GDP	0.5605	0.8864	1	0.9786	0.9514
EXD	0.6218	0.9144	0.9786	1	0.9621
CPI	0.6766	0.8269	0.9514	0.9621	1

APPENDIX C

6.2.6 ANGOLA

Vector Error Correction Estimates
Date: 04/25/20 Time: 23:41
Sample (adjusted): 2005Q4 2017Q1
Included observations: 46 after adjustments
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	CointEq1
INF_INV(-1)	1.000000
GFCF(-1)	0.053169 (0.14342) [0.37071]
GDP(-1)	0.358707 (0.15348) [2.33711]
EXD(-1)	-1.843933 (0.37333) [-4.93911]
CPI(-1)	-49758430 (6.4E+07) [-0.77620]
C	-2.42E+10

Error Correction:	D(INF_INV)	D(GFCF)	D(GDP)	D(EXD)	D(CPI)
CointEq1	-0.013483 (0.01870) [-0.72103]	-0.024155 (0.09937) [-0.24308]	-0.013445 (0.05282) [-0.25456]	0.178699 (0.04323) [4.13333]	-7.16E-11 (1.8E-10) [-0.40527]
D(INF_INV(-1))	0.942320 (0.21772) [4.32814]	0.101277 (1.15702) [0.08753]	0.087855 (0.61496) [0.14286]	-0.699874 (0.50338) [-1.39035]	-6.77E-10 (2.1E-09) [-0.32892]
D(INF_INV(-2))	0.011969 (0.22538) [0.05311]	0.594340 (1.19774) [0.49622]	0.189403 (0.63661) [0.29752]	-0.397249 (0.52110) [-0.76233]	5.84E-11 (2.1E-09) [0.02741]
D(GFCF(-1))	-0.020998 (0.04214) [-0.49826]	0.739917 (0.22395) [3.30388]	0.016894 (0.11903) [0.14192]	0.127303 (0.09744) [1.30654]	-5.78E-11 (4.0E-10) [-0.14516]
D(GFCF(-2))	-0.026666 (0.04116) [-0.64784]	-0.231069 (0.21874) [-1.05634]	0.012367 (0.11626) [0.10637]	-0.041980 (0.09517) [-0.44112]	-2.38E-10 (3.9E-10) [-0.61168]
D(GDP(-1))	0.004472 (0.06741) [0.06634]	0.156273 (0.35826) [0.43621]	0.870644 (0.19042) [4.57234]	-0.051795 (0.15587) [-0.33231]	-1.31E-10 (6.4E-10) [-0.20626]

D(GDP(-2))	0.011056	0.396773	-0.094676	-0.000418	-1.73E-10
	(0.07038)	(0.37404)	(0.19880)	(0.16273)	(6.7E-10)
	[0.15708]	[1.06079]	[-0.47623]	[-0.00257]	[-0.26004]
D(EXD(-1))	0.039986	0.021949	0.026204	0.381724	1.80E-10
	(0.07907)	(0.42021)	(0.22334)	(0.18282)	(7.5E-10)
	[0.50569]	[0.05223]	[0.11732]	[2.08799]	[0.24128]
D(EXD(-2))	-0.011666	0.098949	-0.087201	0.019194	-1.27E-10
	(0.07115)	(0.37812)	(0.20098)	(0.16451)	(6.7E-10)
	[-0.16396]	[0.26168]	[-0.43389]	[0.11667]	[-0.18949]
D(CPI(-1))	-24397045	-32018485	-25915453	1.48E+08	0.766046
	(2.5E+07)	(1.4E+08)	(7.2E+07)	(5.9E+07)	(0.24054)
	[-0.95851]	[-0.23671]	[-0.36047]	[2.52034]	[3.18472]
D(CPI(-2))	10335809	38808354	-6009825.	1.13E+08	0.113791
	(2.8E+07)	(1.5E+08)	(7.8E+07)	(6.4E+07)	(0.25990)
	[0.37582]	[0.26553]	[-0.07737]	[1.77986]	[0.43783]
C	92331027	-8.21E+08	1.92E+08	-1.68E+08	1.637624
	(1.0E+08)	(5.3E+08)	(2.8E+08)	(2.3E+08)	(0.94957)
	[0.91889]	[-1.53683]	[0.67487]	[-0.72189]	[1.72460]
R-squared	0.752277	0.672413	0.783393	0.671641	0.920688
Adj. R-squared	0.672131	0.566429	0.713314	0.565407	0.895028
Sum sq. resids	9.25E+17	2.61E+19	7.38E+18	4.95E+18	82.61967
S.E. equation	1.65E+08	8.77E+08	4.66E+08	3.81E+08	1.558843
F-statistic	9.386355	6.344466	11.17876	6.322287	35.88068
Log likelihood	-928.6927	-1005.531	-976.4571	-967.2471	-78.74012
Akaike AIC	40.89968	44.24047	42.97640	42.57596	3.945223
Schwarz SC	41.37672	44.71751	43.45343	43.05300	4.422259
Mean dependent	5.74E+08	3.80E+08	9.22E+08	5.68E+08	4.858696
S.D. dependent	2.88E+08	1.33E+09	8.70E+08	5.79E+08	4.811344
Determinant resid covariance (dof adj.)		4.43E+68			
Determinant resid covariance		9.76E+67			
Log likelihood		-3927.047			
Akaike information criterion		173.5673			
Schwarz criterion		176.1512			

