

AN ANALYSIS OF THE IMPACT OF TRANSPORT INFRASTRUCTURE
DEVELOPMENT ON ECONOMIC GROWTH IN NAMIBIA

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Abstract

The main objective of the study was to measure the impact of transport infrastructure development on economic growth in Namibia for the period, 1990-2019. The Vector Error Correction Model (VECM) was adopted in achieving the objectives of the study. The annual time series data was sourced from the World Bank Database and the Ministry of Finance.

The unit root test was used to determine the order of integration, whilst the Johansen cointegration test was used to test for the existence of the long run relationship.

The unit root test revealed that all the variables are integrated of order one. This warranted the estimation of the VECM which requires all the variables to be integrated of the same order. The Johansen cointegration test revealed a long run relationship amongst the variables, as it was confirmed by both the Trace and Maximum Eigen test statistic. The vector error correction provided both short and long run estimates. The findings revealed a negative long run relationship between expenditure on transport and gross domestic product. On the contrary, the short run estimates revealed a positive relationship between expenditure on transport and gross domestic product in Namibia. However, the relationship is statistically insignificant.

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List of acronyms and abbreviations

ADF – Augmented Dickey-Fuller

BoN - Bank of Namibia

CUSUM – Cumulative Sum of Recursive Residuals

CUSUMQ – Cumulative Sum of Recursive Residuals of Squares

ECT – Error Correction Term

FDI - Foreign Direct Investment

GDP - Gross Domestic Product (Real)

GET - Government Expenditure on Transport

HKIA - Hosea Kutako International Airport

MoF - Ministry of Finance

MTEF - Medium Term Expenditure Framework

NAC - Namibia Airports Company

NamPort - Namibian Ports Authority

NDP5 - Fifth National Development Plan

NDP4 - Fourth National Development Plan

NPC - National Planning Commission

OLS - Ordinary Least Square

TR - Trunk Road

RA - Roads Authority

SADC - Southern African Development Community

SSA - Sub-Saharan Africa

VAR – Vector Auto-Regression

WB – World Bank

WBCG - Walvis-Bay Corridor Group

VECM - Vector Error Correction Model

Dedication

Firstly, I dedicate this thesis to my dear uncle, Florian Shivolo who has had epilepsy from the age of 5 and now is in his mid-50's. I appreciate every effort you have devoted to education and welfare. You were always my holiday English and Mathematics teacher. I always remember your unrealised words “when I am well, I will go back to school and become a teacher”. As well as, you ending our heartfelt session with “study hard, without a paper (qualification) you don't have a future”.

Investing your time and energy in me was not a slip-up, but indeed one of the most strategic and sustainable decisions you ever made. I will fulfil your wish as I promised. Equally I dedicate this paper to my sister Monika Hiskia and her late daughter Ndalila. I LOVE YOU!

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Declarations

I, Ananias Maria Ndahambelega, know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own. I understand what plagiarism entails and am aware of the University's policy in this regard.

I, Ananias Maria Ndahambelega, has used a recognised protocol for citation and referencing. All contributions from the works of others, are duly acknowledged and references were made according to the requirements of the University of Namibia.

I do hereby certify that this submission is my own work. I have not allowed and will not allow anyone to copy this thesis with the intention of passing it off as his or her own work. However, I have granted the University of Namibia permission to reproduce this thesis in whole or in part in any manner or format, which the University of Namibia may deem appropriate.

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Date

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Transport infrastructure investment in developing countries is a major pillar in achieving sustainable development goals (Ross, 2015). Infrastructure investment refers to money used to finance productive public expenditure in infrastructure (such as transport) and human capital with the objective of promoting economic growth (Luiz, 2010). Hence, transport infrastructure development is concerned with investment in key transport sectors such as road, railway, port, and airport infrastructure.

The importance of transport infrastructure development for trade, growth, investment and poverty reduction has been acknowledged. In addition, transport infrastructure enables the mainstream provision of facilities to consumers and affords interim inputs that enter into the production of other sectors and increases factor output. The correlation between transport infrastructure development and economic growth has been broadly treated in theoretical and empirical works. However, economists hold different viewpoints. In the literature on the connection between transport infrastructure development and economic growth, there has been a question that has remained inconclusive and that is, whether policymakers should first pursue transport infrastructure development or economic growth, or if they ought to proceed along with both transport infrastructure development and economic growth.

The aim of this study is to analyse the relationship between transport infrastructure development and economic growth, that is whether transport infrastructure development in Namibia is an effective tool in stimulating economic growth.

1.2 PROBLEM STATEMENT

The rate of government infrastructure investment and development, which hovers around 5.0 percent, straggles behind the levels required to impel the economic growth of Namibia as envisioned in the Namibia Development Plan 4 (NDP4). It is also 4.0 percent behind developed economies like China (Namakalu, *et al.*, 2014). This study intends to determine the nexus between infrastructure development and economic growth and the causality among the concerned variables.

Studies conducted on Africa (Saidi *et al.*, 2018, Boopen, 2006; Muvawala *et al.*, 2019); Pakistan (Awan & Anum, 2014; Batool & Goldman, 2019) and China (Yu *et al.*, 2013; Magazzino, 2019) on transport development and economic growth present mixed results. While this could result from differences in adopted methodologies, it is evident that the effect of transport development on economic growth is inconclusive, and thus for better policy options, country-specific studies are required.

There is limited evidence on the effects of infrastructure development and economic growth in Namibia (Mapaure, 2014; Melber, 2019 and Tiyitende, 2015). However, little is known regarding the impact of transport infrastructure

development on economic growth (Mungendje, 2017 and Saruchera, 2017). This study contributes to this literature by investigating the effects of transport development and economic growth in Namibia, a country that is currently making huge investments in transport development. This research is important as Namibia embarks on a major expansion of its transport infrastructure such as the Hosea Kutako International Airport runways, Okahandja dual carriageway, Airport Road, and the refurbishment of the railroad network, among others.

The World Development Indicators (n.d) on Namibia from 1984 to 1993 showed an average economic growth of 2.9 percent, whilst the government expenditure on transport infrastructure development showed an average growth of 0.13 percent. Additionally, statistics (Namakalu, *et al.*, 2014) showed an increase to 7.3 percent average economic growth from 1994 to 2003 and an average increase to 0.61 percent in government expenditure on transport infrastructure development.

Mungendje (2017) further noted that, between 2004 and 2014, economic growth increased while expenditure in transport infrastructure development declined with an average increase of 4.7 percent and a 0.19 percent decline, respectively. The question that arises is, therefore, if economic growth can be driven by government expenditure on transport infrastructure development or vice versa then why is it that there is such a divergence in the Namibian economic growth rate and the government expenditure on transport infrastructure development?

1.3 OBJECTIVES OF THE STUDY

The main objective of the study is to measure the economic impact of transport infrastructure development on Namibian economic growth.

The specific objectives of the study were:

- To examine the effects of transport infrastructure development on economic growth in Namibia
- To determine the nature of the effect of transport development and economic growth in Namibia

1.4 The hypothesis of the study

In line with the above objectives, the research theories that are tested are as detailed below:

H¹₀: Transport infrastructure development has no effect on economic growth in Namibia

H¹₁: Transport infrastructure development has an effect on economic growth in Namibia

H²₁: There is no relationship between transport development and economic growth in Namibia

H²₀: There is a relationship transport development and economic growth in Namibia

1.5 SIGNIFICANCE OF THE STUDY

In order to justify that government resources are well spent; policymakers need to have an empirical basis on which to ground their national development strategies. Empirical studies on how transportation infrastructure development will influence economic growth and vice versa will assist policymakers in this regard. The study also complements existing literature to provide a base for upcoming academic studies.

1.6 LIMITATIONS OF THE STUDY

The study is limited in that there are many other determinants such as general government expenditure and movement in customer expenditure trends that could also have an impact on economic growth. However, this study only concentrated on the impact of government expenditure on transport infrastructure development and economic growth.

1.7 DELIMITATION OF THE STUDY

The study focused mainly on government transport infrastructure development for 30 years, from 1990 to 2019.

