

**THE CAUSAL RELATIONSHIP BETWEEN ROAD TRANSPORT
INFRASTRUCTURE DEVELOPMENT AND ECONOMIC GROWTH
IN NAMIBIA (1990-2014)**

A Dissertation

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By

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Dedication

Firstly, I dedicate this thesis to my mother who passed away on the 7th of June 2015 and I have this to say, “Without your unwavering support and distinct care since my childhood I wouldn’t have reached this far. It is common knowledge that everyone has a mother but with you it is different because of the extraordinary role you played in my life, being a single parent forced you to act as a father, friend, mentor and spiritual guide. This made me very strong and ambitious, and cultivated in me the culture of “Never give-up till you reach the top”. I know your relationship with God was pure and genuine and I am sure you are enjoying the afterlife in the Kingdom of Heaven. Investing in me was not a mistake, but indeed one of the most strategic and sustainable decisions you ever made – something you will never regret. I will fulfil your wish as I promised.”

May your soul rest in eternal peace.

Love you Mom, For Ever and Ever,

Amen

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I take this opportunity to express my special gratitude to my lovely wife, Panguu, without your continuous support, this achievement could not have been possible.

May God Bless YOU All.

Amen

Abstract

The major aim of the study was to examine the short and long-run relationships and directional causality flow between road transport infrastructure development and economic growth in Namibia for the period 1990-2014. To achieve this objective, the study adopted the auto regression distributive lag (ARDL) Bounds testing approach to co-integration, to examine the short-run and long-run relationship between economic growth and transportation infrastructure in Namibia. The data was sourced from the World Bank Database on GDP from 1990 to 2014, the Namibia National Planning Commission MTEF (Medium-Term Expenditure Framework from 1990-2015) and the Roads Authority Annual Reports from 1999 to 2014, which were imported into the E-view tool to run quarterly regressions from 1990 - 2014.

The results confirm a relationship among the variables. The Bounds test results indicated that there exists a long-run relationship among the variables under study. The estimated long-run model showed that there is a statistically insignificant positive relationship between expenditure on road transport and economic growth as well as between information communication technology and economic growth in Namibia. However, the short-run model revealed a positive and statistically significant relationship between expenditure on road transport and economic growth. Conversely, both the long-run and short-run estimates showed a statistically insignificant and negative relationship between foreign direct investment and economic growth. Lastly, the Granger causality test results showed no causality between expenditure on road transport and economic growth in Namibia.

The present study offers fresh insights to policy makers on crafting appropriate policies to regulate tax consolidation revenue and infrastructure levies collection; secondly, to boost public sector borrowing on international capital markets through bond issues, infrastructure funds and revenue bonds; thirdly, to develop partner financing business models through sector budget support; fourthly, to secure private sector financing through a private debt, private equity or capital structure leveraging business model; and lastly, implementing fast-tightened fiscal and monetary policy measures on foreign direct investment which currently severely affect Namibian capital outflows.

Key words: Road Transport Infrastructure Development, Economic Growth, Namibia, ARDL
Paper type Research paper.

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List of Abbreviations and Acronyms

AD	-	Aggregate Demand
AfDB	-	African Development Bank
ARDL	-	Autoregressive Distributed Lag Model
AIT	-	Amount of Air Transportation
RAT	-	Amount of Rail Transportation
BoN	-	Bank of Namibia
CEO	-	Chief Executive Officer
DBSA	-	Development Bank of Southern Africa
DCA	-	Directorate of Civil Aviation
DFIs	-	Development Financial Institutions
DOT	-	Department of Transport
DRC	-	Democratic Republic of Congo
DR	-	District Road
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
GERT	-	Government Expenditure on Road Transport
GIPF	-	Government Institutions Pension Fund
GMM	-	Generalised Methods of Moment
GRN	-	Government of the Republic of Namibia
HPI	-	Human Poverty Index
HKIA	-	Hosea Kutako International Airport
HPP	-	Harambee Prosperity Plan

JICA	-	Japan International Cooperation Agency
ICT		Information Communication Telecommunication [According to the Oxford Dictionary: Information and Computing Technology]
IRI	-	International Roughness Index
KfW	-	Kreditanstalt für Wiederaufbau
LDCs	-	Least Developed Countries
MDCs	-	Most Developed Countries
MLTRMP	-	Medium to Long Term Road Master Plan
MoF	-	Ministry of Finance
MWT	-	Ministry of Works and Transport
MTEF	-	Medium Term Expenditure Framework
MR	-	Main Road
NAC	-	Namibia Airports Company
NamPort	-	Namibian Ports Authority
NDP5	-	Fifth National Development Plan
NPC	-	National Planning Commission
OLS	-	Ordinary Least Square
PPP	-	Public Private Partnership
TR	-	Trunk Road
RA	-	Roads Authority
RCC	-	Roads Contractor Company
RMS		Road Management System
RFA	-	Road Fund Administration

ROT	-	Amount of Road Transportation
RUC	-	Roads Users Charges
SADC	-	Southern African Development Community
SDMS	-	Sovereign Debt Management System
SIDS	-	Small Island Developing States
SOEs	-	State-Owned Enterprises
SOC	-	Social Overhead Capital
SSA	-	Sub-Saharan Africa
SVAR	-	Structural Vector Autoregressive
UK	-	United Kingdom
US	-	United States
WBCG	-	Walvis-Bay Corridor Group
VECM	-	Vector Error Correction Model
VAR	-	Vector Auto Regression

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The concept of “Road transport infrastructure development” is the foremost structure of the component parts of the transportation structure that offers the foundation or the provision of transport facilities and operations to all sectors of the economy across the country, regionally and continentally by means of the road mode of transport with the key aim of achieving economic goals. The probable significance of transport development for investment, trade, growth and poverty lessening has long been acknowledged. Not only does transport infrastructure enable the orthodox provision of amenities to consumers but also affords transitional inputs that enter into the production of other sectors and raises factor output. The correlation between road transport infrastructure development and economic growth has been broadly treated in theoretical and empirical works, but economists hold different viewpoints. In the literature on the connection between road transport infrastructure development and economic growth, one question has remained inconclusive, and that is whether policy makers should first pursue road transport infrastructure development, or economic growth, or whether they should pursue both road transport infrastructure development and economic growth at the same time.

This version was further supported by Hirschman (1958) and Nurske (1961), who focused on social infrastructure investment and they contended that the unbalancing of the economy with social overhead capital (SOC) would at a later stage embolden private investment in unswervingly productive activities. Social overhead capital comprises of the simple facilities, without which, primary, secondary and tertiary productive undertakings are unable to operate.

Social overhead capital includes: investment in education, public health, communications, transportation and conventional public utilities such as electricity, water, irrigation and drainage schemes. Lin (1994) also sketches some significant methods in which the government can increase economic advancement.

These embrace the provision of public goods and substructures, societal facilities and beset interference (such as export subsidies).

Furthermore, Gramlich (1994) adds that it remains fundamentally uncertain whether the path of causation is from transport infrastructure to economic growth or vice-versa or both. Numerous prior studies could not evidently ratify the direction of causation regarding the development of the transport sector and economic growth. However, it has been claimed that the direction of causality is affected by the scale of the infrastructure investment in the economy.

Zhang *et al.*, (2012), stated that Namibian infrastructure stock as a percentage of gross domestic product (GDP) stands at 5%. This is a bit on the low side when equated to growing economies such as China that invest about 9% of their GDP in infrastructure advancement. This infrastructure investment to-GDP ratio is relatively low to immaterial to stimulate Namibian economic growth.

Conferring to BoN (2014), the infrastructure backing requisite of Namibia for 2014/15 to 2019/2020 stood at N\$223.6 billion. Transport infrastructure represents 55% of the aggregate amount, trailed by energy (23%) and housing (20%). But the modest analysis among each transport method reveals that the road transport method is third with 14.5%, port 28.4%, rail 49.4% and 7.9% for the air transport method of the all-inclusive budget distribution.

1.2 STATEMENT OF THE PROBLEM

The intention of this study is to determine the nexus between road infrastructure development and economic growth, and the directional causality among the concern variables. Similar empirical studies have been conducted on few African countries (Kweka and Morrissey, 2000; Jung and Thorbeeke, 2001 and Garba and Abdullahi, 2013) but most of them have focused on European and Asian countries (Li and Liang 2010; Soli, Harvey and Hagan, 2008; Dipietro and Anoruo, 2012 and Ahmad, 2014. However, as argued by Mitchell (2005); Muthui, Kosimbei, Maingi and Thuku (2013) literature from these studies reveals no consensus on the impact of government spending on economic performance. As argued by Ogbuagu (2015) understanding the link between fiscal strategies and economic growth has elevated massive debate theoretically and empirically. However, expansion in Namibian public expenditure has become a topical issue in the light of escalating public expenditure which is resulting in a wide spreading budget deficit; as a result, the government is relentlessly under pressure to borrow to settle-off the budget deficit.

The data from the World Bank on Namibia; World Development Indicators from 1984 to 1993 showed an average economic growth of 2.9%, while the government expenditure on road transport infrastructure development showed an average growth of 0.13%. This has continued from 1994 to 2003 with an average economic growth increase of 4.4% and 0.48% increase in government expenditure on road transport infrastructure development. The last century between 2004 and 2014 reported an average of 4.7% increase in economic growth and 0.19% decline in government expenditure on road transport infrastructure development. From this statistical data there seems to be a lot of disparity between economic growth and government expenditure on road transport infrastructure development. The question that begs to be answered therefore is that, if economic growth can be impelled on by government expenditure on road transport infrastructure development then why is it that there is such a disparity in the Namibian economic growth rate and vice versa. We also need to question whether a short and long run connexion between government expenditure on road transport infrastructure development and economic growth still exists in Namibia and if so what is the directional causality flow?

1.3 OBJECTIVES OF THE STUDY

The main objective of the study was to inspect the short-run and long-run relationships and directional causality flow between road transport infrastructure development and economic growth in Namibia.

The specific objectives of the study were:

- To examine short-run and long-run relationships between road transport infrastructure development and economic growth in Namibia.
- To examine the directional causality flow between road transport infrastructure development and economic growth in Namibia.

1.5 HYPOTHESIS OF THE STUDY

The research theories to be tested are itemized below:

- H₀: There is no relationship between road transport infrastructure development and economic growth in Namibia.
- H₁: There is a relationship between road transport infrastructure development and economic growth in Namibia.
- H₀₋₂: There is no directional causality flow between road transport infrastructure development and economic growth in Namibia.
- H₁₋₂: There is a directional causality flow between road transport infrastructure development and economic growth in Namibia.

1.6 SIGNIFICANCE OF THE STUDY

Primarily, the study is vindicated by the requirement to deliver an empirical, view of the short-run and long-run relationships and directional drift of causality between road transport infrastructure expansion and economic advancement in Namibia and how it influences the development process. Thus, there is no distrust that transportation is crucial in the scheme of a market economy. As stated by Boopen (2006), transportation improvements create an opportunity cost in terms of substitute investments that can be supported by the government administration.

To warrant that resources are well distributed, policy makers need to have an experimental base on which to base their national development strategies. Empirical acquaintance on how road transportation infrastructure expansion will affect economic advancement needs to be established so that passable well-calculated decisions can be made for the transport segment.

Furthermore, there is a necessity to have a direct association between transport infrastructure and economic advancement, in which predictions can be made to govern the level of transport outlay that can achieve a desired level of economic advancement. If capital advances in transportation facilities leads to better development than when capital is used in other areas, then planners should comprehend the benefits to be enjoyed by developing conveyance infrastructure. If, on other hand, capital advance in transportation services cannot be allied to economic enactment, then limited resources could, perhaps, be put to better usage.

Hence, there is a necessity to study the association between transport infrastructure and the economic advancement of developing countries, particularly Namibia in order to help policy makers to articulate strategies that will favour the transport arena and enhance Namibia's economic evolution; Secondly, this study will give the general public a comprehensive account of the connection between road infrastructure expansion and Namibia's economic advancement;

Thirdly, to scholars and academics, this study exposes the current relationship between road infrastructure expansion and economic advancement in Namibia, by complimenting the literature from previous researchers so as to provide a base for upcoming academics.

Fourthly, to the policy makers, this study will divulge the nexus between road infrastructure expansion and Namibia's economic advancement; making it known that both fiscal and monetary guidelines need to be transformed and properly applied so as to boost Namibian economic advancement.

Lastly, the importance of this study is based on the fact that no exploration on this subject has been previously carried out in Namibia, so the researcher will build a foundation for future local researchers.

It is against this background that this researcher saw the requisite to fill this gap and add to the body of knowledge by exploring both theoretical and empirical phenomena to affirm whether there are short-run and long-run relationships and a directional causality flow between transport infrastructure advancement and economic expansion in Namibia.

The findings of this study will complement the implementation of the National Development Plan five (5) ` four (4) pillars, especially the Economic Progression- sub-pillar area of the Economic Development (Economic Infrastructure) in order to achieve inclusive, equitable and sustainable economic growth in Namibia. This study also took cognisance of the positive multiplier effect of public investment on roads infrastructure development on social transformation, environmental sustainability and good governance which finally lead to economic prosperity and social justice.

1.7 LIMITATIONS OF THE STUDY

Primarily, this study will use secondary data, and therefore such methodological limitations of misplaced variable bias are anticipated such as stake-holders' views, macroeconomic variables such as interest rate, investment, inflation, budget deficit, etc. Succeeding to that, the movement in customer expenditure trend, government expenditure, investment expenditure and net exports could also act as a considerable stimulus to economic growth. This study is though, only concerned with the causative link and directional drift of the causal relationship between road transport infrastructure expansion and economic advancement in Namibia.

Lastly, the initial period of data collection was limited by the availability of data and the historical milestone of Namibia with regards to its pre and post-independence period. The choice of the periodisation was made in order to edge the range of coverage for the study with an aim to make an evocative contribution to the present literature.

1.8 ORGANISATION OF THE STUDY

This paper is structured into six chapters which are interconnected. The first chapter is the introduction, which outlines the introductory aspects of the study and it primarily focused on the problem statement, the objectives of the study, the significance and the limitations of the study.