6.2.7 DRC

Vector Error Correction Estimates
Date: 04/25/20 Time: 23:29
Sample (adjusted): 2005Q4 2016Q1
Included observations: 42 after adjustments
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	CointEq1
INF_INV(-1)	1.000000
GFCF(-1)	0.075892
	(0.02196)
	[3.45652]
GDP(-1)	-0.066942

	(0.01069)				
	[-6.26179]				
EXD(-1)	-0.086040				
	(0.01148)				
	[-7.49673]				
CPI(-1)	-2341584.				
	(1443305)				
	[-1.62238]				
C	1.98E+09				

Error Correction:	D(INF_INV)	D(GFCF)	D(GDP)	D(EXD)	D(CPI)
CointEq1	-0.363342	-1.289224	0.310731	0.985579	3.76E-09
	(0.11516)	(0.64520)	(0.16254)	(0.85708)	(1.6E-09)
	[-3.15509]	[-1.99819]	[1.91173]	[1.14993]	[2.35558]
D(INF_INV(-1))	0.719677	-0.413222	0.136099	0.346102	1.24E-09
	(0.18760)	(1.05103)	(0.26478)	(1.39619)	(2.6E-09)
	[3.83627]	[-0.39316]	[0.51401]	[0.24789]	[0.47560]
D(INF_INV(-2))	0.205097	1.203518	-0.220726	-0.444614	-2.20E-09
	(0.21022)	(1.17775)	(0.29670)	(1.56453)	(2.9E-09)
	[0.97565]	[1.02188]	[-0.74393]	[-0.28418]	[-0.75308]
D(GFCF(-1))	0.052006	1.031288	-0.046472	-0.169257	-6.88E-10
	(0.05422)	(0.30376)	(0.07652)	(0.40352)	(7.5E-10)
	[0.95920]	[3.39505]	[-0.60729]	[-0.41945]	[-0.91453]
D(GFCF(-2))	0.043654	0.144297	-0.036046	-0.283071	-5.84E-10
	(0.05817)	(0.32592)	(0.08211)	(0.43296)	(8.1E-10)
	[0.75040]	[0.44273]	[-0.43901]	[-0.65381]	[-0.72435]
D(GDP(-1))	0.242574	0.980391	0.753179	-0.691228	-2.27E-09
	(0.14992)	(0.83992)	(0.21160)	(1.11575)	(2.1E-09)
	[1.61805]	[1.16724]	[3.55953]	[-0.61952]	[-1.09095]
D(GDP(-2))	0.034326	-0.273854	-0.132197	0.555760	-2.07E-09
	(0.15058)	(0.84366)	(0.21254)	(1.12071)	(2.1E-09)
	[0.22795]	[-0.32460]	[-0.62200]	[0.49590]	[-0.99139]
D(EXD(-1))	0.041641	0.182873	-0.029315	0.632365	-4.53E-10
	(0.03523)	(0.19739)	(0.04973)	(0.26221)	(4.9E-10)
	[1.18191]	[0.92646]	[-0.58952]	[2.41166]	[-0.92669]
D(EXD(-2))	-0.019209	-0.018228	0.008612	-0.103942	-2.86E-10
	(0.03315)	(0.18573)	(0.04679)	(0.24672)	(4.6E-10)
	[-0.57946]	[-0.09814]	[0.18407]	[-0.42129]	[-0.62292]
D(CPI(-1))	22841606	72423823	-21844382	-55702158	0.563332
	(1.6E+07)	(9.2E+07)	(2.3E+07)	(1.2E+08)	(0.22879)
	[1.38448]	[0.78353]	[-0.93809]	[-0.45364]	[2.46223]
D(CPI(-2))	15504539	40241072	-11380915	16688735	-0.214833
	(1.6E+07)	(8.8E+07)	(2.2E+07)	(1.2E+08)	(0.21864)
	[0.98338]	[0.45556]	[-0.51143]	[0.14222]	[-0.98257]
C	-1.75E+08	-4.61E+08	2.01E+08	1.03E+08	2.739673