1.8 THE ORGANISATION OF THE STUDY

This paper is arranged into six chapters. The first chapter is the introduction, which outlines the introductory aspects of the study. It mainly focused on the problem statement, the objectives of the study, the significance, the limitations

of the study, and the delimitation of the study. Chapter 2 highlights an overview of transport infrastructure development in Namibia. It also covers the importance of transport infrastructure development in Namibia, the conditions of the transport network in Namibia, the current infrastructure funding model and the infrastructure funding needs in Namibia.

Chapter 3 reviews both theoretical and empirical studies related to the study. Chapter 4 looks at the research methods. This chapter is structured around the methodological processes that were followed in this study. It begins with research data, then the procedure, and adopted data analysis. Chapter 5 provides a discussion of the results, that is, the Johansen-Juselius co-integration and vector error correction model (VECM) test estimates to determine the effect and the swiftness of change of both the short-run and long-run relationships among variables, while Chapter 6 provides a summary of the conclusions, findings, and recommendations from the understanding of the study's empirical results with support from both the theoretical and empirical results from the literature reviewed.

CHAPTER 2

OVERVIEW OF ROAD INFRASTRUCTURE DEVELOPMENT IN NAMIBIA

2.1 INTRODUCTION

This chapter outlines Namibia's transport infrastructure development. It is subdivided into four sections. Section 2.1.1 examines the importance of transport infrastructure development. Section 2.1.2, the condition of Namibia's transport network. Sections 2.1.3 and Section 2.1.4 looks at the financing models in Namibia.

2.1.1 The importance of transport infrastructure development in Namibia

A solid transport framework decreases the time and cost of production and comparatively streamlines the associations among the different regions that improve cooperation within a country. This is reinforced by the extract from the NDP4, "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 a high potential for economic growth and job creation" (Namakalu, *et al.*, 2014).

Funding transport infrastructure development makes it possible for other sectors to increase, develop and contribute verifiably to the economic growth of the country. On the other hand, an underdeveloped transport infrastructure can

adversely affect the economy. Deficiencies in the transport sector arise from among other factors: declining maintenance of roads and rail network. If not attended to, these difficulties could become impediments to Namibia's objective of turning the country into the main logistic hub in the region.

2.1.2 The state of the transport network

The Namibian transport infrastructure consists of roads, rail, airports and ports.

2.1.2.1 Road network

The road system is made up of paved and unpaved roads. The absolute distance of the Namibian road network adds up to 44 428 kilometres (Roads Authority, n.d.). That consists of 6 199 km, or 14 percent of the total length being bitumen, 9 007 km about 20 percent, and 24 944 kilometres or 56 percent of the gravel road. The remaining 272 km of the access road which is also equivalent to 0.6 percent are salted roads, 241 km, or 0.5 percent is earth sand, and 1 437 km or 3 percent of the total length of earth roads. Approximately, 2 328 km of road systems are declared, but not yet put into use.

The administration of the public road network is the responsibility of the Roads Authority (RA) in terms of the Roads Authority Act 18 of 1999.

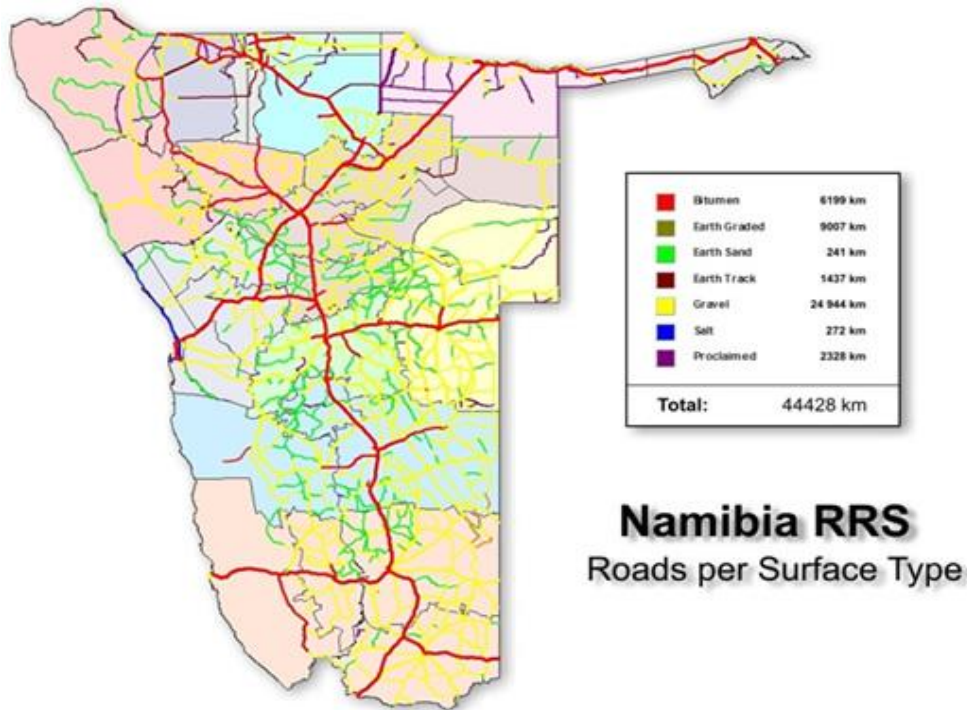


Figure 2.1: Roads Network in Namibia

Source: (Roads Authority, n.d.)

2.1.2.2 Railway network

All rail line networks in Namibia are overseen by TransNamib as per Act no. 28 of 1998. The rail line network contains 2,382 km of limited measure track with the fundamental line running from the South African border at Ariamsvlei through Keetmanshoop to Windhoek, Okahandja, Swakopmund, and Walvis Bay. The northern area connects Omaruru, Otjiwarongo, Otavi, Tsumeb, Oshikango, and Grootfontein. The east is connected from Windhoek to Gobabis, while the South from Windhoek-Keetmanshoop to Lüderitz.

Different railway undertakings yet to be attempted incorporate designs to improve the railroad lines from Rehoboth to Keetmanshoop (410 km), Keetmanshoop toward the South African border (361 km), Keetmanshoop to Aus

(226km), Windhoek to Usakos (210km) and Walvis Bay to Tsumeb (600km). The 400km Kranzberg-Tsumeb Railway Rehabilitation Project is already underway.



Figure 2.2: Railway Network in Namibia

Source: (TransNamib, 2016)

2.1.2.3 Airports

Namibia Airports Company (NAC) manages the 8 eight airports of Namibia. The significant air terminals in Namibia incorporate, Hosea Kutako International Airport, Walvis Bay Air terminal, and Keetmanshoop Air terminal. Rundu, Mpacha, Ondangwa, Oranjemund, Swakopmund, and Eros are smaller compared

to the beforementioned airports. Air Namibia flies local air routes to Lüderitz, Mpacha, Ondangwa, Oranjemund, Walvis Bay, and Windhoek. Internationally Air Namibia flies to Cape Town, Frankfurt, Johannesburg, Luanda, Maun, and Victoria Falls. Since 2018 Air Namibia has also introduced flights to Lagos and Accra. NAC is upgrading the Hosea Kutako International Airport, the goal is to update the HKIA to meet the 4F worldwide ranking.



Figure 2.3: Airport facilities and Air Namibia Routes

Source: Air Namibia (n.d)

2.1.2.4 Ports and Waterways

The Walvis Bay and the Luderitz ports are Namibia's only ports and they are administered by the Namibia Ports Authority (NamPort). Due to Namibia's vital geological area, Namibia's ports and corridors provide Southern African landlocked nations with shorter transport time, connecting them to markets in Europe and the Americas between the various corridors. The NDP4 features the significance of expanding funding to extend the limits of the Walvis Bay Port. The Walvis Bay Corridors is an organisation of transport corridors involving the Trans-Kalahari, Trans-Caprivi, Trans-Cunene, and Trans-Oranje Corridors, which connect various southern African nations with Namibia's port of Walvis Bay.