Chapter two highlights the overview of the Namibian road infrastructure, specifically the importance of road infrastructure expansion in Namibia, the quality of the road system in Namibia, the conditions of the road network in Namibia, the current infrastructure funding model in Namibia, the infrastructure funding needs, potential funding sources in Namibia, situations and perspectives for PPPs in the road sub-sector in Namibia and sectoral legal and institutional frameworks in Namibia.

Chapter three reviews both theories and empirical studies related to the study.

Chapter four looks at the methodological process that begins with research data, the model which was modified and adopted and the estimations approach.

Chapter five provides a discussion of the results, that is, the Bounds test to co-integration Engle-Granger and ARDL Error Correction estimations to determine the directional causality flow and the speed of adjustment of both the short-run and long-run relationships among variables, while

Chapter six provides a brief summary of the conclusions, findings and policy recommendations from the interpretation of the empirical results with support from both theoretical and empirical literature.

CHAPTER 2

OVERVIEW OF THE ROAD INFRASTRUCTURE IN NAMIBIA

2.1 Introduction

This chapter delivers an outline of the nature of Namibia's road infrastructure. The chapter is delineated into eight sections. Section 2.1 discusses the multiplier effect of road transport infrastructure development. Section 2.2 discusses the quality of road networks in Namibia. Section 2.3 provides details on the conditions of road networks in Namibia. In Sections 2.4 and 2.5 a discussion on the current infrastructure funding model in Namibia and the infrastructure funding needs of Namibia is provided. Section 2.6 analyses situations and perspectives for PPP in the road sub-sector in Namibia. Section 2.7 discusses the policy implications and road sector restructuring in Namibia, whilst section 2.8 completes the chapter.

2.1 THE IMPORTANCE OF ROAD TRANSPORT INFRASTRUCTURE DEVELOPMENT

An effectual road system reduces the time and cost of the movement of merchandise within a country and similarly simplifies the connections among the various parts of the country which improve collaboration. Anyanwu, Adebuseyi and Kukah (2003), discern that the growth of economic deeds in Nigeria depended on the level of enhancement of the roads sector. Aigbokhan (1999) opines that infrastructure variables have a positive correlation with private investment and economic development, and that promoting investment-led growth demands similar capital to generate new abilities and equally upholding prevailing ones.

Disbursement on roads improves the delivery of goods & services through domestic and foreign markets and good carriage links condense transport overheads, while stimulating industrial growth. Furthermore, Aigbokhan (1999) gave cases of infrastructure such as community services like electricity, communications, piped water supply, hygiene and sewerage, solid waste collection and disposal, and piped gas, as well as public works which included roads, major dams and canals for irrigation and other transport projects like urban and inter urban railways, etc. In this respect, Aigbokhan (1999) claims that public infrastructure has three effects:

Firstly, it affords facilities that are part of the ingesting bundle for citizens. Secondly, it affords across-the-board outflows for public works that increase collective demand and affords short-run stimuli to the economy. It also serves as a contribution into private sector invention, thus augmenting output and productivity.

Thirdly, road infrastructure and carriage are essential for humanity. Transportation is very important to economic growth; henceforth an undeviating relationship exists amongst a country's economic prosperity and kilometres of paved roads (Owen, 1964, Queiros & Gautam, 1992). Conversely, many developing countries lack suitable transport services and facilities.

Additionally, Namakalu *et al.*, (2014) suggest that the African Development Bank estimates that deprived or insufficient infrastructure in sub-Saharan Africa (SSA) shrinks the region's Gross Domestic Product (GDP) by up to 40%. With reference to sub-Saharan Africa, economic, social and human development has been the discussion for the past few epochs. Trade could back both economic growth and transport infrastructure. The Trade Model asserts that net exports increases the growth of the local economy via numerous networks. A rise in the net exports of a nation escalates real productivity and enhances domestic industries. Similarly, very skilled labour is working in the export-dominated industries of the country. As a result, a more industrious sector and the incompetent non-trade sector emanate from these developments. Trade, permits nations to have right of entry to more progressive manufacturing methods in order to improve business and fast-track economic growth. So, a nation will advance its production in accord with its comparative advantage and will attain economies of scale to reach regional and international markets (Giles & Williams, 2000).

Equally, trade expansion hypothetically stimulates the need for economic advancement and development of transport infrastructure (Borrone, 2005; Lee & Rodrigue, 2006; Beningo, 2008). The latter can be supported by the quote from Namibia's NDP4, which stresses that "if investment in infrastructure is not increased, industries across the board will be affected, including the nascent transport and logistics sector, the manufacturing sector, the agricultural sector, the mineral sector, and the tourism and hospitality sector – all of which have high potential for economic growth and job creation" (Namakalu *et al.*, 2014).

Investment in road transport infrastructure development creates an opportunity for other economic sectors to magnify, grow and contribute implicitly to the economic progress of the country.

Therefore, from the literature it is empirically revealed that indeed transport infrastructure expansion contributes absolutely to economic progression, depending on each country's economic priorities.

In Namibia's situation, transport infrastructure expansion contributes significantly to economic growth, because it is one of the pillars in NDP4 and 5 and it is also strongly emphasised in the Harambee Prosperity Plan (HPP). This is outlined in the infrastructure development pillar under HPP, which ambitiously highlights the importance of Namibia to become a logistics and distribution hub by 2030. This vision will be achieved through the following projects: the improvement of the Windhoek-Okahandja road to double carriage; the upgrade of the Windhoek-Hosea Kutako International Airport road to double carriage; the upgrade of the Omuthiya-Ongwediva road to dual carriage; the upgrade of the Karibib-Usakos-Swakopmund road to a two plus one cross-section road; the upgrade of the Swakopmund-Walvis Bay road to dual carriage; and the upgrade of the Swakopmund-Hentiesbay-Kamanjab road to bitumen standard. The investment in these road infrastructure developments is expected to improve the Namibian economy significantly by 2020. This plan further states that the bitumen road network will be expanded by 526 kilometres during the Harambee tenure. The trust and belief of the Namibian people in the HPP will ensure the milestone achievement of this national initiative over its duration.

2.2 The quality of road networks in Namibia

The diverse perceptions concerning transport infrastructure investment and the recent worldwide economic downturn has encouraged some policy makers to use their fiscal policy instruments to stimulate economic salvation, strengthening the debate on the economic bearing of road infrastructure investment. Thus, Namibia as a republic is not insusceptible to such interventions; additionally, this analysis explores the qualities of road transport infrastructure development in Namibia. This chapter further outlines the specifics of the road system and road conditions in Namibia from 1984 to 2014.

2.2.1 Road network

According to the Technical Assistance for the Namibia Integrated Transport Master Plan - TA2010050 NA ITF (2012), there are about 44,000 km of asserted roads of which around 6,660 km are paved.

This is nonetheless the very precise geography of Namibia, with a vast terrain sparsely occupied by large barren zones, thus the present volume of its road network ranks Namibia as one of the African countries with the uppermost density in terms of inhabitants per square kilometre and arable land per square kilometre. For the same indicators, Namibia is positioned in the top list of SADC countries. The total distance of the Namibian classified road network amounts to 44,121 kilometres, of which 6,664 km, or 15% of the total stretch, is 25,709 kilometres paved, or 58% of the total length being gravel roads.

The remaining are salted roads (287 km, which are equal to 0.7% of the total length), and earth roads (11,459 km or 26% of the total length). In addition, there are 1,523 km of roads which are proclaimed, but not operationalized. Generally speaking, the degree of the Namibian road network can be stated as acceptable with regards to African and SADC standards.

One of the key features of the Namibian paved road network is that nearly 60% of its road length, representing 3,900 km, narrates to sections of international transportation corridors: the trans-Kalahari towards Botswana and Gauteng Province in South Africa, the trans-Orange towards the Northern Cape Province in South Africa, the trans-Caprivi towards Zambia and the DRC, and the trans-Cunene towards southern Angola.

2.2.2 Regional road network

The Technical Assistance for the Namibia Integrated Transport Master Plan - TA2010050 NA ITF (2012) added that 17 regional road transportation corridors have been recognized at the SADC level. Most of them link main consumption / production midpoints with ports on the east coast (Dar Es Salaam, Beira, Nacala, Maputo, Durban), south coast (Port Elisabeth, Cape Town) or west coast of southern Africa (Lüderitz, Walvis Bay, Namibe, Lobito, Luanda, Matadi). Out of these seventeen corridors, four emanate from Namibian ports:

- The Trans-Orange corridor from Lüderitz (or Walvis Bay) to Noordoewer at the border with South Africa. Further south, this corridor continues to Cape Town.
- The entire length of this corridor (Lüderitz – Cape Town) is 1,200 km, of which 550 km is in Namibia (Lüderitz – Noordoewer)
- The Trans-Kalahari corridor from Walvis Bay to the Buitepos border with Botswana.

Further east, this corridor continues to Gaborone in Botswana and Pretoria in Gauteng province in South Africa where it connects to the North South Corridor which is the most important SADC corridor in terms of traffic. The total length of this corridor (Walvis Bay – Pretoria) is 1,900 km, of which 650 km is in Namibia (Walvis Bay – Buitepos).

- The Trans-Caprivi corridor from Walvis Bay to Katima Mulilo at the border with Zambia. Further east, this corridor continues to Livingstone in Zambia, where it connects with the North – South corridor. The over-all length of this road corridor is about 1,500 km (Walvis Bay-Livingstone), of which about 1,300 km is in Namibia (Walvis Bay-Katima Mulilo).
- The Trans-Cunene corridor from Walvis Bay to Oshikango (Santa Clara) at the border with Angola. Further north, this corridor continues to Lubango where it links with Angola's Namibe Corridor. The total length of this corridor (Walvis Bay – Kubango) is about 1,300km, of which about 900 km is in Namibia (Walvis Bay – Oshikango).

The point of emphasis is that Namibia is linked by all-weather bitumen roads to Angola, Zambia, Zimbabwe, Botswana and South Africa. Most importantly roads provide a fast and comfortable road link between Namibia's port of Walvis Bay on the Atlantic coast and landlocked neighbouring countries. This wide-ranging road network simplifies regional trade between Namibia and its neighbouring countries. Of particular importance is the Trans-Kalahari Highway which links Walvis Bay to Botswana and the Gauteng province, the trade heart of South Africa.

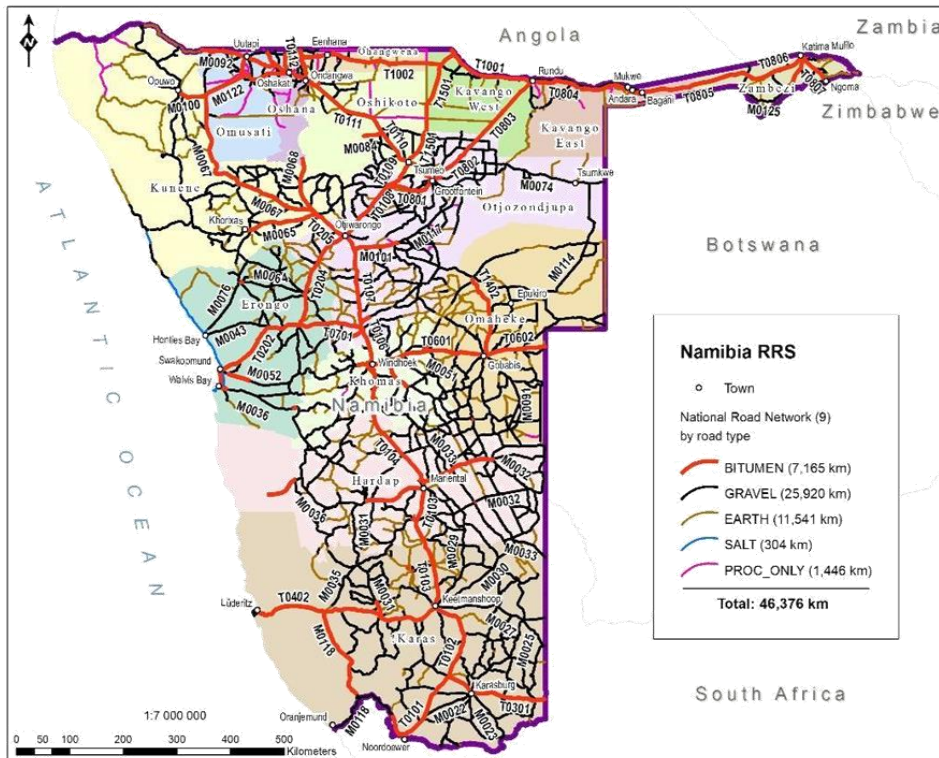


Figure 1: Namibia Road Network Map (Source: Roads Authority (1999))

2.2.3 Road traffic

Due to the degree of the country, the low population and the large barren zones, the traffic on Namibian roads is low. Seventy six percent of the paved roads carry traffic lower than 1,000 vehicles per day and the average traffic on paved roads is only 766 vehicles per day. This is low by African standards where it is estimated at 1,050 vehicles per day in low-income countries and 1,500 vehicles per day in lower middle-income countries.

Obviously, the traffic on unpaved roads is meaningfully lower than on paved roads: the traffic is lower than 50 vehicles per day for almost eighty percent (80%) of the unpaved roads, whilst in Africa it is on average 50 vehicles per day in low-income countries and 100 vehicles per day for lower middle-income countries.

2.3 THE CONDITIONS OF THE ROAD NETWORK IN NAMIBIA

The Technical Assistance for the Namibia Integrated Transport Master Plan - TA2010050 NA ITF (2012) emphasises that the Road Management System (RMS) has been developed within the Road Authority to frequently monitor the state of the Namibian road system.

The Namibian road system comprises of a paved road network, an unpaved road network and other road classifications.

2.3.1 Paved roads

The state of the paved roads is evaluated based on the results of visual assessments following the standardised visual valuation methodology and surveys with high speed profilometer (for assessment of road roughness - International Roughness Index, IRI - and rut depth) and falling weight deflect-ometer (for assessment of the deflexion). Road situations are classified into five categories, namely: “Very Good”, “Good”, “Fair”, “Poor” and “Very poor”.

In 1990, approximately 80% of the roads were in “Very good” or “Good” conditions, and the remaining 20% were in a “Fair” condition. Twenty years after independence the percentage of roads which were considered as of “Very good” or “Good” conditions dropped to 50%, with 9% being considered as of “Poor” or “Very poor” condition (representing approximately 600 km).