	(6.8E+07)	(3.8E+08)	(9.7E+07)	(5.1E+08)	(0.94865)
	[-2.55248]	[-1.20170]	[2.08601]	[0.20312]	[2.88796]
R-squared	0.640020	0.610044	0.811216	0.606653	0.776139
Adj. R-squared	0.508028	0.467060	0.741996	0.462426	0.694057
Sum sq. resids	8.60E+16	2.70E+18	1.71E+17	4.77E+18	16.54437
S.E. equation	53551016	3.00E+08	75582659	3.99E+08	0.742616
F-statistic	4.848916	4.266528	11.71928	4.206234	9.455627
Log likelihood	-799.9676	-872.3432	-814.4405	-884.2701	-40.03132
Akaike AIC	38.66512	42.11158	39.35431	42.67953	2.477682
Schwarz SC	39.16160	42.60806	39.85079	43.17601	2.974159
Mean dependent	1595238.	1.10E+08	3.62E+08	-1.41E+08	1.702381
S.D. dependent	76347974	4.11E+08	1.49E+08	5.44E+08	1.342593

Determinant resid covariance (dof adj.)	2.28E+64
Determinant resid covariance	4.24E+63
Log likelihood	-3374.656
Akaike information criterion	163.7932
Schwarz criterion	166.4824

6.2.8 GHANA

Vector Error Correction Estimates

Date: 05/06/20 Time: 12:07
Sample (adjusted): 2005Q4 2017Q1
Included observations: 46 after adjustments
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	CointEq1
INF_INV(-1)	1.000000
GFCF(-1)	-0.127372
	(0.02733)
	[-4.66026]
GDP(-1)	0.026856
	(0.03921)
	[0.68489]
EXD(-1)	0.185648
	(0.05613)
	[3.30763]
CPI(-1)	-31740557
	(4506727)
	[-7.04293]
C	1.04E+09

Error Correction:	D(INF_INV)	D(GFCF)	D(GDP)	D(EXD)	D(CPI)
CointEq1	-0.812642	0.152739	0.306504	-0.190723	-9.75E-10
	(0.15004)	(0.39810)	(0.11222)	(0.17112)	(4.0E-10)
	[-5.41617]	[0.38367]	[2.73135]	[-1.11455]	[-2.42798]
D(INF_INV(-1))	0.909223	-0.037038	-0.008498	0.012763	-6.99E-11
	(0.14740)	(0.39110)	(0.11024)	(0.16811)	(3.9E-10)
	[6.16841]	[-0.09470]	[-0.07708]	[0.07592]	[-0.17716]