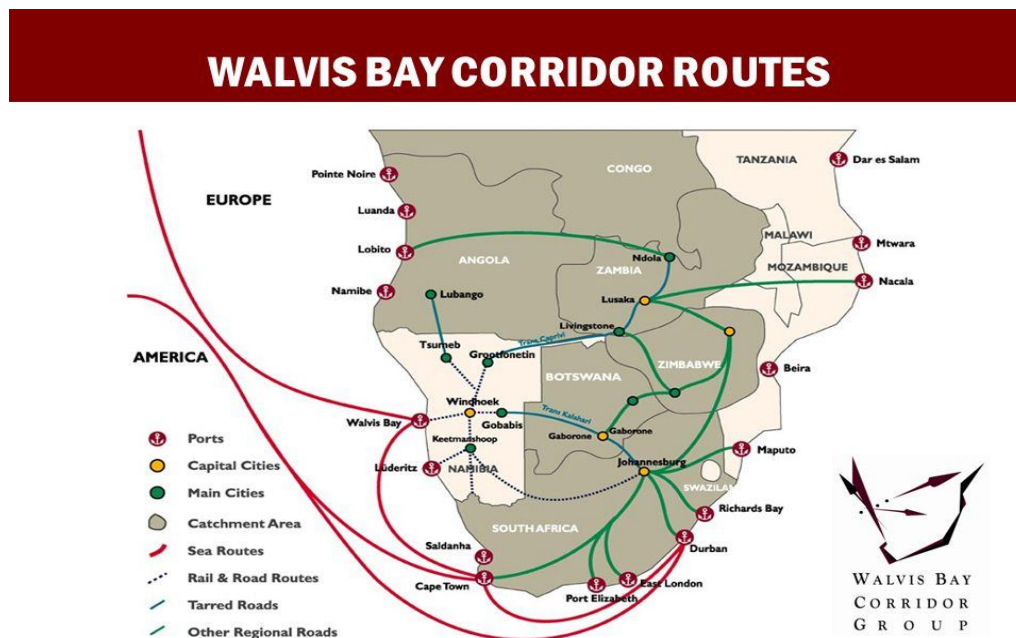


Figure 2.4: Ports of Namibia

Source: Walvis Bay Corridor Group (n.d.)

2.1.3 Current government transport infrastructure funding

According to Zhang, *et al.*, (2012) in terms of GDP, infrastructure investment is roughly 9 percent in China but only 5 percent in Namibia. It is commonly known that transport infrastructure is a public resource and transport development is a focal government obligation through its assigned transport sectorial establishments. Namibia was affected by the world crisis in 2008 and that seriously influenced monetary and money related approaches for the country. Therefore, spending requests were cut and this hampered considerable advancement in all sectors of government expenditure in Namibia.

In response to the global economic crisis, the government of the Republic of Namibia has however increased its expenditure to revitalise economic development as shown in the table 2.1 below.

Table 2.1: Actual government expenditure on transport infrastructure

Sector	2008/	2009/	2010/	2011/	2012/	2013/	2014/	2015/	2016/	2017/
(N\$ millions)	9	10	11	12	13	14	15	16	17	18
Transport	935	1234	1231	2411	2377	3474	2094	4495	3461	3699
Infrastructure										

Source: MoF - various Estimates of Revenue, Income and Expenditure 2010-2019/2020

The current government expenditure levels are however still inadequate to fund advanced transport infrastructure and maintenance programs in the transport sector (Mungendje, 2017).

2.1.4 Infrastructure funding needs in Namibia

Transport infrastructure investment remains significant in light of other sectors because it affects all other sectors positively. Nevertheless, the current condition of the transport infrastructure requires maintenance and thus infrastructure financing needs arise (Namakalu, *et al.*, 2014). The transport infrastructure needs an amount of approximately NAD123.4 billion, of which most, being 49.3 percent of the total amount is allocated to rail, followed by the ports with 28.3 percent of the total infrastructure finance need as shown in figure 2.5.

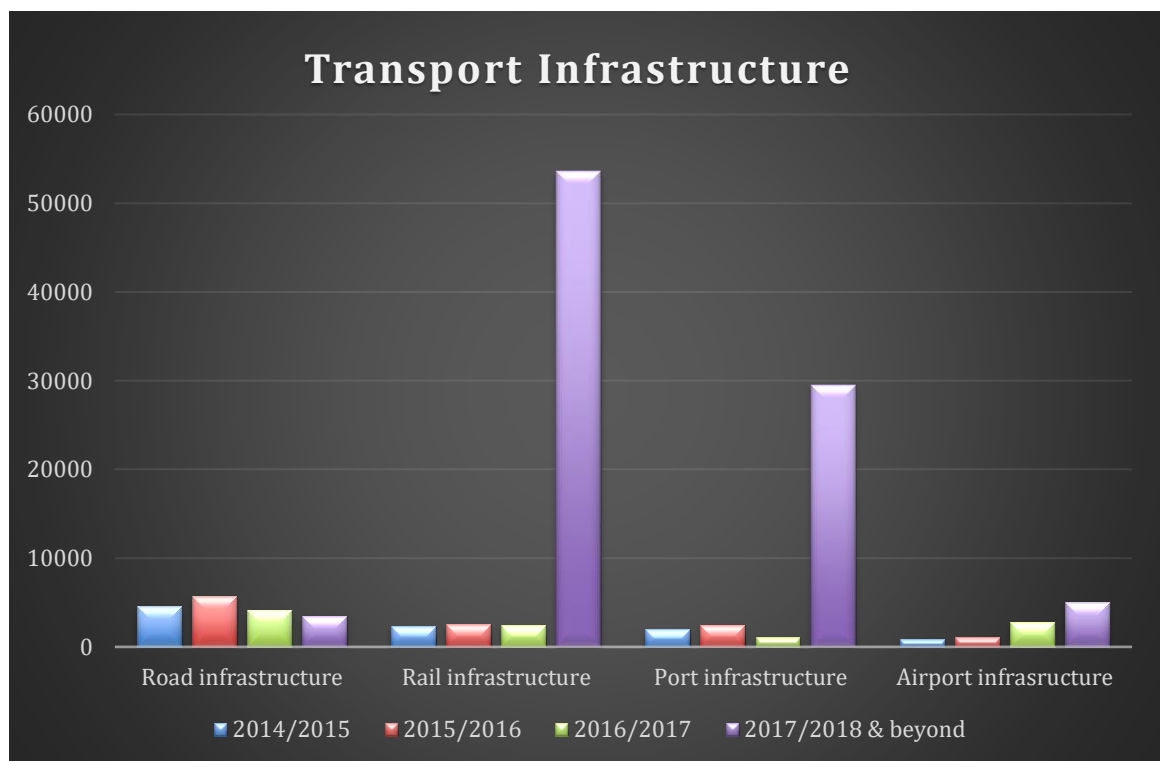


Figure 2.5: Transport infrastructure finance needs in Namibia

*Source: Bank of Namibia, 2014 *Amounts are in N\$ millions*

In recent years, there has been a fast pace of degradation of the national transport infrastructure compared to the pace of improvement and maintenance. This could

be a result of the lack of finance for the upkeep of the infrastructure by the government and also failure to secure external finance.