Even though Namibia inherited a well-preserved road network after independence, major rehabilitation or resurfacing works are essential.

Based on the current propensity of worsening, approximately 38% of paved roads (representing approximately 2,400 km) will reach the end of their remaining life within a shorter period. From a broad-spectrum, Namibian paved roads are still in a superior state than in the “typical” sub-Saharan African countries (if South Africa is excluded) but in considerably worse conditions than of South Africa.

2.3.2 Unpaved roads

Ultimately, the condition of the unpaved roads (gravel, salt, earth) is determined by means of a standardised visual assessment methodology. Similar to paved roads, unpaved roads are categorised according to their conditions into five categories, namely “Very Good”, “Good”, “Fair”, “Poor” and “Very poor”.

The results of the visual inspection show that in 2010, about 38% of unpaved roads which were surveyed (about 34,500 km out of a total of 37,500 km) were in “Poor” or “Very poor” condition, representing 13,000 km.

In 2002, the percentage of unpaved roads in “Poor” or “Very poor” form was 20%, around half the present quality, which shows a substantial worsening of the unpaved road network over the last years.

The road compactness in kilometres per one thousand kilometres square is 54 km/, 000 km², if all roads are measured, and 8 km/, 000 km², if only paved roads are considered. This compactness is quite a little in relation to the African standards: in sub-Saharan Africa, the ordinary compactness of paved roads is 74 km/, 000 km², if all roads are measured, and 13 km/, 000 km², if only paved roads are considered.

Currently, SADC countries’ ordinary compactness is double the Namibian values: 110 km/, 000 km² (all roads), and 20 km/, 000 km² (paved roads only). The little compactness is evidently the result of the degree of Namibia, with a population of about 2, 5 million people and huge barren zones. Then, road compactness indicators are evidently diverse when estimated in km per one 1000 km² of arable land, which is a joint indicator: with 5,262 km/, 000 km² arable land (all roads) and 795 km /, 000 km² arable land (paved roads).

Saharan Africa’s average (respectively 1,060 km /,000 km² arable land and 182 km/,000 km² arable land) and about twice the SADC average (2,114 km/, 000 km² arable land and 383 km/, 000 km² arable land). Surprisingly Namibia is thriving beyond the sub-Saharan Africa average standards.

However, Namibian road compactness is equating to the African lower middle-income countries with 4,233 km/, 000 km² arable land for all roads and 1,176 km/, 000 km² arable land for paved roads only. Again, Namibian road compactness is to all intents and purposes around those in non-African lower middle-income countries with 10, 624 km/, 000 km² arable land for all roads and 1,919 km/, 000 km² arable land for paved roads merely.

2.3.3 Other road classifications

The Namibian roads are categorised and declared as trunk roads (TR), main roads (MR), district roads (DR) and farm roads. Farm roads distance is approximately 23,000 km. Trunk road network is 4 592 km, which equals to 10% of the total distance of the road network.

The road network distance of about 11,195 km represents the main roads which is approximately a quarter of the total road network. While two thirds of the network distance accounts for the district road network which is about 28,332 km.

This study finds the need to outline that most of the Namibian road maps are “touristic maps” which fail to embrace the authorised road classification.

These “touristic maps” are classified as follows: TRs are generally numbered as “B” roads; MRs are numbered a “C” roads; and DRs are numbered as “D” roads.

2.4 CURRENT INFRASTRUCTURE FUNDING MODEL IN NAMIBIA

It is world-widely known that the road infrastructure is a national asset and transport infrastructure expansion is primarily the obligation of the central government through its designated transport sector`s institutions. All have been well functioning till 2008, when the world economic shutdown severely affected fiscal and monetary policies of most of the nation. As a result, budget demands were cut and this hampered substantive progress in transport infrastructure expansion in Namibia.

This notion was braced by Basso and Duvall (2012) who advance that the United States federal surface transportation initiative has factually been backed by devoted taxes, levies and duties on gasoline, diesel, and other transport-related taxes paid into the Federal Highway Trust Fund and then capitalised in roads, bridges, transit systems, and transportation projects via state and local governments. However, the Fund was estimated to be a deficit in 2015, with the deficit outlook rising rapidly each year (Basso & Duvall, 2012).

Markovich (2014) further indicated that infrastructure is indeed vital to economic advancement, however the inadequate budgetary support for transport infrastructure development in the US, has resulted in inadequate structural development. In support of Markovich`s (2014) view, Namibia also lags behind and experiences the infrastructure expansion shortfall syndrome. This situation is substantively concurring with the global insufficient infrastructural funding dilemma. Subsequently, this has left most of the central Governments to initiate other funding mechanisms such as external concessional loans, Development Finance Institutions (DFIs) loans, PPP agreements and issuance of bonds and deviation from the budget financing model as the only infrastructure financing mechanism.

This study further reviews infrastructure investment, carried directly by the central Government and by its designated state-owned enterprises (SOEs). In the Namibian context, the infrastructure investment is approximately 9% of the GDP in terms of infrastructure development (Zhang *et al.*, 2012) as highlighted before.

Namibia's infrastructure investment-to-GDP ratio status quo shows that additional investment in road structural development is essential to make a substantive impact on economic advancement.

The government of the Republic of Namibia has invested approximately N\$23.6 billion in repairs and improvement of current infrastructure and construction of first-hand infrastructure as shown in Table 1 below.

Table 1: Infrastructure Funding by the Government

Sectors (N\$ millions)	2010/2011	2011/12	2012/13	Total
Transport Infrastructure	3,487.5	11,319.6	5,227.0	20,034.0
Energy Infrastructure	119.9	411.2	232.0	763.0
Water Infrastructure	748.7	-	-	748.7
Social infrastructure ⁴	1,938.0	-	122.7	2,060.7
TOTAL	6,294.1	11,730.8	5,581.7	23,606.4

Source: Development Budget 2010-2014/15 and author's own calculations.

According to BoN (2014), most of the projects were financed through direct transfers from the state coffers to State Owned Entities, accompanied by their own budgets and on the balance sheet borrowing primarily from Development Financial Institutions. However, in most cases the Government back this SOE's borrowings with issuances of guarantees.

To validate that notion, the Namibian infrastructure investments escalated from N\$189.6 million in 1995/96 to N\$4.2 billion at the end of 2013/14 as result of constant issuances of guarantees.

Subsequent to that, the on-lending at non-market rate of 3% to SOEs by the Namibian government through the on-balance sheet borrowing resulted in a shocking rise of the national debt from N\$384.2 million in 2003/04 to N\$626.8 million 2013/14 respectively.

This study unearths that most of SOEs are not performing well financially, the on-lending agreements were terminated. Hence, SOEs were left with no option than to provide funding from their own balance sheets, and Government issuances of guarantees where there was a need. To date, the government investment infrastructure projects through long-term foreign loans debt stands in excess of N\$2 billion and road infrastructure investment stands at N\$1, 6 billion. This amount seems to be very high, but this type of financing model is economical than market-based subsidy model, particularly when provided by the Government as they sometimes comprise of a built-in funding component.

Table 2: Government external loans for infrastructure projects

<u>Sectors</u>	<u>Amount (N\$)</u>
ICT infrastructure	18,659,949
Road infrastructure	1,649,124,916
Rail infrastructure	262,049,078
Airport infrastructure	135,745,526
Water infrastructure	140,715,749
Port infrastructure	<u>32,488,013</u>
Total	<u>2 238 783 232</u>

Source: Ministry of Finance

In summary, it's ideal to call for stakeholder participation as alluded earlier. This platform allows both the Namibian government and the private sector to form joint ventures through Public-Private-Partnership agreements. However, the Public-Private-Partnership (PPP) policy was drafted in 2013 and operationalised as from June 2017. The objective was to provide a permissible structure for public private partnership projects; to form the Public Private Partnership Committee; to control public private partnership projects via the stages of initiation, preparation, procurement, conclusion of public private partnership treaties and implementation; and to offer support for incidental matters. This ensures that resources are best used by both the public and private sectors to ensure infrastructure delivery.

2.5. INFRASTRUCTURE FUNDING NEEDS IN NAMIBIA

BoN (2014) asserted that the Namibian infrastructure financing needs would account for N\$223.6 billion between 2014/15 to 2019/2020. Table 3 below clearly indicates that transport infrastructure accounts for 55% of the aggregate balance, trailed by energy with (23%) and housing (20%).

This study takes a look at other infrastructure financing which complements road transport infrastructure development. For instance, the port sector (N\$29.5 billion), rail sector (N\$53.6 billion) includes the upgrading of almost the entire railway network. Likewise, capital needs for the housing division is unpersuasive because the yearly average amount of financing needs is 5 times bigger than the amount required between 2014/15 and 2016/17 as indicated in table 3 below.

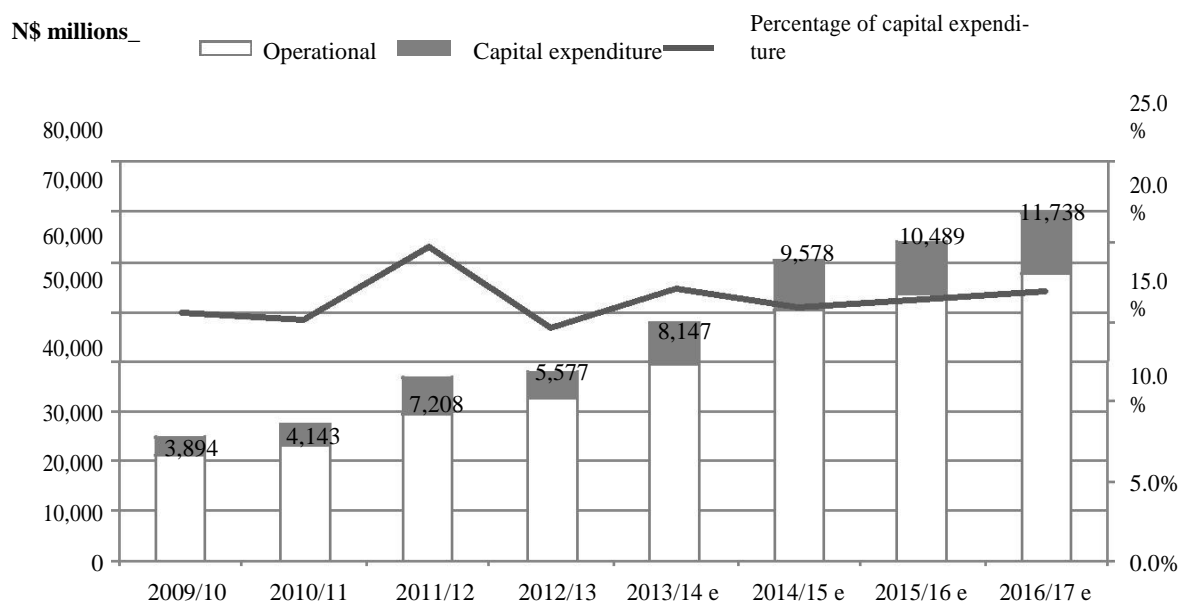
Table 3: Infrastructure Funding Requirements in Namibia

N\$ millions	2014/15	2015/16	2016/17	2017/18 –2019/20	Grand Total
Transport infrastructure	9,649.90	11,689.80	10,359.50	91,652.30	123,351.50
Roads infrastructure	4,572.30	5,659.80	4,136.60	3,492.30	17,861.00
Rail infrastructure	2,300.00	2,500.00	2,400.00	53,600.00	60,860.00
Port infrastructure	1,967.60	2,450.00	1,012.90	29,500.00	34,930.50
Airport infrastructure	810	1,080.00	2,810.00	5,000.00	9,700.00
Energy infrastructure	1,902.50	11,423.40	13,350.30	24,161.20	50,837.40
Water infrastructure	101.7	395.2	540.9	592.9	1,630.70
ICT infrastructure	737	608	642	701	2,688.00
Housing infrastructure	2,500.00	2,500.00	2,500.00	37,500.00	45,000.00
Grand Total	14,891.10	26,616.40	27,392.70	154,607.30	223,607.30

Source: Infrastructure Financing in Namibia, September 2014, Bank of Namibia

In addition, from table 3 above it is evident that the annual financing needs for transport infrastructure was N\$9.6 billion representing 64.8 % of total annual infrastructure funding requirements of N\$14.6 billion in 2014/15. Though in 2015/16 to 2016/17, energy infrastructure financing needs was becoming an essential sector due to the climate change. Transport annual infrastructure financing needs remains important because it's a driver of most if not all other sectors. However, the aging state of the prevailing infrastructure in the road transport sector stimulates the infrastructure financing needs. More than 20 years after independence, there has been rapid deterioration of both social and capital infrastructure compared to the pace of maintenance. Hence, urgent interventions are highly needed by private-public engagements to avoid further infrastructure deterioration.

Figure 2: Operational and capital expenditure of GRN from 2009/10 to 2016/17.



Note: “e” means estimated amount.