D(INF_INV(-2))	0.621659	-0.040977	-0.237512	0.262866	7.11E-10
	(0.22784)	(0.60452)	(0.17040)	(0.25985)	(6.1E-10)
	[2.72853]	[-0.06778]	[-1.39383]	[1.01161]	[1.16610]
D(GFCF(-1))	0.033729	0.794858	-0.026826	0.031707	1.32E-10
	(0.07215)	(0.19143)	(0.05396)	(0.08228)	(1.9E-10)
	[0.46750]	[4.15223]	[-0.49715]	[0.38534]	[0.68462]
D(GFCF(-2))	-0.070894	-0.166020	-0.022374	-0.042738	-3.45E-11
	(0.07420)	(0.19688)	(0.05550)	(0.08463)	(2.0E-10)
	[-0.95542]	[-0.84325]	[-0.40317]	[-0.50501]	[-0.17364]
D(GDP(-1))	0.119263	-0.034056	0.793852	-0.008941	-6.73E-11
	(0.25217)	(0.66908)	(0.18860)	(0.28760)	(6.8E-10)
	[0.47295]	[-0.05090]	[4.20920]	[-0.03109]	[-0.09973]
D(GDP(-2))	0.045296	0.213709	-0.016905	0.158468	2.38E-11
	(0.25033)	(0.66421)	(0.18723)	(0.28550)	(6.7E-10)
	[0.18095]	[0.32175]	[-0.09029]	[0.55505]	[0.03556]
D(EXD(-1))	-0.188251	0.106234	0.084910	0.670539	-2.45E-10
	(0.15859)	(0.42078)	(0.11861)	(0.18087)	(4.2E-10)
	[-1.18705]	[0.25247]	[0.71588]	[3.70730]	[-0.57779]
D(EXD(-2))	-0.021830	0.103737	0.065106	-0.038599	1.19E-10
	(0.14521)	(0.38530)	(0.10861)	(0.16562)	(3.9E-10)
	[-0.15033]	[0.26924]	[0.59946]	[-0.23306]	[0.30562]
D(CPI(-1))	-78806885	69954323	12788957	-1266925.	0.779034
	(6.9E+07)	(1.8E+08)	(5.2E+07)	(7.9E+07)	(0.18532)
	[-1.13838]	[0.38084]	[0.24700]	[-0.01605]	[4.20367]
D(CPI(-2))	-56372964	-1.07E+08	32173299	-40352441	0.050039
	(7.0E+07)	(1.9E+08)	(5.3E+07)	(8.0E+07)	(0.18866)
	[-0.79989]	[-0.56964]	[0.61038]	[-0.50203]	[0.26523]
C	4.56E+08	16405748	-58074557	2.10E+08	0.776864
	(1.2E+08)	(3.3E+08)	(9.3E+07)	(1.4E+08)	(0.33220)
	[3.67524]	[0.04983]	[-0.62573]	[1.48661]	[2.33856]
R-squared	0.705004	0.626814	0.796060	0.680873	0.948198
Adj. R-squared	0.609564	0.506077	0.730079	0.577626	0.931438
Sum sq. resids	1.36E+18	9.59E+18	7.62E+17	1.77E+18	9.757376
S.E. equation	2.00E+08	5.31E+08	1.50E+08	2.28E+08	0.535707
F-statistic	7.386881	5.191577	12.06503	6.594612	56.57673
Log likelihood	-937.5810	-982.4682	-924.2195	-943.6287	-29.60696
Akaike AIC	41.28613	43.23775	40.70520	41.54907	1.808998
Schwarz SC	41.76317	43.71478	41.18223	42.02611	2.286035
Mean dependent	2608696.	1.79E+08	5.74E+08	3.59E+08	3.826087
S.D. dependent	3.20E+08	7.56E+08	2.88E+08	3.51E+08	2.045910

Determinant resid covariance (dof adj.)	1.85E+66
Determinant resid covariance	4.09E+65
Log likelihood	-3801.118
Akaike information criterion	168.0921
Schwarz criterion	170.6760
Number of coefficients	65

APPENDIX D

E1: ANGOLA

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/25/20 Time: 23:43
Sample: 2005Q1 2017Q4
Included observations: 47

Joint test:

Chi-sq	df	Prob.
421.4261	300	0.0000

E2: DRC

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/25/20 Time: 23:33
Sample: 2005Q1 2017Q4
Included observations: 43

Joint test:

Chi-sq	df	Prob.
446.3588	300	0.0000

E3: GHANA

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 04/25/20 Time: 23:17
Sample: 2005Q1 2017Q4

Included observations: 46

Joint test:

Chi-sq	Df	Prob.
272.0829	330	0.9912

APPENDIX E

7.16 ANGOLA

VEC Residual Serial Correlation LM Tests
Date: 05/06/20 Time: 13:39
Sample: 2005Q1 2017Q4
Included observations: 46

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.22972	25	0.9736	0.502447	(25, 94.4)	0.9742
2	15.10823	25	0.9388	0.579018	(25, 94.4)	0.9401

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.22972	25	0.9736	0.502447	(25, 94.4)	0.9742
2	49.84515	50	0.4796	0.988351	(50, 94.6)	0.5087

*Edgeworth expansion corrected likelihood ratio statistic.