Ranking	Growth	Total Investment	Foreign Direct Investment	Infrastructure Development Index	
1	Tanzania (7.2%: 6.8%)	Mozambique (38.5: 49.8)	Angola (USD 8.7 bn: USD 9.7 bn)	Seychelles (93.9: 1 out of 54)	89.2 (84.4)
2	Seychelles (4.9%: 5.3%)	Lesotho (35.8: 33.3)	Mozambique (USD 3.7 bn: USD 25.0 bn)	South Africa (75.5: 4 out of 54)	76.2 (79.0)
3	Mozambique (4.5%: 7%)	Seychelles (32.5: 36.7)	South Africa (USD 1.8 bn: USD 28.3 bn)	Mauritius (74.1: 5 out of 54)	70.8 (67.0)
4	Namibia (4.2%: 5.6%)	Zambia (31.5: 33.3)	DRC (USD 1.7 bn: USD 13.6 bn)	Botswana (35.6: 10 out of 54)	34.6 (33.5)
5	Madagascar (4.1%: 2.2%)	Tanzania (30.7: 30.2)	Zambia (USD 1.7 bn: USD 10.8 bn)	Namibia (28.8: 11 out of 54)	28.3 (27.8)
6	DRC (3.9%: 7.7%)	Botswana (30.4: 34.5)	Tanzania (USD 1.5 bn: USD 10.5 bn)	Swaziland (24.6: 17 out of 54)	23.5 (22.3)
7	Mauritius (3.5%: 3.6%)	Namibia (29.2: 27.6)	Namibia (USD 1.1 bn: USD 5.4 bn)	Zimbabwe (24.1: 19 out of 54)	24.3 (24.7)
8	Botswana (3.1%: 5.3%)	Mauritius (21.7: 24)	Madagascar (USD 0.5 bn: USD 3.9 bn)	Zambia (21.5: 22 out of 54)	20.9 (20.1)
9	Zambia (3%: 6.1%)	South Africa (19.6: 20.3)	Zimbabwe (USD 0.4 bn: USD 2.3 bn)	Malawi (18.4: 28 out of 54)	17.2 (16.5)
10	Malawi (2.7%: 4.6%)	Madagascar (15.3: 17.2)	Botswana (USD 0.4 bn: USD 3.4 bn)	Angola (16.5: 31 out of 54)	16.1 (15.0)
11	Lesotho (2.4%: 4.4%)	DRC (14.9: 17.3)	Mauritius (USD 0.2 bn: USD 2.4 bn)	Lesotho (15.7: 34 out of 54)	15.4 (15.1)
12	Swaziland (0.5%: 2.1%)	Zimbabwe (14.2: 16.4)	Seychelles (USD 0.1 bn: USD 1.2 bn)	Tanzania (12.0: 43 out of 54)	11.1 (10.2)
13	South Africa (0.1%: 2.3%)	Malawi (12.6: 13.9)	Lesotho (USD 0.2 bn: USD 0.8 bn)	Mozambique (11.6: 45 out of 54)	11.1 (10.5)
14	Angola (0%: 4.5%)	Angola (9.7: 13.6)	Malawi (USD 0.14 bn: USD 0.8 bn)	Madagascar (8.5: 47 out of 54)	7.4 (6.6)
15	Zimbabwe (-0.3%: 7.2%)	Swaziland (9.4: 7)	Swaziland (-USD 0.2 bn: USD 0.2 bn)	DRC (8.2: 49 out of 54)	7.5 (6.8)
TOP COUNTRY BY CATEGORY					
Key and Notes	Country (Est 2016 Growth: Ave Growth 2010-2015)	Country (Est 2016 GFCF, % of GDP: Ave GFCF 2010-2015)	Country (FDI Flows: 2015, Stock:2010-15)	AfDB AIDI 2016 Rankings Country (Score: Position in Africa)	Ave Score: 2013-2016 (Score: 2013)
DRC = Democratic Republic of Congo; GFCF = gross fixed capital formation (public and private investment); AfDB = African Development Bank					

Figure 2.6: Relative spending on Infrastructure in the SADC region

Source: PESA (2017)

Investment in infrastructure, particularly in transport, is very vital SADC trade activity. Investment in infrastructure has also been the largest attraction of Foreign Direct Investment in Angola, Mozambique and South Africa. Making use of the Infrastructure Development Index in Figure 2.6, Namibia is doing well in its investment in infrastructure compared to other African countries.

2.2 Summary

Namibia is linked to Angola, Zambia, Zimbabwe, Botswana and South Africa and beyond by a good transport network. Remarkably, roads provide a convenient transport link between Namibia's port of Walvis Bay and landlocked neighbouring African countries. Although the transport facilities are not exceptionally well-maintained, they facilitate trade between Namibia and its neighbouring African countries and also globally.

CHAPTER 3

LITERATURE REVIEW

3.1 INTRODUCTION

The nexus between transport infrastructure improvement and economic growth has become topical in recent years. Previous studies examined this nexus with both hypothetical and empirical studies to confirm the short- and long-term relationship between transport infrastructure improvement and economic growth. In light of this, this chapter surveys both theoretical and empirical literature related to the current study.

3.2 THEORETICAL FRAMEWORK

This section analyses what researchers have examined in relation to the potential hypothetical connections between public use of infrastructural development and economic growth. The hypothesis of insecure growth is related to Hirschman (1958) who favoured the uneven growth hypothesis. The insecure growth is the finest technique to accomplish economic growth in poor economies. In those economies the government either invests in Direct Productive Activities (DPA) or Social Overhead Capital (SOC). This hypothesis is an immediate opposite of the principle of stable development, where, all variables are assumed to grow at a constant rate and investment must be made simultaneously. As per Hirschman (1958) investment ought to be made in specific areas as opposed to simultaneously in all areas of the economy.

Barro (1991) concurs with the unbalanced growth theory of Hirschman, (1958). Barro (1991) opined that development is conversely identified with the portion of government utilisation in GDP, yet unimportantly identified with the portion of public investment. This is in agreement with the unbalanced theory by Hirschman (1958). Deng (2013) contributed greatly to the subject of transport by systematically reviewing the effect of transport infrastructure on productivity and economic growth. The study used empirical studies to analyse the attributes of the controversial results regarding the subject matter. The study found 10 reasons and 3 distinguishing categories, namely: (1) difference in contexts, the period of research, and the country's ability in terms of economic performance; (2) different phenomena being measured, differences in economic sectors, the types and quality levels of the transport infrastructure; and (3) the distinct ways of measuring a similar phenomenon amongst others. The results revealed the benefits, both in terms of capturing flexibility in variable effects and data fit, to adopting the proposed structure.

The World Bank Report (1994) entitled "Infrastructure for Development" appropriately refers to "the adequacy of infrastructure helps determine one country's success and another's failure in diversifying production, expanding trade, coping with population growth, reducing poverty, or improving environmental condition". This is in accordance with Deng (2013) when the researcher mentioned that the flexibility of the data fit and proposed structure has an impact on a country's performance. In support of the World Bank study Aschauer (1989) states that with the drop in public investment, the economic

growth reduced drastically. This study confirms that public infrastructure is a foundation of quality human life. This is because well maintained transport infrastructure reduces accidents, good water supply and waste management improves the well-being of the people and reduces the spread of diseases. Consequently, improving a country's infrastructure and in turn improves its economic growth. Similarly, Fernald (1999) states that an expansion of the transport stock empowers fast product development in businesses.

A later study by Aschauer (1990) shows a positive relation between transportation infrastructure and per capita income. He defined an exact transportation infrastructure rather than a basket of infrastructure measures and selected highways to analyse the impact on per capita income. Another study by Sanchez-Robles (1998) that looked at the relation between the per capita growth and the infrastructure expenditures as a percentage of Gross Domestic Product yield indeterminate results, but the indicators of infrastructure physical units were significant and positive.

Mamatzakis (2002) held that there is a momentous link between public infrastructure such as transport, energy and ICT and private investment output of the Greek industrial sector. Henceforth, there is a confirmed relationship between public infrastructure and private efficiency. Even so, Mittnik & Neumann (2001) asserts that capital investment positively influences GDP. In contrast, there is an insignificant relation deriving from Gross Domestic Product to social investment.

A study by Erdon, *et al.* (2020) using the environmental Kuznets curve (EKC) hypothesis on rail and air transport explored the degree of contribution of air and

rail transport on urbanisation and economic growth. The analysis shows a constructive notable relationship between emissions and economic growth, thus, economic growth is emission-embedded with little sustainable growth. The existence of the EKC phenomenon in this study is affirmed, where economic growth is deemed more important than environmental quality.

3.3 EMPIRICAL LITERATURE

In most developing countries, over the past decade, government spending on transport infrastructure development has reduced due to fiscal deficits and budget constraints (Percoco, 2012). A study by Nketiah-Amponsah and Sarpong (2019) on 46 Sub-Saharan African countries concluded that transport infrastructure development reduces the cost of production for enterprises, thus giving them an inducement to increase investment in the domestic economy and turn to sustainable economic growth.

Another study on Uganda by Muvawala, *et al.* (2019) on the impact of road transport infrastructure investment on its economic performance and the economic cost associated with inadequate urban road transport infrastructure network. This study used the Auto Regression Distribution Lag (ARDL) and the empirical results indicated a significantly long and short run impact between the investment in road transport infrastructure and Uganda's economic growth. In the long run, it concluded that there was a positive and significant impact whilst in the short run, there is a negative impact between road transport infrastructure and

economic growth of Uganda. Largely, the paper concluded that 6.7 percent of GDP is lost concerning the current condition of the flow of traffic.