Source: Estimates of revenue, income and expenditure, annual issues, MO

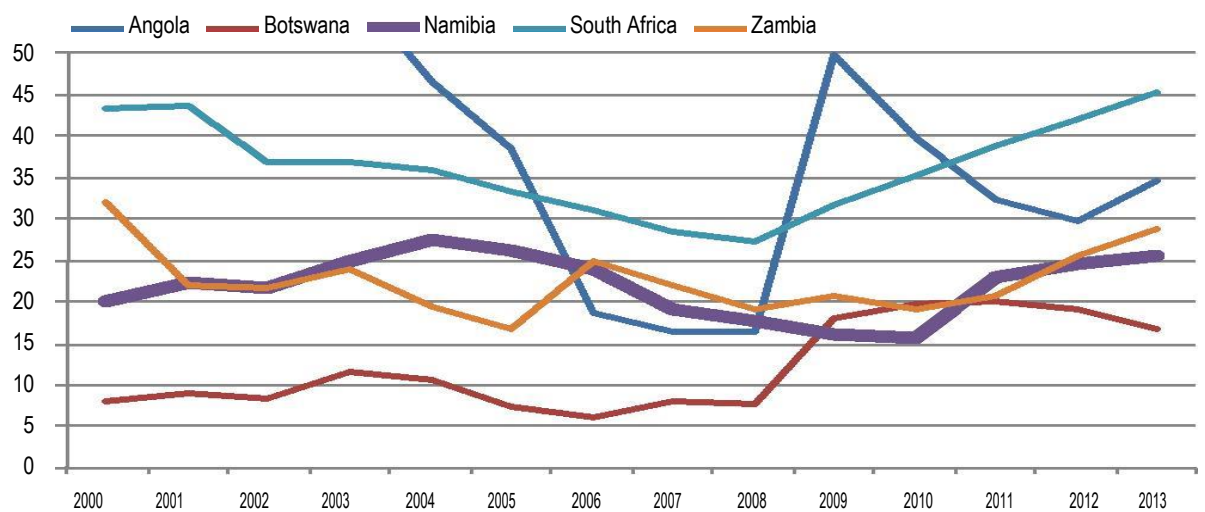
As much as the Namibia dream of being an industrialised nation by 2030, it is very essential to deviate from investing more in operational expenditure to infrastructural investments. Figure 2 indicates how the Namibian national budget is pre-dominated by recurrent expenditure. It is evident that, from 2009/10 to 2016/17 capital investment has been growing at a snail’s pace of about 1.5% annually which should be a huge concern as growing nation.

2.6 POTENTIAL FUNDING SOURCES IN NAMIBIA

2.6.1 Soft loan from DFIs

The Project Master Plan for Development of an International Logistics Hub for SADC Countries in the Republic of Namibia (2012), stress that a lax or soft loan from development financial institutions (DFIs) is one of the key financial bases for infrastructure expansion. Since a soft loan from DFIs has no conditionality attached to mobilise capitals, quick funding for infrastructure expansion is likely.

Figure 3: Comparison of gross public debt/GDP ratio



Source: World Economic Outlook Database, October 2014, IMF

Figure 3 shows the gross public debt to GDP ratio of southern African countries (Angola, Botswana, Namibia, South Africa and Zambia). Although Namibia's ratio is second lowest to Botswana, this should not be used as an opportunity to excess funding through loans from DFIs. The Namibian annual budget plan of 2014/15, shows an accumulated public debt of N\$32.4 billion Namibia dollars representing 26.3% of debt to GDP in 2014/15 financial year. This is also alarming, because debt to GDP ratio is growing at N\$2.3 billion annually. Meaning in 2020 debt to GDP ratio will be 48.5 billion which will exceed the national ceiling of the public debt at 35% of GDP.

This study highly condemns the acquiring of un-manageable credit facilities which does not yield substantive return on investment and consider the financing cost of the credit facilities.

Thus, also negatively impact the sovereign rating over a long-run which affect the foreign direct investment due to the economic and financial vulnerability.

2.6.2 Pension funds and long-term insurance investments

In today's world, pension fund institutions and long-term insurance companies are feasible infrastructure financing mechanism to finance infrastructure development. GIPF as one of the local pension fund with designated authority to manage the pension fund of all the public servants and other private investors in Namibia. So, it is against this background that this study highlights how GIPF manage its equity base and how the Government can mobilise funds through pension fund institutions and long-term insurance companies to finance the infrastructure requirements.

Government Institutions Pension Fund (GIPF) had invested 69% of its assets in equity, and 26% to bonds. In compliance with Regulation 28, GIPF invested 37% of its assets in the local market, 29% internationally and regionally, while 8% are invested in other African countries.

In 2015 GIPF launched the Developmental Investment Policy in response to the ever-rising needs of infrastructure expansion. The Developmental Investment Policy highlighted the key target sectors of the economy in which joint ventures, private sectors and other financial intermediaries can tip in and explore in;

Logistics infrastructure (railways, roads, ports and telecommunications), renewable energy and energy frontier technologies, Agriculture and food processing. Other economic sectors such as education and skills development, health and healthcare services, housing were also of great importance. Small and medium enterprises (SMEs), and Information and communication technology (ICT) are also key sectors in infrastructure financing. Yet, GIPF as vast growing institution aims to invest approximately 5% of its total asset amount of N\$82 billion in all key sectors. In terms of evaluating yield and risk of a particular investment proposal, one looks at each sector differently.

2.6.3 Mobilisation of private funds

As alluded to in The Project Master Plan for Development of an International Logistics Hub for SADC Countries in the Republic of Namibia (2012), limited investment opportunities in Namibia affect the portfolio investment outflows. This increases the investment opportunity for the “Infrastructure Financing in Namibia” with a proposition for privatisation and “Listed Infrastructure Fund” being developed and implemented. The Listed Infrastructure Fund aims to list parastatals on FOREX to raise funds for infrastructure financing. The other lucrative idea is to relax regulations for bond insurance for infrastructure development. This surely will attract public-private partnership projects.

When public-private partnership projects have to be undertaken, an SPV (special purpose vehicle) is set-up as a fund raising mechanism to finance projects through equity finance, bank loans and bond issuance. All these credit facilities used as financial instruments to mobilise funds are an obligation to be honoured through a regulatory framework for “revenue bonds”. The government or the parastatal would establish the revenue bond as a specific revenue source to finance the debt repayments. Furthermore, the government does not provide guarantees on revenue bonds and funds raised through this financing mechanism are managed separately.

In Namibia, most parastatals are performing badly financially and this is because of corporate governance principles and guidelines which are manipulated for personal gain. Moreover, the political interference severely affected the implementation of the dual carriage from Windhoek to Hosea Kutako International Airport, the rehabilitation of Ondangwa airport just to mention a few. However, this study applauds the government for the successful implementation of the Trans-Kalahari highway and others among many others. However, if Namibia is affirming that mobilising resources to finance infrastructure development, it's important we revive the institutional capacity by making use of Nam-Code as an obligatory sub-law in all the parastatals' legal framework. This would strengthen the parastatals and facilitate disclosure of information on each infrastructure development project and provide transparent and accurate information to key investors. In addition to that, since the government provides subsidies to the parastatals, the “beneficiaries pay” principle should be introduced to achieve the sound management of parastatals.

Furthermore, in order to address the issue of private funds mobilisation, it is also equally important to categorise, the parastatals according to their economic viability and how their subsidies are financed, e.g. user charges and by taxes based upon social criteria.

Table 4: Sources of funds

<u>N\$ millions</u>	<u>2014/15</u>	<u>2015/16</u>	<u>2016/17</u>	<u>2017/18</u>	<u>Grand total</u>
				<u>2019/20</u>	
User Fees	3,446.3	5,964.6	6,279.7	10,426.6	26,117.2
Government Subsidy	1,999.0	4,523.4	3,598.9	4,787.8	14,909.1
Borrowing	<u>2,176.6</u>	<u>6,723.8</u>	<u>8,639.4</u>	<u>14,965.2</u>	<u>32,505.0</u>
Total	<u>7,622.0</u>	<u>17,211.8</u>	<u>18,518.1</u>	<u>30,179.6</u>	<u>73,531.4</u>

Source: Infrastructure Financing in Namibia, September 2014, Bank of Namibia

Table 4 above sketches out user fees, borrowing through loans and bond issuances, government transfers and subsidies the core sources of infrastructure financing. Approximately N\$73.5 billion was estimated from 2014/15 to 2018/2020, but N\$223.6 billion was capital needed to finance infrastructure development through these three sources.

As mentioned before, parastatals still heavily rely on borrowed funds, this study projected that an estimated amount of N\$32.5 billion is required from borrowing followed by user fees with N\$26.1 billion and N\$14.9 billion government subsidy as projected capital needs respectively.

2.5.1.4 Funding legislative and regulatory limitations

The Namibian infrastructure funding legislation and regulations on private and/or public participation in infrastructure funding are limited and therefore fiscal policies such as The State Finance Act and the Sovereign Debt Management Strategy (SDMS) directly have an impact on infrastructure funding (BoN, 2014). Primarily, the State Finance Act allows the Minister of Finance to borrow prudently and within Sovereign Debt Management Strategy document on behalf of the Namibian Government. However, the Sovereign Debt Management Strategy's key objective is to maintain national debt within 35% of the GDP threshold.

Subsequently SDMS ensures, that Government guarantees stay within the limit of 10% of GDP. These prudential limits outlined in the Sovereign Debt Management Strategy document may constrain the Government from investing in loose infrastructure projects which will negatively affect the debt management.

At the time of research, the Namibian debt stock stood at 25% of GDP, with permitted borrowing for infrastructural needs and other funding necessities at 10% of GDP (N\$14.1 billion). Equally, about 6% of GDP (N\$5.8 billion) could still be issued as assurances for infrastructure as well as other financing requirements.

The fast growth in the economy and aged stock of infrastructure also instigated an emergent need for more infrastructure support to supplement Government efforts. As a result, a new financing methodology of revenue collection in the form of direct transportation revenue is of great importance. Motorists are obliged to pay a toll fee or a fare or a ticket price in the airline world (Basso & Duvall, 2012). This financing methodology has been efficiently effected in our neighbouring countries like South Africa and Zimbabwe. Another alternative is private-sector involvement through public-private partnerships (PPPs) thru long-term contracts amongst the public and private sector in infrastructure financing (Markovich, 2014).

2.6 THE SITUATION AND PERSPECTIVES FOR PPP IN THE ROAD SUB-SECTOR IN NAMIBIA

Currently no public private partnership agreements exist in the Namibian road sub-sector due to the reasonable level of traffic on the Namibian road network. Few chances for Build-Own-Transfer (BOT-concessions) for the construction of toll roads in Namibia exist. Even if raising private capital is not the main objective, other forms of PPPs could perhaps be foreseen in the road sub-sector, for instance: performance-based maintenance contracts; operation and maintenance concession, or shadow toll system.

One of the main problems is that the Road Fund`s revenue receipts annually are insufficient to adequately maintain and rehabilitate the current roads and at the same time avoid a backlog.

However, the other players like the Roads Construction Company could come on board, but due to their financial woes lately from 2012 to 2017, it has become very difficult to complement the government to finance the road infrastructure development in Namibia. Nonetheless, this study appreciates the efforts by the Namibian Roads Authority in co-financing roads construction projects together with the Namibian government and developmental partners.

2.7 NAMIBIA ROADS SECTOR LEGAL AND INSTITUTIONAL FRAMEWORK

Namibia, like many other developing countries, should warrant that road transport infrastructure is in place and well-maintained to optimise the levels socio-economic development.

However most developing countries failed this test due to deficiency in their legal system and institutional framework which must ensure the effective implementation of the projects contracts. Although Namibia was colonised by neighbouring South Africa, financing and management of the road infrastructure was great. This is one of the achievements which boosted tourist arrivals and investor confidence then.

In 1990, the Ministry of Works and Transport (MWT) was established as a custodian ministry to manage and control all transport related entities

Ramji (2003) asserts that the Ministry of Works and Transport takes a supervisory roles of transport services, and this mandate encompasses regulating the road transportation, civil aviation and merchant shipping. Hence the inclusive objective of the transport sector in Namibia is to safeguard the readiness of safety, effectiveness and efficiency in transport facilities and services in the various transport modes.

However, in April 2000, three state-owned enterprises were established by an Act of Parliament and the State-owned Enterprises Governance Act, 2006 (Act No.2 of 2006) and assigned under the department of transport (DOT) in the Ministry of Works, Transport and Communication (MWTC) as a supervisory Ministry.

- Management of national roads was tasked to Road Authority as a company under Road Authority Act, 1999 (Act, 18 of 1999).
- Management of road user charging system was tasked to Road Fund Administration as a company under Road Fund Administration Act, 1999 (Act, 18 of 1999).
- Supervising and oversees the construction, maintenance and rehabilitation of all national roads was tasked to Road Contractor Company under Act, 1999 (Act, 18 of 1999).

The above-mentioned SOEs adopted a self-financing system as sources of financing their operational budget, while the transfer payments from the central government were allocated to infrastructure developmental programmes. Road Fund Administration was administered by Ministry of Finance as an autonomous state agency and generate their revenue through Road User Charging System. In addition, the Roads Authority was administered by the Ministry of Works, Transport and Communication (MWTC) as a supervisory Ministry and source their funds motorists through motor vehicle registration, load charges etc. whereas RCC sustains its operations from revenue generated from private contract engagements.

Certainly, there are other stakeholders within the transport sector who also play a very significant role in the transport fraternity. Therefore, the acts, policies and regulations that govern these institutions must be highly considered in this study. Having said that, it is essential and equally important to outline how these institutions were established and under which act of parliament these institutions were established:

- National Transport Services Holding Company Act, 1998 (Act 28 of 1998) which administers Trans-Namib Holdings Ltd,
- Namibian Port Authority Act, 1994 (Act 2 of 1994) which directs the Namibian Ports Authority (NamPort),)
- Namibia Airports Company Act, 1998 (Act 25 of 1998) which administers the Namibia Airports Company. Air Namibia is governed under the Companies Act of 2004 and
- The Walvis-bay Corridor Group (WBCG), which was established in 2000 to support the utilisation of the Walvis Bay Corridors (Walvis Bay-Ndola-Lubumbashi Development Corridor, the Trans-Cunene Corridor, and the Trans-Orange-Corridor).

Though Namibia is being praised to have an entrenched transport system inherited from South Africa and graded second in SADC after South Africa. The crux of the matter is institutional capacity of the designated establishments to maintain, rehabilitate and update the existing road infrastructure in Namibia. Therefore, it was important for the study to explore the legal and institutional framework of the institutions that were tasked with ensuring safety, effectiveness and efficiency in the transport facilities and services in the entire transport sector.

CHAPTER 3

LITERATURE REVIEW

3.1 INTRODUCTION

The nexus between road transport infrastructure development and economic advancement has become an essential area of study in economics and the development finance discipline lately. The past researchers found the need to justify this nexus with both theoretical and empirical research to attest it with the causal direction flow, the short and long-term correlation between transport infrastructure development and economic growth. With this in mind, this chapter reviews both theoretical and empirical studies related to the study under investigation.

3.2 THEORETICAL FRAMEWORK

In the 20th century revolutionary economist John Maynard Keynes, highly emphasised for government expenditure to generate employment and to permit the use of idling capital resources at a time of economic recession when employment of capital and labour was high. This, has tempted many scholars to examine the long-term possible relationships between public expenditure on infrastructural expansion and the growth level of the economy. The validation of this research on the subject matter of this study has mixed conceptions across countries, statistics and approaches.