7.17 DRC

VEC Residual Serial Correlation LM Tests
Date: 05/06/20 Time: 13:40
Sample: 2005Q1 2017Q4
Included observations: 42

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	21.60227	25	0.6586	0.852028	(25, 79.5)	0.6655
2	16.00948	25	0.9145	0.611686	(25, 79.5)	0.9169

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	21.60227	25	0.6586	0.852028	(25, 79.5)	0.6655
2	114.2807	50	0.0000	3.242118	(50, 76.3)	0.0000

*Edgeworth expansion corrected likelihood ratio statistic.

7.18 GHANA

VEC Residual Serial Correlation LM Tests
Date: 05/06/20 Time: 13:17
Sample: 2005Q1 2017Q4
Included observations: 46

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	44.11398	25	0.0105	1.951257	(25, 94.4)	0.0113
2	12.86810	25	0.9781	0.487862	(25, 94.4)	0.9786

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	44.11398	25	0.0105	1.951257	(25, 94.4)	0.0113
2	122.0728	50	0.0000	3.404026	(50, 94.6)	0.0000

*Edgeworth expansion corrected likelihood ratio statistic.

APPENDIX F

VARIANCE DECOMPOSITIONS

TABLE 6.7.I ANGOLA

Variance Decomposition of INF_INV: Period	S.E.	INF_INV	GFCF	GDP	EXD	CPI
1	1.43E+08	100.0000	0.000000	0.000000	0.000000	0.000000
2	2.86E+08	97.53558	0.627613	0.066984	0.016275	1.753550
3	4.37E+08	93.91057	2.737676	0.343382	0.056115	2.952259
4	5.92E+08	89.73636	6.204460	0.905380	0.156463	2.997333
5	7.50E+08	85.01973	10.45118	1.778018	0.336940	2.414131
6	9.11E+08	79.90896	14.86891	2.928528	0.558551	1.735050
7	1.07E+09	74.63952	19.08312	4.275757	0.741750	1.259856
8	1.23E+09	69.37433	22.98483	5.713940	0.822839	1.104058
9	1.37E+09	64.15502	26.62025	7.133016	0.791037	1.300675
10	1.51E+09	58.94963	30.06781	8.428467	0.687675	1.866411
11	1.64E+09	53.72756	33.36108	9.505336	0.583723	2.822303
12	1.76E+09	48.51640	36.46087	10.28325	0.554768	4.184712
13	1.88E+09	43.42351	39.26410	10.70551	0.662862	5.944016
14	2.00E+09	38.62048	41.63630	10.75012	0.947188	8.045910
15	2.12E+09	34.30028	43.45344	10.43746	1.422208	10.38662
16	2.25E+09	30.62621	44.63743	9.829398	2.080904	12.82606
17	2.39E+09	27.69332	45.17360	9.019001	2.900504	15.21358
18	2.54E+09	25.51401	45.10799	8.114112	3.848529	17.41535
19	2.69E+09	24.02726	44.53070	7.220394	4.887967	19.33368
20	2.85E+09	23.12179	43.55446	6.428084	5.981324	20.91434
21	3.02E+09	22.66257	42.29572	5.804389	7.093732	22.14359
22	3.20E+09	22.51334	40.86120	5.391309	8.195219	23.03893
23	3.38E+09	22.55178	39.34057	5.207529	9.262086	23.63804
24	3.55E+09	22.67761	37.80380	5.252656	10.27733	23.98860