A similar study on Namibia was conducted by Mungendje (2017) on the causal relationship between road infrastructure development and economic growth for the period 1990-2014. The study also used the Auto Regressive Distributed Lag (ARDL) and the results were contrasting. The long-run relationship between those variables revealed an insignificant statistically positive relationship and a short run statistically significant positive relationship.

In another study over 38 years (1980-2017) by Apurv & Uzma (2020) on Brazil, Russia, China, and South Africa (BRICS countries) found that, in China there is a negative connection between transport infrastructure investment and economic growth. The study also found an insignificant association in Brazil and South Africa but a positive relationship between transport infrastructure investment and economic growth in Russia. Another study on West China for the period from 1990-2009 on 12 provinces (Yu, *et al.*, 2013) revealed conflicting results by showing a positive direct effect between transport network capital stock and economic growth in those 12 provinces.

The above study was supported by Wang, *et al.* (2020) who investigated the impact of Transport infrastructure on China's Belt and Road Initiative (BRI) countries' economic growth from the period 2007 to 2016. This study yielded mixed results, showing a negative impact in East Asia-Central, the Commonwealth of Independent States and in South Asia but a positive impact in Central and Eastern Europe. A negative relation can indicate that transport

infrastructure investment is at its optimal level, and an increase in infrastructure investment will not have a significant positive impact on the GDP of the country.

Boopen (2006) conferred greatly on the topic by examining a sample of two groups of countries: 13 small island countries and 38 sub-Saharan countries. The study looked at transport infrastructure and economic growth. The study found that transport infrastructure significantly aids economic growth. Using the panel data analysis the analysis reveals that in SIDS, transport capital has an average efficiency level of overall capital stock while SSA transport capital has greater efficiency in comparison to the overall stock.

An empirical evaluation on a panel of 18 OECD countries by Farhadi (2014) during 1870 and 2009, was carried out using the GMM technique (Generalised Methods Moments). The results revealed that the rate of return to funding in infrastructure exceeds the private rate in the OECD countries. In the case of the MENA countries which are subdivided into 3 groups of countries; the GCC panel, N-GCC panel, and North African countries for the period of 2000-2016 used the Generalised Methods of Moments (GMM) (Saidi, *et al.*, 2018). The study concluded that in all 3 MENA region panel subdivisions, transport infrastructure showed a significantly positive contribution to the economic growth of all the regions. Additionally, an empirical analysis by Saidi, *et al.* (2020) on 46 developing countries from the period 2000-2016 shows that transport and logistics infrastructure adds to FDI attractiveness and feasible economic growth.

Studies on Pakistan by (Awan & Anum, 2014 and Batool & Goldman, 2019) using the Auto Regressive Distributed Lag Model (ARDL) and vector error correctional models, Granger Causality tests and impulse response analysis both found a positive correlation between transport infrastructure and economic growth in the country. The 2 studies concluded that focusing on a decent legal environment for private capital is a good and sustaining measure for accelerating economic growth.

Tripathi & Vikash (2010) explored the relationship between road transport infrastructure and economic growth in India. The study found that the percentage increase in GDP from transport came from the road transport sector only. This study used vector autoregression (VAR) throughout and covered the period 1999-2000. The study also concluded that there was positive long-run elasticity between road transport networks and Gross Domestic Product (GDP).

An investigation by Amaira & Amaira (2017) into the relationship between transport infrastructure and economic growth, in Tunisia between the period 1980-2013 using the AutoRegressive Distributed Lag model (ARDL). The results reveal a strong and statistically significant positive contribution to economic growth by the transport infrastructure and investment in transport infrastructure.

Meersman & Nazemzadeh (2017) applied aggregate growth modelling and a causality test and error-correction models using annual data for Belgium. The finding was that economic growth is positively impacted by transport (roads,

railways, and ports) infrastructure and not only by ICT, the rate of investment, and the countries' openness. In the Namibian context, this could not be asserted, because Namibians abandon rail transport due to low satisfaction from customers (Saruchera, 2017). This study further noted that rail transport needs immense upgrading.

Nketiah-Amponsah & Sarpong (2019)'s empirical analysis on 46 Sub-Saharan African countries looked at the effects of infrastructure and foreign direct investment (FDI) on the economic prosperity of those countries. Using the generalised method of moments (GMM) results indicate that an increase in transport infrastructure increases economic growth. Furthermore, FDI shows that it is growth-enhancing only when it interrelates with infrastructure. The conclusion, likewise suggests that the effect of FDI on economic development is expanded when there is a degree of economic infrastructure.

Research on transport infrastructure and macroeconomic performance in European countries carried out by Chi (2015) from 1995 through 2010 used a dynamic panel data approach. The causality between government spending and the transport infrastructure showed a positive correlation. An increase in government expenditure impacts favourably on economic growth.

Another study on Namibia on the causal relationship between the economic growth of Namibia and government expenditure, employed the general government consumption expenditure and real Gross Domestic Product (GDP) (Shafuda, 2015). The study used statistics from 1980-2012 and applied the

Vector Error Correction Model (VECM). The results showed a unidirectional connection between government spending and economic growth. The conclusion is that there is a significantly positive relationship between the two variables.

3.4 SUMMARY

Theoretical studies suggest a relationship between economic growth and government spending on transport infrastructure. A significant number of theories indicate a positive relation between economic growth and government spending. Some theories, however, conclude that there is a negative relationship between economic growth and sustainable development, especially in relation to transport infrastructure development.

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, the country, econometric model and data collection period. In summary, the literature shows no agreement on the impact of government spending on transport infrastructure development and economic growth, and which one of the two variables causes the other.

The most noteworthy finding from the literature is that there appears to be no consensus on the impact of infrastructure development on economic growth and which of the two variables gives rise to the other. This suggests that the relationship is an empirical question which has to be tested to make informed policy decisions. Therefore, this study was undertaken to provide insights on the inclusive debate on the relationship between transportation infrastructure and

economic growth from the Namibian perspective. In doing so, this study builds on the study by Mungendje (2017) who looked at the causality relationship between road infrastructure and economic growth from 1990 – 2014.

CHAPTER 4

RESEARCH METHODS

4.1 INTRODUCTION

This chapter is structured around the methodological processes that were followed in this study. It describes the sources of data as well as the regression model employed to test the research hypotheses.

4.2 RESEARCH DESIGN

This study used a quantitative approach by using regression analysis in looking at the impact of transport infrastructure development on economic growth in Namibia.

4.3 PROCEDURE

The study uses secondary time series annual data for the following variables: gross domestic product (GDP) Foreign Direct Investment (FDI) Gross Fixed Capital Formation (GFC) and Exports obtained from the World Bank, covering the period 1990 to 2019. The other data, covering the impact of Government Expenditure in Transport on GDP (GET) was obtained from the Ministry of Finance.

4.4 DATA ANALYSIS

The study uses a time-series data analysis method. The yearly data is constructed for the period from 1990-2019. This study uses a similar methodology to that of Awan and Anum (2014)'s study on Pakistan. The study nonetheless, used GDP

(gross domestic product) in Namibia as the dependent variable (as a proxy for economic growth) while Gross Fixed Capital Formation (GFC) Government Expenditure on Transportation (GET) Exports (Exp) and Foreign Direct Investment (FDI) values were used as independent variables.

The validation behind the selection and change of this model was that Pakistan and Namibia are both developing nations. Consequently, the model, empirical tests and the outcomes from the Pakistan study can be used to predict and compare the results of this examination. The conventional econometric model for estimating the impact of transport infrastructure development and economic growth is specified as follows:

$$\ln GDP_t = \beta_0 + \beta_1 \ln GET_t + \beta_2 \ln GFC_t + \beta_3 \ln Exp_t + \beta_4 \ln FDI_t + \mu_t$$

(4.1)

Where Gross Domestic Product (GDP) is the dependent variable. The explanatory variables are the total of Government Expenditure on Transport in the GDP (GET) Gross Fixed Capital Formation (GFC) Exports (Exp) and Foreign Direct Investment in the GDP (FDI). The variables are all converted into a natural logarithm.