The conjectural base of this research is focused on the concept of the theory of unstable economic growth. The theory of unstable growth is associated with Hirschman (1958) and Nurse (1961) who also preferred the unbalanced growth theory. The theory is a direct contrary of the doctrine of stable growth. According to Hirschman (1958), investment should be made in certain sectors rather than concurrently in all sectors of the economy.

For Hirschman (1958), emphasis on the unbalanced economy according to a pre-considered strategy is the finest technique to accomplish economic advancement in deprived economies. Hirschman (1958) also minutes that investments in strategically chosen industries of the economy would lead to fresh investment prospects and so pave the way to further economic expansion. Hirschman (1958) added that the unbalanced economy with social cost capital would increase private investment in directly productive activities over the long-run.

Social costs of capital encompasses the essential services, manufacturing and services dominated sectors for which the economy would stall without them.

For instance, investment in education, public health and health care services, Information and communication technology (ITC), transportation, public services such as power, clean water and sanitation, housing and shelter and well-functioning sewage systems etc. Bitnik and Neumann (2001) asserts that capital investment positively influences GDP. On the contrary, there is an insignificant causality relation outing from Gross Domestic Product to societal investment. Nonetheless, Mamatzakis (2002) believed that significant link between public infrastructure such as airports, railways, transportations, energy and ICT and private investment output of the Greek industrial sector. Hence, a causal relationship was confirmed to be from public infrastructure to private efficiency.

Reinikka and Svensson (1999) argue that infrastructure services deficiency discourages private investment. Meaning that to invest in “complementary capital” for an example, deliver of their own infrastructure facilities rather than “productive” capital. This will be lessening the ratio of return on private investment. Their study concluded that the transformation of macroeconomic policies needs to be supported by appropriated levels and quality of infrastructure facilities to be effectively operational to enhancing economic expansion.

Exertion by Fernald (1997) was that an increase the road stock encourages rapid production growth in industries that intensively rely on road use. However, his relationship was estimated flowing from infrastructure expansion to productivity growth, as oppose to the other way. Further, in the same paper De la Fuente (2000) detects that: “Appropriate infrastructure investment provision is probably a key input for development policy, even if it does not hold the key to rapid productivity growth in advanced countries where transportation and communication needs are already adequately served.”

Eberts and McMillen (1999) opined that the concept on agglomeration economies “inextricably” connect such economies with infrastructure by virtue of the proposition that agglomeration economies transpire when industries / institutions in suburbs setting shares a public good as a production input. They further assert that, urban public facilities are shareable input that positively influence the smooth operation of larger cities and thus alone stimulates achieving agglomeration economies.

The presence of adequate social infrastructure such as highway system, running water and working sewage systems which positively contribute to the well-being of the society. Consequently, towns of similar dimensions understand diverse stages of production from accumulation economies, since the size and quality of their public infrastructure varies.

Eberts and McMillen (1999) further concentrated on the impact of agglomeration economies or of impact of substructure investment to productivity. They confidently assert that industrialised towns are extra productive opposed to less industrialised towns with a bigger stock of public infrastructure. This justified the positive relationship between the two and Eberts and McMillen (1999) who further suggested that infrastructure “provides the means by which the close spatial proximity of economic activities can lead to increased productivity for all parties” (p.133)

Eberts and McMillen (1999) appeal for further studies to deliberate on the two effects concurrently and to scrutinize the dynamic forces of the linkage. Thus, Aschauer (1989) emphasises that infrastructure in the development course in the United States and claimed that non-military public spending is very vital in increasing total output than military expenditure. Aschauer (1989) resolved that basic facilities such as street lights, freeways, aerodromes, etc., enhance efficiency more than other structural financing. Subsequently, Munnell (1990), Garcia-milla and Fernald (1999) discovered the route of the causal linkage between infrastructure and productivity using statistics from 29 US manufacturing industries from 1953 to 1989.

Fernald’s (1999) affirm that connexion from roads to efficiency infers that the output drop in US manufacturing after 1973 as a result of lesser infrastructure investment on road infrastructural expansion. His study similarly recommends that the revenues generated from road substructural funding are immaterial, reason being that road construction provide once upsurge in the level of productivity rather than a constant series of effects.

Gannon and Zhi (1997) also in line with Canning and Beneatha (2000) who also established that access to transport harmonise to other services such as health services & health care facilities and education, which enhance economic growth. Research report by FanHazell and Thorat (1999) on rural areas of India, China and Thailand also projected the effect of infrastructure spending on economic growth and poverty. Likewise, in rural India, investment in public roads infrastructure had a substantial impact on agri-business output and GDP growth, asserts (Fan *et al.*, (1999).

In the case of China and Thailand, where road infrastructure investments significantly led to growth in both agricultural and non-agricultural growth and obviously the total GDP (Fan, Zhang & Zhang, 2002; Fan, Jitsuchon & Methakunnavut, 2002). In conclusion they combined both detailed statistics on net exports and transportation costs in sub-Saharan Africa, which revealed that most of Africa's weak trade performance is negatively affected by infrastructure deficiency.

3.3 EMPIRICAL LITERATURE

Over time numerous economists publicised their acute curiosity in economic variables fast-tracking the economic advancement of particular countries. In addition, many findings revealed that an integrated transport system based on well-functioning fiscal and monetary support enhances the national well-being and improves the well-being of society. This chapter is built on the theoretical studies and reveals the past empirical examination on the directional causality flow and correlation integration findings between economic variables and economic growth. It is therefore essential to justify the theoretical approach with empirical evidence to prove the validity of this study.

The study by Mittnik and Neumann (2001) found that investment capital infrastructure positively impacts economic growth. Though no material causality linkage track from economic growth to capital infrastructure investment could be found. The results outcomes presented a proof for a complementary connection between social and capital infrastructure financing using time series statistics for the US economy and co-integration examination.

Boopen (2006) contributed immensely to the subject by analysing the contribution of transport assets to economic growth for a sample of 38 sub-Saharan African countries of Small Island Developing States (SIDS). His analysis resolved that transport assets significantly contribute to the economic progress of these countries. Furthermore. This analysis revealed that in the SSA case, the output of transport capital stock is greater in comparison with the entire overall capital whereas for SIDS, transport capital average the efficiency level of aggregate capital stock using both cross sectional and panel data analysis.

In another study Herranz-Loncan (2007) examined the bearing of infrastructure investment on Spanish economic growth using the VAR system. Herranz-Loncan's (2007) document showed that investment in local scope infrastructure exerted evidently the positive influence on Spanish economic growth between the period of 1850 and 1935.

Pradhan and Bagchi (2013) applied the Vector Error Correction Model to observe the impact of transport (road and rail) infrastructure on economic growth in India over the period 1970-2010. This finding was that not only does transport infrastructure impact economic growth but also influence the gross capital development.

Researchers like Neuser (1993), Ford and Poret (1991) felt that the subject of infrastructure expansion and economic development has been overemphasised. However, they applied Total factor productivity growth and co-integration techniques to the sample using public capital data for the G7 countries over the period 1970- 1987. Their report reveals irrelevant and unstable results on causality and correlations. Taylor-Lewis (1993) applied the same data set for 41 countries under observation but regressing a Cobb-Douglas function and establish that the contribution of public physical infrastructure to national productivity were insignificant.

Ram (1986)'s input on the empirical analysis of transport-economy linkage, used cross-sectional data for 1960-1970 and 1970-1980 on separate time series estimates for some countries as well as taking real government consumption as his measure of government size. He found a positive correlation amongst growth in government expenditures and overall economic growth.

Josaphat *et al.*, (2000), explored a study on the influence of public expenditure on economic development in Tanzania (1965-1996) using time series data for 32 years by formulating a simple growth accounting model. He adapted Ram (1986) in which aggregate government spending is disaggregated into expenditure on infrastructure investment, consumption and human capital investment. This study found that an increased productive expenditure infrastructure investment negatively impacts the economic growth, whereas consumption expenditure positively influence growth. Finally, on human capital investment expenditure insignificant influence public investment in Tanzania has not been productive.

An investigation by Pravakar, Ranjau, and Geethanjali (2010) about the role of infrastructure in promoting economic growth in China between the period 1975 and 2007 was carried, using GMM (Generalized Methods of Moment) and ARDL (Autoregressive distributed lag model) techniques. The results reveal that infrastructure investment significantly impact the economic growth of China.

A study by Calderon (2009) assessed the impact of infrastructure development on growth in African countries based on econometric estimates from a sample of 136 countries from 1960-2005. The examination evaluated the impact on per capita growth of faster growth of infrastructure stocks and improvement in the quality of infrastructure facilities for 39 Africa countries in three crucial infrastructure sectors: telecommunications, electricity, and transportation (i.e. road), using an econometric technique suitable for dynamic panel models and likely endogenous regressors.

Ogun (2010) examined the effects of infrastructure development on poverty reduction in Nigeria. By specifically looking at the effects of physical and social infrastructure on living standards, with a prime intention to provide experimental proof on the consequences of expansion of infrastructure for the urban poor. The secondary data for the period between 1970 and 2005 was mined and structural vector autoregressive (SVAR) technique was adopted in the analysis. The study explicitly established that physical and social infrastructure promote reduce poverty level and economic growth.

The above study was supported by Akinbobola and Saibu (2004) who further examined the nexus between income inequality, unemployment and poverty in Nigeria using a vector autoregressive (VAR) approach. But this study collected quarterly data for 1986 – 2000 period on unemployment level, human development index, real per capita income and infrastructure investment for the analysis. The results presented that a decrease in the unemployment rate increases human development and therefore decrease poverty level. Furthermore, public infrastructure investment lessens unemployment rate and enhance the human development index.

A third study on nexus in Nigeria by Unridden and Usman (2010) was conducted using cointegration and error correction approach to examine the connexion between public infrastructure investment and GDP in Nigeria between 1970 and 2008. Which revealed that government aggregate infrastructure budget, total operational budget, and public expenditure on education have an adverse impact GDP. Divergently, an increase in social infrastructure investment on transportation and communication significantly contribute to economic growth.

Fedderke *et al.*, (2006, as cited in Moctezuma, 2008) applied a time series study to examine the nexus between road infrastructure investment and economic growth in South Africa. The finding was that, road infrastructure obviously promotes economic growth in South Africa, by boosting GDP directly and alleviate marginal products various productive factors.

Another study carried by Kumo (2012) conducted using Granger causality tests between GDP, capital infrastructure investment, and level of employment in South Africa for the period between 1960 and 2009 by means of a bivariate vector auto-regression (VAR) model. The outcomes showed a robust causality between capital infrastructure investment and GDP growth that flows in similar directions.

The research topic on Public and Private Investment and Economic Growth in Namibia (1970-2005) was carried by Kandenge (2004) using co-integration and error correction modelling tactics. The results suggested exports and imports, economic liberation and prosperity, labour, human intellectual capacity development, public and private investment significantly and positively impact on short and long-term economic growth. Another examination by Ashipala and Haimbodi (2003) focused on the relationship between public investment and GDP in South Africa, Botswana and Namibia using the VECM methodology. The results revealed that, the impact of social infrastructure investment on growth is slightly immaterial enough. While private investment shown a long- run growth impact in South Africa and Namibia. Nonetheless, the results evidently presented opposite causation from GDP growth to social infrastructure investment. The finding further found interconnection in case of Botswana to be negative.

Shafuda (2015) studied the causal relationship between government spending and economic growth in Namibian using government consumption expenditure and real (GDP) statistics for the period 1980 to 2012. The study applied Granger causality test, Co-integration test and Vector Error Correction Model (VECM). This model results supported the assumption of public expenditure causing economic growth. The results showed a unidirectional connexion between public expenditure causing economic growth, government spending positively and significantly impact on economic growth in Namibia.

3.3 Summary

Based on the results of the empirical studies, the link between transportation infrastructure and economic growth is complex depending on the economic variable in the equation, econometric model and data collection period of a particular country. The most significant finding from the literature is that currently there appear not to be any consensus on the impact of government spending on roads infrastructure development and economic growth and which one of the two variables causes the other. This suggests that the relationship is an empirical question which has to be tested to make informed policy decisions. Hence, this study seeks to provide insights on the inclusive debate on the relationship between transportation infrastructure and economic growth from the Namibian perspective.

CHAPTER 4

METHODOLOGY

4.1 INTRODUCTION

This chapter is structured around the methodological processes that were followed in this study. It begins with research data, the model modified and adopted and estimations approach. It describes the sources of data as well as the regression model employed to test the research hypotheses.

4.2 RESEARCH DATA

The study used the time series data in particular, annual data on general government gross domestic product (GDP) data obtained from the World Bank covering the period 1990 to 2014. The other data is that of general government final consumption expenditure based on constant 2010 US\$ (US dollar). The period chosen is dictated by the data availability.

4.3 MODEL

This study adopted Bloch and Tang (2003) model, which was also used in almost a similar study carried in Nigeria. However, this study used GDP (gross domestic product) in Namibia as the explained variable, while information and communication and technology (ICT), government expenditure on road transportation (GERT), and foreign direct investment [Exchange] (FDI) values were used as explanatory variables. This model was used to establish the relationship between economic growth and transportation infrastructure in Namibia. This study found it appropriate to adapt a similar model and modify it to suit the current settings.

The rationale behind the adoption and modification of this model was that both countries are regarded as developing countries, therefore the empirical tests, model and the results from that study predicts similar outcomes as this study. Although this study considered other variables outside the road transport sector, the philosophy of examining the long-run and short-run effect, the causal relationship between road transport infrastructure development and economic growth in Namibia remains the same.

Model specification:

The specification of the model is rooted from a theoretical framework and can be expressed as:

$$GDP = f(ICT, GERT, FDI) \dots\dots\dots (1)$$

Where the GDP represent the gross domestic product in Namibia, ICT is the volume of information, communication and technology in the gross domestic product, GERT is the total of government expenditure in road transport in gross domestic product and FDI is the total of foreign direct investment in the GDP in Namibia. The formulated model was adopted to establish the connexion between the variables of interests which are economic growth and transportation infrastructure in Namibia. However, the model was modified to suit the Namibian case and subsequently achieve the objective of the study. Thus, the function in equation 1 is expanded into a time series model in equation 2 below;

$$GDP_t = \alpha_t + \beta_1 ICT + \beta_2 GERT_t + \beta_3 FDI_t + \varepsilon_t \dots\dots\dots (2)$$

To examine the relationship between economic growth and transportation infrastructure in Namibia, the following autoregressive distributive lag (ARDL) model was adopted.