TABLE 6.7.II DRC

Variance Decomposition of INF_INV: Period	S.E.	INF_INV	GFCF	GDP	EXD	CPI
1	46969284	100.0000	0.000000	0.000000	0.000000	0.000000
2	82419456	97.80991	0.002279	1.807608	0.084717	0.295488
3	1.09E+08	92.31452	0.237988	6.299383	0.169224	0.978890
4	1.28E+08	83.48790	1.961277	12.35431	0.214730	1.981784
5	1.43E+08	72.46918	6.260106	17.87014	0.233238	3.167337
6	1.57E+08	61.82481	12.36436	21.20860	0.248260	4.353971
7	1.68E+08	53.75380	18.10896	22.41823	0.285697	5.433318
8	1.76E+08	48.84515	21.85749	22.54399	0.375112	6.378251
9	1.81E+08	46.51864	23.32484	22.45676	0.548157	7.151606
10	1.83E+08	45.73798	23.31552	22.45562	0.827745	7.663127
11	1.84E+08	45.39186	23.15834	22.40867	1.208205	7.832920
12	1.86E+08	44.65140	23.91313	22.08224	1.644057	7.709171
13	1.89E+08	43.30820	25.69111	21.43905	2.071720	7.489920

14	1.92E+08	41.70276	27.78927	20.67485	2.448586	7.384530
15	1.96E+08	40.29231	29.43747	20.03146	2.765986	7.472770
16	1.98E+08	39.32682	30.30504	19.64144	3.032133	7.694566
17	2.00E+08	38.80446	30.51202	19.50393	3.252903	7.926684
18	2.00E+08	38.57096	30.40644	19.53068	3.425467	8.066454
19	2.01E+08	38.43795	30.32742	19.60572	3.543086	8.085818
20	2.01E+08	38.27038	30.44926	19.63761	3.603873	8.038877
21	2.02E+08	38.02127	30.75113	19.58977	3.616114	8.021714
22	2.04E+08	37.71381	31.09846	19.47848	3.596459	8.112788
23	2.05E+08	37.39828	31.35718	19.34661	3.563439	8.334500
24	2.06E+08	37.11700	31.46405	19.23405	3.531652	8.653253

TABLE 6.7.III GHANA

Variance Decomposition of INF_INV: Period	S.E.	INF_INV	GFCF	GDP	EXD	CPI
1	2.02E+08	100.0000	0.000000	0.000000	0.000000	0.000000
2	3.55E+08	99.49802	0.239646	0.084925	0.042590	0.134819
3	4.30E+08	98.35583	1.103464	0.098590	0.058152	0.383966
4	4.44E+08	96.60982	2.605227	0.170759	0.055994	0.558198
5	4.55E+08	94.60520	3.626923	1.098004	0.137396	0.532477
6	4.96E+08	92.87346	3.288708	2.882707	0.269740	0.685385
7	5.40E+08	91.21800	2.779602	4.391580	0.319550	1.291271
8	5.61E+08	89.56787	2.739575	5.238004	0.305600	2.148955
9	5.64E+08	88.47445	2.831497	5.488026	0.326414	2.879611
10	5.72E+08	88.32666	2.752398	5.338277	0.438791	3.143876
11	5.89E+08	88.46147	2.839174	5.080739	0.580101	3.038514
12	6.04E+08	88.08146	3.474524	4.879570	0.668042	2.896407
13	6.10E+08	87.23482	4.454173	4.780363	0.693011	2.837633
14	6.13E+08	86.45713	5.215135	4.819868	0.687894	2.819972
15	6.18E+08	86.07061	5.449534	4.968283	0.683620	2.827949
16	6.24E+08	85.93515	5.382342	5.102944	0.688978	2.890585
17	6.27E+08	85.82548	5.343063	5.141275	0.698084	2.992103
18	6.27E+08	85.70930	5.388087	5.132553	0.704215	3.065841
19	6.28E+08	85.61947	5.408091	5.194009	0.704430	3.073995
20	6.31E+08	85.50316	5.368960	5.377400	0.700880	3.049597
21	6.33E+08	85.30007	5.331187	5.624879	0.701286	3.042575
22	6.35E+08	85.05900	5.322331	5.844372	0.715182	3.059118
23	6.35E+08	84.88127	5.313008	5.986277	0.746837	3.072611
24	6.37E+08	84.78455	5.297635	6.059618	0.790911	3.067283