The modelling technique followed in this study using the time series data is the vector error correction model (VECM). The general model specification of the VECM model can be expressed as follow:

$$\Delta y_t = \pi y_{t-k} + r_1 \Delta y_{t-1} + r_2 \Delta y_{t-2} + \dots + r_{k-1} y_{t-(k-1)} + \mu_t$$

(4.2)

Where $\pi = (\sum_{i=1}^k \beta_i) - I_g$ and $r_i = (\sum_{j=1}^i \beta_j) - I_g$, the VECM contain g variables in I (0) and I (1) on the right side on the equation, and k-1 represent the lags of dependent variables (differences) each with r coefficient matrix attached to it. There are various steps that must be followed prior to estimating the VECM as discussed in detail below.

4.4.1 Unit Root Test

The fact that the study deals with time-series data requires that such data undergoes treatment in the form of unit root test. Furthermore, to ascertain the order of integration and the appropriate technique for analysis, this test is also necessary to avoid spurious or nonsensical regression results. According to Gujarati (2013) a series is described to be stationary if the mean and variance are constant over time. Furthermore, the value of the covariance between the two time periods, depends on the lag between the two time periods and not the actual time at which the covariance is computed.

In this study, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests will be used for that purpose. The tests are based on the first order auto-regressive [AR (1)] process as proposed by Enders (2004). The reason for using a second test, the PP is to address the weakness of the ADF which is that it tends to under-reject the null hypothesis of unit root when there is serial correlation. The null

hypothesis is that the series contains unit root, meaning nonstationarity, while the alternative hypothesis states the series does not contain unit root, meaning stationary. The series is stationary when the null hypothesis is rejected such that the absolute calculated test statistic is greater than at least one of the critical values at a given level of significance (Gujarati, 2003). The series can either be stationary in level or in difference if found to be nonstationary in levels.

4.4.2 Optimal Lag Length

After determining the order of integration for the variables, the reduced form VAR model is estimated. The importance of this step is based on the fact that since the model is autoregressive in nature it is sensitive to the lags because specifying too many or too little lags will have an effect on the estimation. Thus, the selection of the optimal lag length is usually dictated by the criteria, namely: the LR test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ). These tests show the convergence in the lag length and that is, the essence of this test.

4.4.3 VAR stability

In addition to checking the lag length, it is also important to establish whether or not the characteristic of the VAR (p) process is dynamically stable (Datta, 2012). In fact, Pfaff (2008) states that this is an important step because it implies that the process generates stationary time series with time invariant means, variances and covariance structure, given sufficient starting values. Thus, at a chosen lag

length, all the inverse roots of the characteristic AR polynomial have a modulus in the range of -1 to 1 (inside the unit circle), indicating that the estimated VAR satisfies the stability condition. This ensures that the VAR model does not diverge to infinity (blow up) because if it does, then the impulse response functions and the forecast error variance decomposition will be invalid.

4.4.4 Lag Exclusion

Testing or determining the lag length alone is not enough but it should be backed up by an additional test. The essence of this procedure is to determine whether or not the model should be estimated using lags. The determination of rejecting or not rejecting the null hypothesis of the restricted model (model without lags) is done based on the p-value from the Wald test statistic.

4.4.5 Diagnostic tests

Before VAR estimation, its appropriateness must be checked in order to avoid spurious VAR. Among the diagnostic tests are autocorrelation, normality and heteroscedasticity.

4.4.5.1 Autocorrelation

The residuals have to be tested for serial correlation using the LM test. The null hypothesis is that there is no serial correlation, while the alternative hypothesis is that there is serial correlation. The decision is arrived at when comparing the p-value with the level of significance, usually 5 percent. The null hypothesis is rejected when the p-value is less than the level of significance.

4.4.5.2 Normality

As it is standard with classical linear regression model assumptions, the residuals are also tested for multivariate normality using the Jacque Bera test. The null hypothesis postulates that the residuals are multivariate normal, while the alternative is that they are not. The null hypothesis is rejected when p-value is less than the level of significance.

4.4.5.3 Heteroscedasticity

The assumption of equal spread of the variance of the error term better known as homoscedasticity is also tested on the residuals. In this regard, the White test can be used to test for pure heteroscedasticity resulting from specification or both. If no cross products are included in the model, then it is a test for pure, otherwise both. The null hypothesis is that the residual is homoscedastic (no heteroscedasticity), while the alternative is that there is a problem of heteroscedasticity.

4.4.6 Cointegration

Upon ascertaining the appropriateness of the VAR model. One can test for the presence of the long run relationship better known as cointegration test. Cointegration refers to a linear combination of nonstationary variables. In theory, there are an infinite number of cointegrating vectors.

Since the study uses the matrix approach which is a multivariate system of equations, the suitable test would be the Johansen cointegration test which uses two tests to determine the number of cointegration vectors. The tests are namely:

the Trace test and the Maximum Eigenvalue test. Trace statistics investigate the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations, where n is the number of variables in the system for $r = 0, 1, 2, \dots, n-1$. Its equation is computed according to the following formula:

$$LR_{tr}(r/n) = -T * \sum_{i=r+1}^n \log(1 - \hat{\lambda}_i)$$

(4.3)

The Maximum Eigenvalue statistic, tests the null hypothesis of r cointegrating relations against the alternative of $r+1$ cointegrating relations for $r = 0, 1, 2, \dots, n-1$. These test statistics are computed as:

$$LR_{max}(r/n+1) = -T * \log(1 - \hat{\lambda})$$

(4.4)

Where λ_i is the Maximum Eigenvalue and T is the sample size.

In some cases, Trace and Maximum Eigenvalue statistics may yield different results and Alexander (2001) indicates that in this case the results of trace test should be preferred. The null hypothesis is that there is no cointegrating relationship, whilst the alternative is that there is cointegration. The null hypothesis will be rejected if the calculated statistic is greater than the critical values.

4.4.7 Vector Error Correction Model: Short and Long Run Estimates

The presence of cointegration or cointegrating vectors amongst the variables allows for the estimation of the adjustment of the short-run to the long-run

equilibrium through the vector error correction model (VECM). The VEC model starts from the standard reduced form of the VAR (p) model

$$Y_t = A_1 Y_{t-1} + \dots + A_p Y_{t-p} + ED_t + \mu_t$$

(4.5)

Where Y_t is a $(n \times 1)$ vector of $I(1)$ variables, D_t a vector of deterministic terms, and A_1, \dots, A_p are $(n \times n)$ coefficient matrices. E is the coefficient matrix associated with the deterministic terms, such as a constant, trend and seasonal dummies.

Subtracting Y_{t-1} from both sides of the VAR equation yields the following model which represents a Vector Error Correction model:

$$\Delta Y_t = \mu + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \dots + \alpha_{p-1} \Delta Y_{t-p+1} + BX_{t-1} + \varepsilon_t$$

or we can write it in different way

$$\Delta Y_t = \mu + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \dots + \alpha_{p-1} \Delta Y_{t-p+1} + BA'Y_{t-1} + \varepsilon_t$$

(4.6)

Thus, in the VEC model one regress changes in each variable on a constant (μ) (p-1) lags of the variable's own changes, (p-1) lags of changes in each of the other variables, and the level of the h elements of X_{t-1} . Where $BA'Y_{t-1}$, represents the Error Correction Term.

$X_t = A' Y_t$ is $(h \times I)$ stationary vector must be $I(0)$.

Y_t : is $(n \times I)$ vector of $I(1)$ variables.

B : is $(n \times h)$ matrix contains the adjustment parameters (long run relationship).

α_i : holds the short run parameters (the coefficients on the lagged terms).

h : represent the number of cointegrating equations.

μ : is $(n \times I)$ constant matrix

A' : represents $(h \times n)$ matrix of cointegrating vectors, whose rows are linearly independent such that $A' Y_t$ is a stationary $(h \times I)$ vector.

$A' = \begin{bmatrix} a'_1 \\ a'_2 \\ \cdot \\ \cdot \\ a'_h \end{bmatrix}$ and a_i 's are nonzero $(n \times I)$ cointegrating vector such that $(a_i' Y_t)$ is a stationary.

It follows that if one is interested in the long run process, then matrix B will be of interest, whereas for the short run process, the α_i 's will be of interest. However, in an event that co-integration is not found to exist, the standard VAR model is estimated.

In addition, the use of Vector Error Correction Estimates is very relevant and appropriate to examine the long run and short run effect of transport infrastructure development on economic growth in Namibia. The study applies different diagnostic tests to confirm the unbiased and overall significance of generated results as well as the stability of the estimated models. In order to

achieve that, the study has conducted the normality, serial correlation, heteroscedasticity, and CUSUM as well as CUSUM square tests for stability to certify the reliability of the findings established by the study.