The ARDL modelling approach deals with co-integration and it was firstly introduced in 1999 by Pesaran and Shin. Thus equation 2 is transformed into an ARDL model as shown by equation 3 to allow for estimating and examining the short-run dynamic and long-run relationship.

$$\begin{aligned} \Delta GDP_t &= \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta GDP_{t-1} + \sum_{i=1}^n \alpha_{2i} \Delta LNICT_{t-1} + \sum_{i=1}^n \alpha_{3i} \Delta LNGERT_{t-1} + \sum_{i=1}^n \alpha_{4i} \Delta LNFDI_{t-1} \\ &+ \beta_1 GDP_{t-1} + \beta_2 LNICT_{t-1} + \beta_3 LNGERT_{t-1} \\ &+ \beta_4 LNFDI_{t-1} + \varepsilon_t \dots\dots\dots (3) \end{aligned}$$

Where Δ is the first-difference operator, $(\alpha_1 - \alpha_4)$ are the long-run relationship parameters, $(\beta_1 - \beta_4)$ represent the short-run dynamic of the model, α_0 is a drift component and ε_t is the white noise error term. It follows that transforming equation 2 to equation 3 is because a long-run multiple linear equation is said to be more likely to find evidence of determining the effect of independent variables on dependent variables than the linear form.

4.4 ESTIMATION APPROACH

The study used the quantitative research approach, particularly econometric modelling by employing the E-Views software package to capture, process and analyse data. Firstly, the Augmented Dickey–Fuller (ADF) was applied for the unit root to test the stationarity and Bounds test to co-integration in order to establish the long-run and short-run relationships. This is possible by estimating the error correction model. The Granger causality was also employed to investigate the direction of the causal relationship that existed between the variables.

Following recent studies, GDP or GDP per capita was used as a proxy for economic growth (Liu Chin, Hsu & Younis, 2008; Wahab, 2004; Vamvoukas & Loizides, 2005), by a few researchers.

4.4.1 Unit Root Test

The statistical properties of the series in the study were first investigated through unit root tests. Unit root tests help to test whether the series can provide correct inferences.

In standard economic theory, the stationarity test is important to ascertain that estimations of regression are consistent. The unit root test applied the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests.

In econometric analysis, the stationarity test of variables is an essential step to determine the order of integration. There are three conditions to be satisfied for the series to be stationary as shown below:

- the constant mean through time, thus

$$(Xt) = \mu \tag{4}$$

- the constant variance through time, thus

$$(Xt) = [(Xt - \mu)] = \sigma^2 \tag{5}$$

- the covariance which rely (rely?) upon the number of periods between two values, thus

$$(Xt, Xt+k) = [(Xt - \mu) (Xt+k - \mu)] = Yk \tag{6}$$

As indicated above, the state of non-stationarity would undermine the results of the regression model better known as spurious regression.

This particularly results in a wrong conclusion which could lead to incorrect policy advice. One way to overcome the non-stationarity problem is by differentiating the variables until they become stationary. This also leads to meaningful results as desired (Gujarati, 2003).

There are several methods used such as the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981), the Philips-Perron (PP) unit root test (Philips & Perron, 1988) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski, Phillips, Schmidt & Shin, 1992). The ADF and PP test uses the same critical values. The unit tests used in this study are therefore, the ADF test, the PP test and the KPSS tests which are used to determine the statistical properties of the series. However, the order lag will be used to determine the optimal lag length for the model after establishing the order of integration

The tests are based on the first order auto-regressive [AR (1)] process as proposed by (Enders, 2004). The ADF test uses additional explanatory variables by lagging the left-hand side variable to approximate the auto-correlation as shown below: in the works of (Arif & Ahmad, 2012).

4.4.2 Co-integration analysis

According to Asteriou (2007), the concept of co-integration was first introduced by Granger (1981) and elaborated further by Engle and Granger (1987), Engle and Yoo (1987), Phillips and Ouliaris (1990), Stock and Watson (1988), Phillips (1986 and 1987), and Johansen (1988, 1991, and 1995).

It was alluded to earlier that non-stationary series can lead to nonsensical results and that it can be overcome by differencing. However, Asterious and Hall (2011) the process of differencing may not be recommended as it does not result in a unique long-run solution because it also differentiates the error term. This necessitated the testing for co-integration to determine if two or more do have some long-run solution for the equilibrium value. This is to say the variables they share a common trend.

The co-integration techniques are used to resolve the problem associated with the spurious regression model and are used when variables are integrated of order one (1) (Du & Zhu, 2001). Hence, the Bounds co-integration test was used in this study to investigate the presence of a long-run relationship between variables.

This study opted for a Bounds co-integration test because of its advantage of testing for long and short-run coefficient in comparison to other methods of co-integration tests such as the Engle-Granger, Two Step Procedure and Johansen co-integration test.

This test assumes that all variables are endogenous and do not necessarily have to be integrated of order 1. Hence, it is applicable to variables with a combination of order 0 and 1 in one set, or strictly order 1 (Dritsakis, 2011). The author further explains that the results of the Bounds test present two critical values for a co-integration test with their lower critical bound and upper critical bound. The earlier (lower) bound implies order of integration zero (0), meaning there is no long-run relationship. The latter (upper) bound assumes order integration one, meaning that the variables are co-integrated.

The null hypothesis of no co-integration can be rejected when the F-statistic is greater than the upper bound critical value and concludes that variables are co-integrated. However, should the F-statistic fall below the lower bound, there is no rejection of the hypothesis of no co-integration, implying there is indeed no co-integration among variables. When the F-statistic falls in-between the two bounds that is an inconclusive state (Senantsi, 2009).

4.4.3 Short-run and long-run estimations

According to Gujarati and Porter (2010), a dynamic model, better known as the error correction model, should be constructed. This enables one to determine the speed of adjustment in the long-run, taking into account the short-run dynamics. In this regard, the Engle-Granger and error correction model (ECM) can be used. Therefore, the following ECM can be estimated from equation 3:

$$\Delta GDP_t = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta GDP_{t-1} + \sum_{i=1}^n \beta_{2i} \Delta LNICT_{t-1} + \sum_{i=1}^n \beta_{3i} \Delta LNGERT_{t-1} + \sum_{i=1}^n \beta_{4i} \Delta LNFDI_{t-1} + \gamma ECM_{t-1} + \varepsilon_t \dots \dots \dots (7)$$

Where:

ECM is a residual obtained from the estimated co-integration equation 3. γ is the parameter which represents the speed of adjustments in the long run. ε_t is the white noise error term (iid(0, σ^2)) [Please re-read this statement.]

Hence, $\beta_1 \dots \beta_4$ are short-run coefficients and γ is a long-run coefficient. To justify, the parameter γ its sign is expected to be negative and significant. However, there are various diagnostic tests used to test whether the regression is well fitted.

4.4.4 Granger Causality Analysis

The Granger causality is a test used to determine the directional causal relationship between a pair of variables (Granger, 1986). A simple Granger causality test involves two variables x and y .

The equation is shown as follows:

$$x_t = \sum_{j=1}^p \alpha_j x_{t-j} + \sum_{j=1}^p \beta_j y_{t-j} + u_t \quad (8)$$

$$y_t = \sum_{j=1}^p \eta_j x_{t-j} + \sum_{j=1}^p \gamma_j y_{t-j} + v_t \quad (9)$$

The null hypotheses to be tested are:

H1: $\eta_j = 0, j = 1 \dots p$ this simply suggest that variable x does not Granger cause y ; and

H1: $\beta_j = 0, j = 1 \dots p$ simply suggest that variable y does not Granger cause x

A case where variable x can help predicting y , then x is said to “Granger cause” y also known as unidirectional. If there is no hypothesis rejected, it simply suggests that none of the variables Granger cause the other. However, if causality run from x or y then there is bidirectional causal relationship.

Summary

This chapter concludes that the adoption of the model used by Bloch and Tang (2003) in Nigeria was very instrumental in determining the causal relationship between road infrastructure development and economic growth. The data sourced from the World Bank between 1990 and 2014 was exported to the E-views tool to run the regression.

This study adopted the Augmented Dickey–Fuller (ADF) for the unit root to test the stationarity and Bounds test to co-integration in order to establish long-run and short run relationships. The co-integration analysis was deemed to be important in the differentiation of the error process in the regression to test the link between the non-stationarity process and long-run equilibrium.

This study further applied the Engle-Granger and ARDL Error Correction estimations to determine directional causality flow and the speed of adjustment of the long-run relationship among variables.

CHAPTER FIVE

DISCUSSION OF THE RESULTS

5.1 INTRODUCTION

This chapter presents the empirical interpretation and results of the study. The chapter provides a discussion of the results of the unit root test, co-integration, error correction model and Granger causality analysis. It concludes with the Engle-Granger and ARDL Error Correction estimations to determine the directional causality analysis and the speed of adjustment of the long-run relationship between road infrastructure development and economic growth in Namibia.

5.1 Stationarity test results

The Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) tests were applied to determine the statistical properties of the series. The study opted to use more than one test for unit root to enrich the robustness and make informed decisions regarding the order of integration. Table 5.1 reports the results of the ADF, PP and KPSS in levels and first difference. The result show that all variables are stationary in first difference, meaning that they are integrated of the order one:

Table 5.1: Unit root test: ADF, PP and KPSS in level and first difference

Variable	Model Specification	Levels			First Difference			Order of Integration
		ADF	PP	KPSS	ADF	PP	KPSS	
GDP	Intercept	-2.916**	-5.921**	0.190**	-7.955**	-7.955**	0.023**	I (0)
	Intercept and Trend	-3.151	-5.979**	0.045**	-7.847**	-7.846**	0.019**	I (0)
LNGERT	Intercept	-0.074	-0.552	1.233	-4.890**	-4.947**	0.048**	I (1)
	Intercept and Trend	-3.707**	-2.282	0.102**	-4.883**	-4.904**	0.048**	I (0)
LNICT	Intercept	-0.13	-0.356	0.83	-5.362**	-5.395**	0.312**	I (1)
	Intercept and Trend	-1.557	-1.167	0.28	-5.547**	-5.592**	0.044**	I (1)
LNFDI	Intercept	-3.362**	-3.342**	0.637***	-	-	0.044**	I (0)
	Intercept and Trend	-3.892**	-3.936**	0.069**	11.036**	11.120**	0.043**	I (0)

Notes: (a) for ADF and PP, ** means the rejection of the null hypothesis of unit root at 5%. b) for KPSS, ** and *** means failure to reject the null hypothesis of stationarity at 5% and 1% respectively. *Source:* author's compilation and values obtained from E-views.

5.1.2 Determining Optimal Lag Length

After establishing the order of integration, the next step was to determine the order of lags on first differenced variables.

This was obtained from the unrestricted error correction model by means of the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQC).

The estimated model based on the highest values obtained from SBC and AIC revealed an optimal lag length of up to 2 as shown in table 5.2. This is appropriate so that one can also avoid the problem of over-identification.

Table 5.2: Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-545.1785	NA	3.095112	12.48133	12.59393	12.52669
1	-52.86072	928.6903	6.16e-05	1.655925	2.218957	1.882757
2	12.42554	117.2185	2.01e-05	0.535783	1.549239*	0.944079*
3	15.29571	4.892328	2.73e-05	0.834188	2.298069	1.423949
4	21.85254	10.58034	3.42e-05	1.048806	2.963112	1.820032
5	59.48403	57.30250	2.13e-05	0.557181	2.921912	1.509872
6	91.47970	45.81199*	1.52e-05*	0.193643*	3.008799	1.327799
7	95.10851	4.865905	2.09e-05	0.474807	3.740387	1.790427
8	100.3580	6.561877	2.81e-05	0.719136	4.435141	2.216221

* indicates lag order selected by the criterion

Autoregressive models require lags and thus it is necessary to determine the optimal lag length for the model. In this regard the appropriate lag length criterion was followed and particularly using the SC because of its consistency.

5.4. Bounds co-integration test

The study employed the ARDL Bounds test to determine the presence of the long-term relationship or some long-term equilibrium value. The results are reported in Table 5.3.

Table 5.3: Bounds test results

Level of Sig-nificance	Lower bound value	Upper bound values	F-statistic Value	Null Hypotheses
10%	2.37	3.20	6.037	No co-integration
5%	2.79	3.67		No co-integration
2.5%	3.15	4.08		No co-integration
1%	3.65	4.66		No co-integration

Source: Author's compilation using E-views, Note: $K=3$ d.f, the lag length is chosen automatically by E-views using Akaike information criteria.

The Bounds test results indicate that there exists a long-term equilibrium value, signifying a long-run relationship thereof. This is so, since the F-statistics value (6.037) is greater than all upper bound critical values of 3.0, 3.67, 4.08 and 4.66 respectively. The Bounds test was conducted at a fixed lag length of 2 as suggested by Schwarz information criteria. Since the variables in the model are co-integrated, the study proceeded to further estimate the short-run (ARDL Error Correction) equation.

5.5. Long-run and short-run estimates

Table 5.4: Estimated Long Run coefficients using the ARDL (2, 0, 0, and 0) based on SIC

Regressor	Coefficient	Std. Error	t-Statistic	Prob.
LNICT	0.038774	0.337214	0.114985	0.9087
LNGERT	0.555368	0.394036	1.409435	0.1622
LNFDI	-0.402150	0.536617	-0.749417	0.4556
C	-6.972518	3.882253	-1.795998	0.0759

Table 5.4 presents the long-run coefficients from the ARDL estimation. The estimated long run model shows a positive, but not statistical significant relationship between expenditure on road transport and economic growth. That also applied to the relationship between information communication technology and economic growth in Namibia. This suggests that an increase in the two mentioned repressors leads to a slight increase in the economic growth.