4.5 RESEARCH ETHICS

As per the standards of the University of Namibia, all sources cited in the study were acknowledged using Harvard referencing style with no alterations of the research findings.

CHAPTER 5

RESULTS & DISCUSSIONS

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 and error correction model. It concludes with the optimal VAR Lag selection criteria to vector error correction model (VECM) test estimates of the relationship between transport infrastructure development and economic growth in Namibia.

5.2 EMPIRICAL ANALYSIS

5.2.1 Stationarity test results

The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were applied to determine the statistical properties of the series. The study opted to use more than one test for unit root to enhance the robustness and enriches informed decisions regarding the order of integration. Table 5.1 and table 5.2 show the results for both the ADF and PP in levels and first difference respectively.

Table 5.1: Unit Root test for the Augmented Dickey-Fuller (ADF) test statistic

Variables	Level		First Difference		Order of integration	
	Lags	Test statistics	Critical value (5 percent)	Test statistics (5 percent)		
LNGDP	3	-1.300	-2.994	-3.736	-2.997	I(1)
LNGET	3	-1.300	-2.994	-4.015	-2.997	I(1)
LNGFC	3	-2.603	-2.997	-4.315	-3.000	I(1)
LNEXP	3	-1.026	-2.997	-3.698	-3.000	I(1)
LNFDI	3	-1.566	-2.997	-4.410	-3.000	I(1)

Source: Author's own compilation using stata14

Table 5.1 shows the results of the Augmented Dickey-Fuller (ADF) test for the variables log of gross domestic product, government expenditure on transport, gross fixed capital formation, exports and foreign direct investments. The null hypothesis of the presence of the unit root could not be rejected at levels. However, all the variables became stationary after differencing once, meaning the null hypothesis of unit root was rejected and the alternative hypothesis of no unit root present applies. Therefore, all the variables are integrated of order one I(1).

Table 5.2: Unit Root test for the Phillips-Perron (PP) test statistic

Variables	Level		First Difference		Order of integration	
	Lags	Test statistics	Critical value (5 percent)	Test statistics		Critical value (5 percent)
LNGDP	3	-2.247	-3.279	-3.937	-3.288	I(1)
LNGET	3	-2.200	-3.279	-3.882	-3.288	I(1)
LNGFC	3	-2.791	-3.288	-4.015	-3.296	I(1)
LNEXP	3	-1.620	-3.288	-3.770	-3.296	I(1)
LNFDI	3	-2.156	-3.288	-3.943	-3.296	I(1)

Source: Author's own compilation using stata14

Similarly, the Phillips-Perron (PP) unit root test results in table 5.2 shows that the data for the log of gross domestic product, government expenditure on transport, gross fixed capital formation, exports and foreign direct investments are all integrated of order one I(1). Therefore, the null hypothesis that the data contain unit root was rejected after differencing once.

The fact that all the variables are integrated of order one suggests that the vector error correction modelling approach is applicable because it requires the variables to be integrated of the same order.

5.3 Lag Length Selection

After the order of integration was established, the next step was to determine the order of lags on the first differenced variables. This was obtained from the Optimal VAR Lag Selection Criteria by means of the Akaike Information

Criterion (AIC) Schwarz Bayesian Information Criterion (SBIC) and Hannan-Quinn Information Criterion (HQIC). The estimated model based on the highest values obtained from AIC and HQIC revealed an optimal lag length of up to 3 as shown in table 5.3.

Table 5.3: Optimal VAR Lag Selection Criteria

Lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	- 50.831				0.000	4.447	4.514	4.690
1	21.423	144.01	25	0.000	1.4e- 06	0.686	1.092	2.149*
2	52.755	62.655	25	0.000	1.1e- 06	0.180	0.923	2.861
3	87.619	69.728*	25	0.000	1.2e- 06	- 0.610*	0.472*	3.291
4			25		-1.6e- 21*			

Source: Authors own compilation using stata14

*Note: *indicates lag order selected by the criterion*

Therefore, the study finds it fitting to use Vector Auto Regression Estimates of 3 Lags as the appropriate optimal lag. This is what should be used in all subsequent estimates as suggested by the different conditions in the section.

5.4 Cointegration Tests

In order to establish whether or not a long run relationship exist amongst the variables. The study employed the Johansen-Juselius Maximum Likelihood test for Cointegration.

Table 5.4: Johansen-Juselius Maximum Likelihood Test for Cointegration

Trace statistics			Maximum Eigenvalues		
Null hypothesis	Statistics	5 percent critical values	Statistics	5 percent critical values	Critical
r=0	73.198	68.52*	37.374	33.46*	
r<=1	35.824	47.21	25.800	27.07	
r<=2	10.024	29.68	7.425	20.97	
r<=3	2.599	15.41	2.517	14.07	
r<=4	0.082	3.76	0.082	3.76	

Source: Author's own compilation using Stata14

Table 5.4 presents the results for the Johansen cointegration test. Both the Trace and Maximum eigenvalues agree that there is at least one cointegrating vector. This is confirmed by the calculated test statistics which are greater than the critical values at 5 percent. Thus, reject the null hypothesis of no cointegration and applying the alternative hypothesis which postulates the presence of cointegration. The 2 tests use a maximum likelihood procedure that jointly estimates the number of cointegration vectors to determine the existence of a long-run relationship between the variables. This signifies the existence of a long-run relationship amongst the variables that can be combined with the short-run dynamics using the Vector Error Correction Model.

5.5 Vector Error Correction Estimates

Table 5.5: Results from the estimated VECM

Variables	Short-run estimates		Long run estimates	
	Coefficients	P-values	Coefficients	P-values
Error correction term	-0.208*** (0.060)	0.001		
Log of GET	-0.042 (0.058)	0.474	0.870*** (0.191)	0.000
Log of GFC	-0.009 (0.039)	-0.822	0.477** (0.199)	0.017
Log of Exports	0.485 (0.414)	0.242	7.026*** (0.870)	0.000
Log of FDI	0.146** (0.063)	0.021	-0.962*** (0.175)	0.000
Constant	0.169		153.744	

Source: Author's own compilation using Stata14

Table 5.5 presents the results for the short and long run estimates from the VECM. The findings reveal that there exists a negative relation between gross domestic product and gross expenditure. That is a 1 percent increase in gross expenditure on transport leads to 87 percent decrease in gross domestic product and this relationship is statistically significant. These results should be interpreted with caution due to the mere fact that the data is for the broad category of transport. The data could reveal different results if specific categories of

transport were explicitly modelled. These findings are similar to those of Apurv & Uzma (2020) who also found a negative relationship between the two variables in the study on Brazil, Russia, China and South Africa (BRICS).

Similarly, gross fixed capital formation also negatively affects gross domestic product in Namibia in the long run. In particular, a 1 percent increase in gross fixed capital formation leads to a close to 47 percent decline in gross domestic product and this relationship is also statistically significant. This is contradicting with what the economic theory hypothesises. Usually, an increase in investment should translate into increased gross domestic product via the expansion in business.

The results further show that exports also negatively affect economic growth in Namibia over the long run. However, on the contrary, foreign direct investment positively affects gross domestic product in Namibia. Particularly, a 1 percent increase in foreign direct investment leads to a close to 96 percent increase in gross domestic product. This relationship is statistically significant. This is in line with economic theory which has hypothesised how FDI positively contributes to gross domestic product.

Table 5.5 also shows the results for the short run estimates. Unlike in the long run, the short run results show that increases in expenditure on transport as well as gross fixed capital formation led to an increase in gross domestic product. A 1 percent increase in expenditure on transport causes gross domestic product to increase by 4.2 percent and 0.9 percent respectively. This relationship is statistically insignificant. On the contrary, exports still negatively affect gross

domestic product but the relationship is statistically insignificant. Unlike in the long run, foreign direct investment negatively affects gross domestic product in the short run.

Of utmost importance is the fact that all the estimated coefficients of the variables helped in bringing the regressand to equilibrium because none of the adjustment coefficients were completely zero. Therefore, the variables do not seem weakly exogenous. Lastly, Table 5.5 shows that the coefficient of the error correction term is -0.208. It is negative and statistically significant as it is the ideal situation. It means that it takes about 21 percent every year for gross domestic product to converge to its long run equilibrium.