Since the long-run coefficients revealed poor results between expenditure on road transport and economic growth and also between information communication technology and economic growth in Namibia, the next researchers should revisit this model with a high degree of consciousness. This finding is supported by the Ashipala and Haimbodi (2003) study which revealed that, the impact of social infrastructure investment on growth is slightly immaterial enough. While private investment shown a long- run growth impact in South Africa and Namibia. Additionally, a study by Shafuda (2015) showed unidirectional connexion between public expenditure causing economic growth, government spending positively, but significantly impacts of the government spending on economic growth in Namibia.

On the contrary, the long-run estimates show a negative relationship between foreign direct investment and economic growth. This is to say that an increase in foreign direct investment brings about a reduction in economic growth. However, it should be noted that in both cases, the relationships are statistically insignificant.

Table 5.5: Error correction model using the ARDL (2, 0, 0, 0, and 2) based on SIC

Regressor	Coefficient	Std. Error	t-Statistic	Prob.*
D(GDP(-1))	2.280058	0.290970	7.836060	0.0000
D(GDP(-2))	-1.649608	0.353336	-4.668673	0.0000
D(LNICT)	0.067743	0.263197	0.257387	0.7975
D(LNGERT)	3.286922	0.926232	3.548704	0.0006
D(LNFDI)	-0.050744	0.193232	-0.262606	0.7935
ECM(-1)	-1.904724	0.417356	-4.563787	0.0000
C	-0.186516	0.080413	-2.319488	0.0229

Table 5.5 shows the estimated short-run function. As in the case of the long-run results, there is a positive bond between expenditure on road transport and GDP in Namibia, which is statistically significant. Similarly, the relationship between information communication technology and GDP was positive, though statistically insignificant. On the contrary, the findings revealed a negative relationship between foreign direct investment and economic growth, though this is statistically insignificant.

The findings on the relationship between expenditure on road transport infrastructure are supported by Aigbokhan (1999) who is of the opinion that in general infrastructure variables positively correlate with private investment and economic growth. Therefore, promotion of investment-led growth demands sufficient funding on infrastructure to create new capacities and equally maintaining the existing ones. Fedderke et al. (2006, as cited in Moctezuma, 2008) found that road infrastructure does indeed lead to economic growth in South Africa, both by boosting GDP directly and by raising the marginal products of other productive factors.

5.5 Granger Causality Tests

The results for the causality tests are presented in Table 5.6. The results revealed that there is no causality between the two variables. This suggests that the two variables do not help predict one another. Since there is no causality between the variables, this means that there is no directional flow of the causality among the variables.

Table 5.6 Granger causality test results

<u>Null Hypothesis:</u>	<u>Obs</u>	<u>F-Stat-</u>	
		<u>tic</u>	<u>Prob.</u>
<u>FDI does not Granger Cause GDP</u>	<u>94</u>	<u>0.03633</u>	<u>0.9643</u>
<u>GDP does not Granger Cause FDI</u>		<u>0.09192</u>	<u>0.9123</u>
<u>ICT does not Granger Cause GDP</u>	<u>92</u>	<u>0.22107</u>	<u>0.8021</u>
<u>GDP does not Granger Cause ICT</u>		<u>0.21124</u>	<u>0.8100</u>
<u>GERT does not Granger Cause GDP</u>	<u>94</u>	<u>1.46531</u>	<u>0.2365</u>
<u>GDP does not Granger Cause GERT</u>		<u>1.26946</u>	<u>0.2860</u>
<u>ICT does not Granger Cause GDP</u>	<u>94</u>	<u>0.80490</u>	<u>0.4504</u>
<u>GDP does not Granger Cause ICT</u>		<u>0.15188</u>	<u>0.8593</u>
<u>ICT does not Granger Cause FDI</u>	<u>92</u>	<u>0.16024</u>	<u>0.8522</u>
<u>FDI does not Granger Cause ICT</u>		<u>0.01086</u>	<u>0.9892</u>
<u>GERT does not Granger Cause FDI</u>	<u>94</u>	<u>0.68468</u>	<u>0.5069</u>
<u>FDI does not Granger Cause GERT</u>		<u>1.69001</u>	<u>0.1904</u>

<u>ICT does not Granger Cause FDI</u>	<u>94</u>	<u>0.14097</u>	<u>0.8687</u>
<u>FDI does not Granger Cause ICT</u>		<u>0.34757</u>	<u>0.7074</u>
<hr/>			
<u>GERT does not Granger Cause ICT</u>	<u>92</u>	<u>0.01560</u>	<u>0.9845</u>
<u>ICT does not Granger Cause GERT</u>		<u>0.23568</u>	<u>0.7905</u>
<hr/>			
<u>ICT does not Granger Cause ECT</u>	<u>92</u>	<u>0.03306</u>	<u>0.9675</u>
<u>ECT does not Granger Cause ICT</u>		<u>0.15345</u>	<u>0.8580</u>
<hr/>			
<u>ICT does not Granger Cause GERT</u>	<u>94</u>	<u>1.87727</u>	<u>0.1590</u>
<u>GERT does not Granger Cause ICT</u>		<u>11.2932</u>	<u>4.E-05</u>
<hr/>			

5.6 Summary

This chapter concluded that the results of the ADF, PP and KPSS show that all variables are stationary in the first difference, meaning that they are integrated of order one. Determining the optimal order of lag length, the estimated model based on the highest values obtained from SBC and AIC revealed an optimal lag length of up to 2 which confirms that the model is dynamically stable.

The ARDL bounds testing approach to co-integration was applied to examine a long-run relationship which was used to determine the long-run relationship among the variables under study. However, the estimated long-run model shows that there is a statistically insignificant positive long-run relationship between expenditure on road transport and economic growth as well as information communication technology and economic growth in Namibia while negative relationships do exist between foreign direct investment and economic growth.

Subsequent to that, the Error correction model was applied using the ARDL Error Correction estimations to determine the short-run relationship which revealed that a statistically significant and positive relationship does exist between expenditure on road transport infrastructure and economic growth in Namibia; while foreign direct investment has a negative relationship though statistically insignificant. The Bounds test results indicated that there exists a long-term equilibrium value, signifying a long-run relationship with an F-statistics value of (6.037) is greater than all upper bound critical values of 3.0, 3.67, 4.08 and 4.66 respectively. The Bounds test was 2 as suggested by the Schwarz information criteria.

Finally, this chapter applied the Engle-Granger test to determine the directional causality flow of the variables, which revealed that there is no causality directional flow between the two variables, and this means that there is no causality among the variables.

CHAPTER 6

CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1 Introduction

This chapter presents a brief summary of the findings from the interpretation of the empirical results with support from both theoretical and empirical literature. This study used the ARDL bounds testing approach to co integration to examine a long-run relationship and ARDL Error Correction estimations to test the short-run relationship, while Engle-Granger was used to determine the directional causality flow of the variables under study.

6.2 Summary and conclusion of the study

This study concluded that, in the long run, the relationship between expenditure on road transport and economic growth are not significant. The long-run relationship between information communication technology and economic growth is also insignificant while a negative relationship exists between foreign direct investment and economic growth.

However, in the short-run relationship estimations, a statistically significant and positive relationship between expenditure on road transport infrastructure and economic growth in Namibia was found while foreign direct investment under short-run relationship estimations showed a negative relationship although it was statistically insignificant.

The study further revealed that there is no causality directional flow between the two variables, and this means that there is no causality among the variables. This means that in the long run, the investments in information technology and government expenditure are insignificant and negatively contribute to the Namibian economy's growth, while capital investment from foreign countries also negatively contributes to the Namibian economic growth.

Similar results were further manifested by the short-run relationship which revealed statistically that the relationship between information communication technology and economic growth was found to be positive, though statistically insignificant. However, in the short-run estimates, the study revealed that a positive connection between expenditure on road transport and GDP in Namibia does exist and subsequently contributes significantly to the Namibian economic growth.

On the contrary, the short-run estimated model showed an adverse nexus between foreign direct investment and economic growth, though this is statistically insignificant.

This paper further revealed that there is no directional causal flow between the two variables, meaning that the two variables do not help predict one another since there is no association between road infrastructure developments and GDP and hence the directional flow is negative.

However, it's imperative that we align the study findings with the objectives of the study with the purpose of ensuring that this paper answers the problem of the study as well.

In the short-run, the relationship between government expenditure on road transport infrastructure development and economic growth in Namibia is statistically significant and positive. Supported by information communication technology with a similar relationship, while foreign direct investment is negative but statistically insignificant.

To fulfill the objectives of this study, it was equally important to reveal that the long-run relationship between government expenditure on road transport infrastructure development and economic growth is positive, though it is statistically insignificant. In addition to that, the nexus between information communication technology and economic growth also have a similar relationship. Contrary to that, a negative relationship between foreign direct investment and economic growth does exist slightly, though not significant.

This study will not do enough justice if directional causality flow between government expenditure on road transport infrastructure development and economic growth in Namibia is not emphasised. From the study, it is evident that there is no directional causality flow between government expenditure on road transport infrastructure development and economic growth in Namibia. Neither does directional causality flow exist among the concerned variables.

The empirical studies attest to the fact that government spending has a significant and positive impact on economic growth in Namibia although there is no directional causality among the concerned variables.

6.3 Recommendations

However, this study suggests some fiscal and monetary interventions are needed, which will indirectly increase the government expenditure on road infrastructure development, economic growth which will influence the relationship between the concern variables and the directional causality among themselves:

- The central government budget allocation to the transport sector should be increased to improve the existing infrastructure and to supplement the prevailing road infrastructure stock.
- Full implementation of public private partnerships (PPPs) in the capital infrastructure investment project.
- Legal, institutional reform and corporate governance compliance which will require all the SOE`s to compulsorily submit annual corporate governance reports before the annual transfers and subsidies are disbursed.
- An increase in the revenue collection base to ease the pressure on Government from the high costs of borrowing, high costs of servicing debt and high risk financial debt instruments by firstly raising capital through taxation and by consolidating revenue and infrastructure levies collection.
- Boosting public sector borrowing on the international capital market through bond issues, infrastructure funds revenue bonds, franchise arrangements, commercialising and outsourcing expensive public services.
- To develop a partner financing business model through sector budget support, loans, grants and contracts, private debt, private equity and mixed debt and equity.
- Treasury and the Bank of Namibia as regulators should reform fiscal and monetary policies to curb the unbearable economic and financial vulnerability which severely affected Namibian sovereign ratings of late by Fitch and Moody`s.

The rating agencies, found “erosion of Namibia’s fiscal strength due to sizable fiscal imbalances and increasing debt burden”, “limited institutional capacity to manage shocks and address long-term structural fiscal rigidities,” and “risk of renewed government liquidity pressures in the coming years”.

The status quo - command all Namibians both in private and public sector to joint force and stand together as “One Nation -One Namibia” and build the Namibian house by moving in one direction and improve on this negative credit rating outlooks.

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APPENDICES

Appendix 1: Semi-Log model: (GDP) (lnict) (lngert) (lnfdi)

Table1: lag selection

VAR Lag Order Selection Criteria

Endogenous variables: GDP LNICT LNGERT LNFDI

Exogenous variables: C

Date: 09/14/17 Time: 22:43

Sample: 1990Q1 2014Q4

Included observations: 88

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-545.1785	NA	3.095112	12.48133	12.59393	12.52669
1	-52.86072	928.6903	6.16e-05	1.655925	2.218957	1.882757
2	12.42554	117.2185	2.01e-05	0.535783	1.549239*	0.944079*
3	15.29571	4.892328	2.73e-05	0.834188	2.298069	1.423949
4	21.85254	10.58034	3.42e-05	1.048806	2.963112	1.820032
5	59.48403	57.30250	2.13e-05	0.557181	2.921912	1.509872
6	91.47970	45.81199*	1.52e-05*	0.193643*	3.008799	1.327799
7	95.10851	4.865905	2.09e-05	0.474807	3.740387	1.790427
8	100.3580	6.561877	2.81e-05	0.719136	4.435141	2.216221

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

✓ *We choose lag 2 based on SC.*

Table 2: ARDL

Dependent Variable: GDP

Method: ARDL

Date: 09/14/17 Time: 22:48

Sample (adjusted): 1990Q4 2014Q1

Included observations: 94 after adjustments

Maximum dependent lags: 2 (Automatic selection)

Model selection method: Schwarz criterion (SIC)

Dynamic regressors (2 lags, automatic): (LNICT) (LNGERT)

(LNFDI)

Fixed regressors: C

Number of models evaluated: 54

Selected Model: ARDL (2, 0, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	1.546349	0.071978	21.48359	0.0000
GDP(-2)	-0.727891	0.072694	-10.01309	0.0000
LNICT	0.007039	0.080957	0.086949	0.9309
LNGERT	0.100822	0.072696	1.386897	0.1690
LNFDI	-0.073007	0.114520	-0.637502	0.5255
C	-1.265800	1.100991	-1.149692	0.2534

R-squared	0.917495	Mean dependent var	4.373194
Adjusted R-squared	0.912808	S.D. dependent var	2.329228
S.E. of regression	0.687782	Akaike info criterion	2.151013
Sum squared resid	41.62792	Schwarz criterion	2.313351
Log likelihood	-95.09761	Hannan-Quinn criter.	2.216586
F-statistic	195.7216	Durbin-Watson stat	2.089552
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Schwarz Criteria (top 20 models)

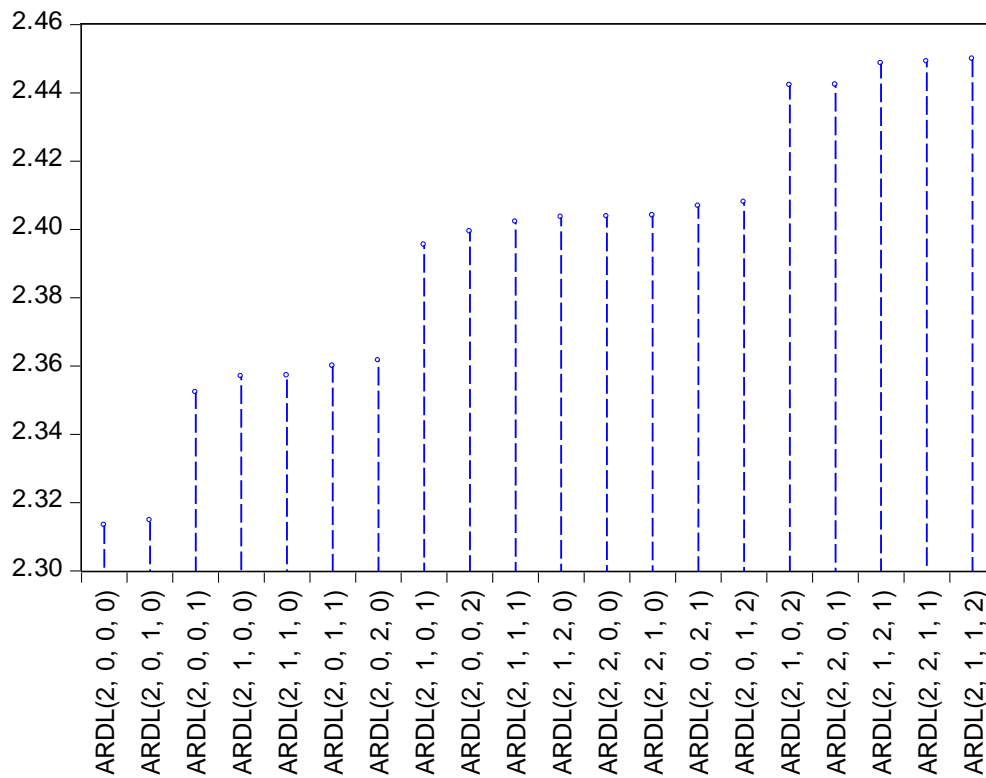


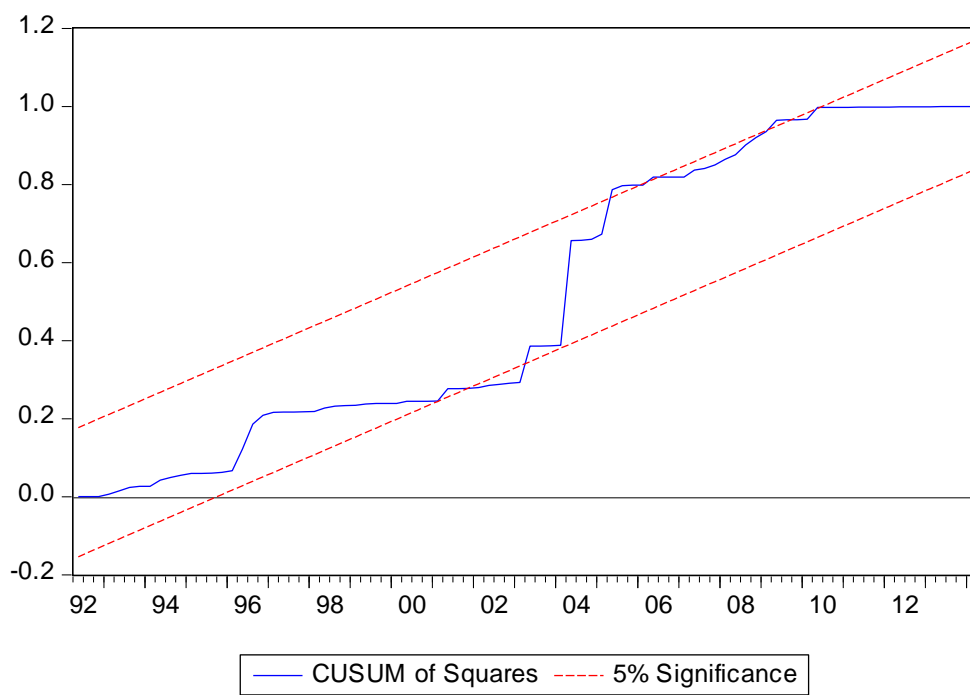
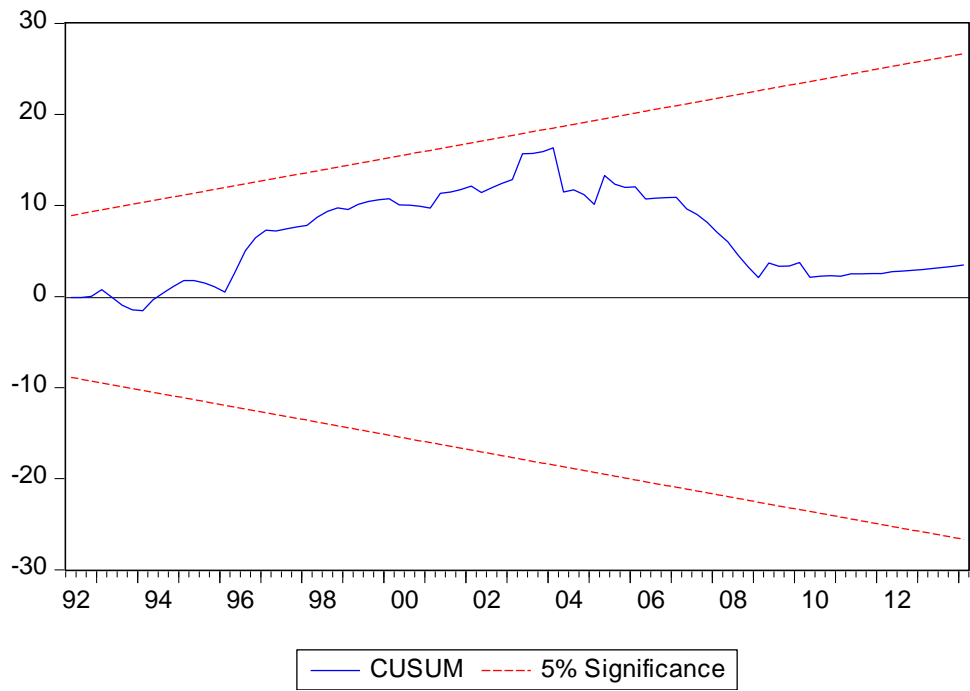
Table 3: Serial correlation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.263626	Prob. F(2,86)	0.7689
Obs*R-squared	0.572787	Prob. Chi-Square (2)	0.7510

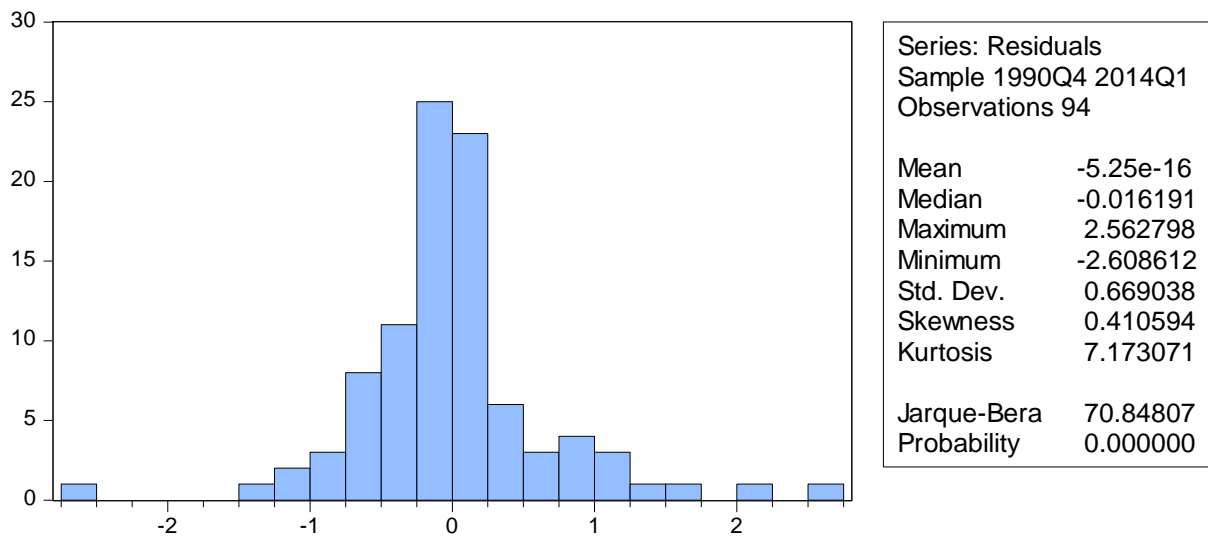
✓ No serial correlation

Table 4: Model Stability



✓ Model not stable

Table 5: Normality test



✓ Residual not normally distributed

Table 6.1: Heteroscedasticity test

Heteroskedasticity Test: White

F-statistic	4.550154	Prob. F(5,88)	0.0010
Obs*R-squared	19.30977	Prob. Chi-Square(5)	0.0017
Scaled explained SS	52.23458	Prob. Chi-Square(5)	0.0000

✓ Heteroscedasticity is present

Table 6.2 Heteroscedasticity assumed

Heteroskedasticity Test: White

F-statistic	4.550154	Prob. F(5,88)	0.0010
Obs*R-squared	19.30977	Prob. Chi-Square(5)	0.0017
Scaled explained SS	52.23458	Prob. Chi-Square(5)	0.0000

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 09/14/17 Time: 23:00

Sample: 1990Q4 2014Q1

Included observations: 94

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.614904	0.359792	1.709056	0.0910
GDP(-1)^2	0.029810	0.018669	1.596709	0.1139
GDP(-2)^2	-0.015861	0.011287	-1.405303	0.1635
LNICT^2	-0.006643	0.003484	-1.906567	0.0598
LNGERT^2	0.004077	0.003404	1.197746	0.2342
LNFDI^2	-0.097297	0.073285	-1.327650	0.1877
R-squared	0.205423	Mean dependent var		0.442850
Adjusted R-squared	0.160277	S.D. dependent var		1.106191
S.E. of regression	1.013673	Akaike info criterion		2.926740
Sum squared resid	90.42297	Schwarz criterion		3.089078
Log likelihood	-131.5568	Hannan-Quinn criter.		2.992313
F-statistic	4.550154	Durbin-Watson stat		1.904158
Prob(F-statistic)	0.000976			

Table 7: Bound test

ARDL Bounds Test

Date: 09/14/17 Time: 23:02

Sample: 1990Q4 2014Q1

Included observations: 94

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	6.037099	3

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
1%	3.65	4.66

✓ There is cointegration (in the long run)

Table 8: Cointegration & Long-run form

ARDL Cointegrating And Long Run Form

Dependent Variable: GDP

Selected Model: ARDL(2, 0, 0, 0)

Date: 09/14/17 Time: 23:05

Sample: 1990Q1 2014Q4

Included observations: 94

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	0.712554	0.070817	10.061863	0.0000
D(LNICT)	0.198751	0.380855	0.521855	0.6031
D(LNGERT)	1.143287	0.639948	1.786531	0.0775
D(LNFDI)	0.024923	0.142434	0.174978	0.8615
CointEq(-1)	-0.198559	0.034135	-5.816919	0.0000

Cointeq = GDP - (0.0388*LNICT + 0.5554*LNGERT -0.4021*LNFDI -6.9725)

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNICT	0.038774	0.337214	0.114985	0.9087
LNGERT	0.555368	0.394036	1.409435	0.1622
LNFDI	-0.402150	0.536617	-0.749417	0.4556
C	-6.972518	3.882253	-1.795998	0.0759

Table 9: Short run dynamics

Dependent Variable: D(GDP)

Method: ARDL

Date: 09/14/17 Time: 23:10

Sample (adjusted): 1991Q3 2014Q1

Included observations: 91 after adjustments

Maximum dependent lags: 2 (Automatic selection)

Model selection method: Schwarz criterion (SIC)

Dynamic regressors (2 lags, automatic): D(LNICT) D(LNGERT)

D(LNFDI)

(ECM(-1))

Fixed regressors: C

Number of models evaluated: 162

Selected Model: ARDL(2, 0, 0, 0, 2)

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(GDP(-1))	2.280058	0.290970	7.836060	0.0000
D(GDP(-2))	-1.649608	0.353336	-4.668673	0.0000
D(LNICT)	0.067743	0.263197	0.257387	0.7975
D(LNGERT)	3.286922	0.926232	3.548704	0.0006
D(LNFDI)	-0.050744	0.193232	-0.262606	0.7935
ECM(-1)	-1.904724	0.417356	-4.563787	0.0000
ECM(-2)	0.541449	0.188800	2.867843	0.0053
ECM(-3)	0.579254	0.168898	3.429602	0.0009
C	-0.186516	0.080413	-2.319488	0.0229
R-squared	0.678655	Mean dependent var	-0.017492	
Adjusted R-squared	0.647305	S.D. dependent var	0.996428	
S.E. of regression	0.591760	Akaike info criterion	1.882232	
Sum squared resid	28.71480	Schwarz criterion	2.130559	
Log likelihood	-76.64157	Hannan-Quinn criter.	1.982417	

F-statistic	21.64722	Durbin-Watson stat	1.531152
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Table 10; Granger Causality

Pairwise Granger Causality Tests

Date: 09/14/17 Time: 18:51

Sample: 1990Q1 2014Q4

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
FDI does not Granger Cause GDP	94	0.03633	0.9643
GDP does not Granger Cause FDI		0.09192	0.9123
ICT does not Granger Cause GDP	92	0.22107	0.8021
GDP does not Granger Cause ECT		0.21124	0.8100
GERT does not Granger Cause GDP	94	1.46531	0.2365
GDP does not Granger Cause GERT		1.26946	0.2860
ICT does not Granger Cause GDP	94	0.80490	0.4504
GDP does not Granger Cause ICT		0.15188	0.8593
ICT does not Granger Cause FDI	92	0.16024	0.8522
FDI does not Granger Cause ECT		0.01086	0.9892
GERT does not Granger Cause FDI	94	0.68468	0.5069
FDI does not Granger Cause GERT		1.69001	0.1904
ICT does not Granger Cause FDI	94	0.14097	0.8687
FDI does not Granger Cause ICT		0.34757	0.7074
GERT does not Granger Cause ICT	92	0.01560	0.9845
ECT does not Granger Cause GERT		0.23568	0.7905
ICT does not Granger Cause ICT	92	0.03306	0.9675
ICT does not Granger Cause ICT		0.15345	0.8580
ICT does not Granger Cause GERT	94	1.87727	0.1590
GERT does not Granger Cause ICT		11.2932	4.E-05