5.6 VECM Diagnostic tests

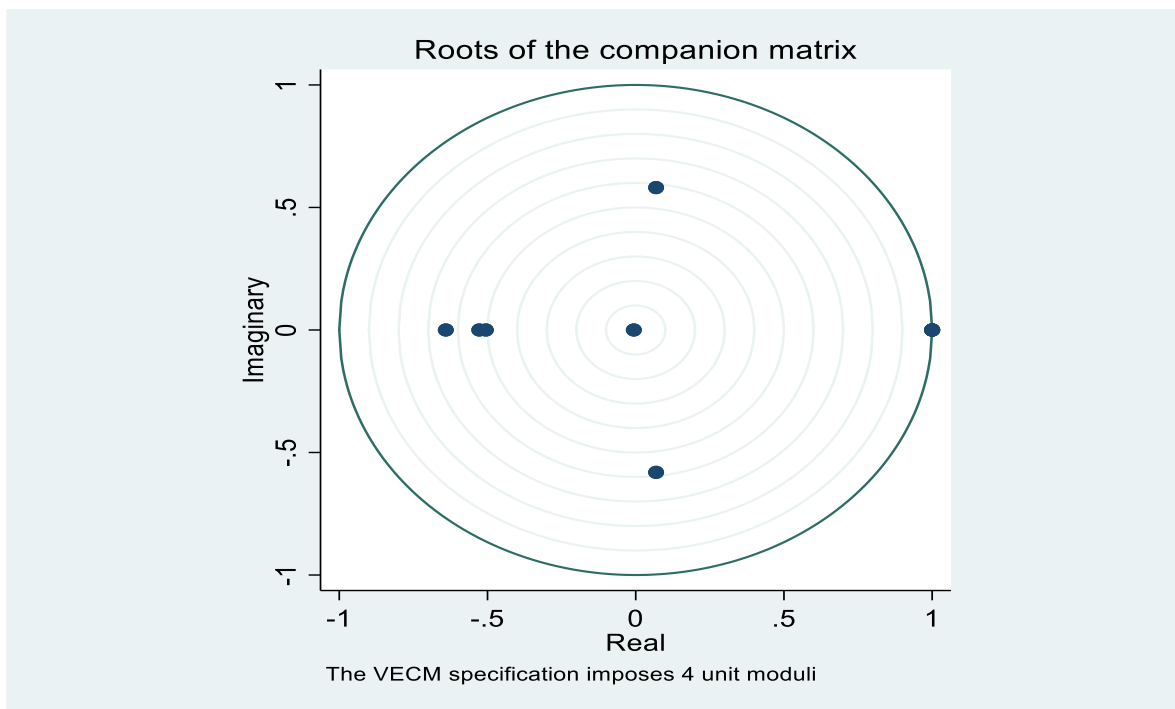


Figure 5.1: VECM Roots of the companion matrix

Source: Author's own compilation using stata14

The stability test as shown in figure 5.1 shows that the model is also dynamically stable at 4-unit moduli. All the dots lie inside the unit circle. Furthermore, the model does not suffer from autocorrelation because the p-value (0.379) is greater than the level of significance (5 percent). Thus, the null hypothesis of no autocorrelation could not be rejected as shown in table 5.6 below.

Table 5.6: Autocorrelation and Normality test

Autocorrelation: LM	26.550
	(0.379)
Normality: Jarque-Bera	1.599
	(0.999)

Note: Author's own compilation using Stata14

Similarly, the residuals are also normally distributed because the p-value (0.999) is greater than the level of significance (5 percent). Hence, the null hypothesis that the residuals are normal could not be rejected. Lastly, the study applied the cumulative sum of recursive residuals of squares (CUSUMQ) to establish parameter constancy.

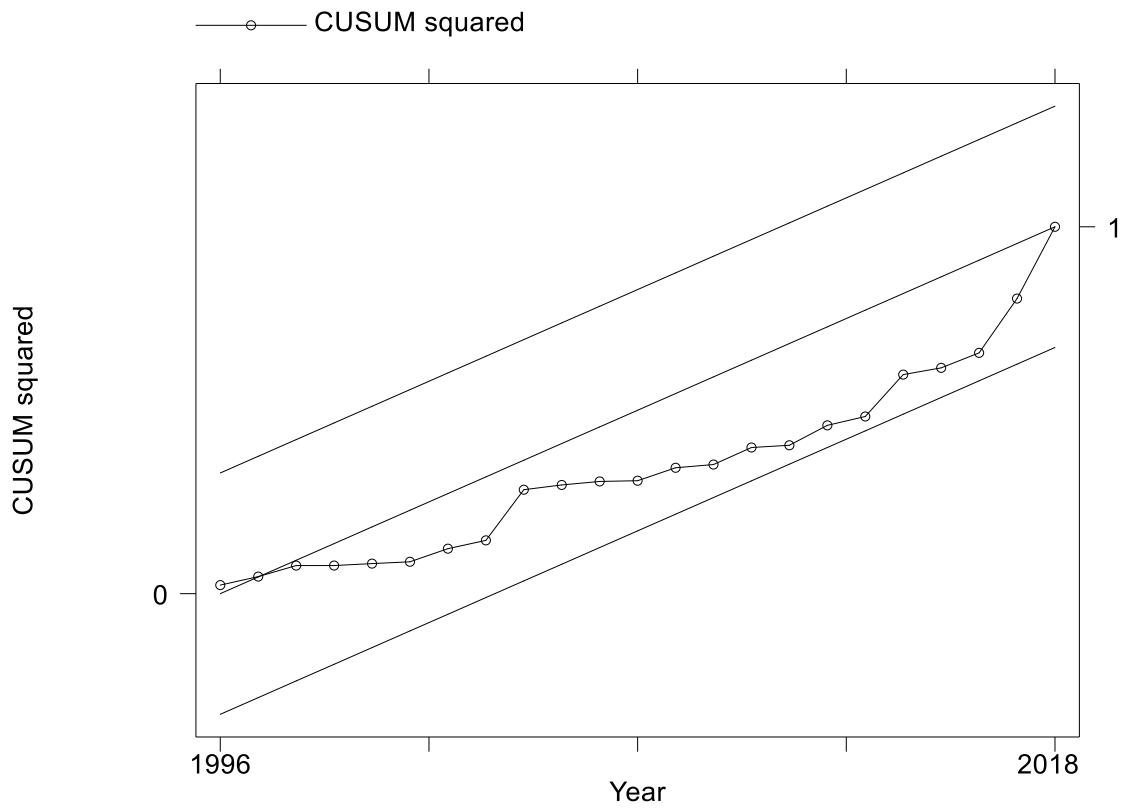


Figure 5.2: CUSUM squares

Note: Author's own compilation using stata14

As observed in figure 8 above, the CUSUM squares of the variables under study are within the critical bounds at a 5 percent level of significance. This infers that the estimated models are correctly specified and stable.

CHAPTER 6

GENERAL CONCLUSIONS & RECOMMENDATIONS

6.1. INTRODUCTION

This chapter presents the general conclusions and policy recommendations. There are two sections that constitute this chapter. Section 6.2 discusses the general conclusions, while the policy recommendations as well as areas for further research are discussed under section 6.3.

6.2. GENERAL CONCLUSIONS

This study examined the nature of the relationship that exists between expenditure on transport and gross domestic product in Namibia for the period 1990 - 2019. The study employed various time-series econometric techniques and tests such as the unit root, cointegration and the Vector Error Correction (VEC) modelling approach. The unit root test was used to determine the order of integration, whilst the Johansen cointegration test was used to test for the existence of the long run relationship.

The unit root test revealed that all the variables are integrated of order one. This warranted the estimation of the VECM which requires all the variables to be integrated of the same order. The Johansen cointegration test revealed a long run relationship amongst the variables, as it was confirmed by both the Trace and Maximum Eigen test statistic. The vector error correction provided both short and long run estimates. The findings revealed a negative long run relationship between expenditure on transport and gross domestic product. On the contrary,

the short run estimates revealed a positive relationship between expenditure on transport and gross domestic product in Namibia. However, the relationship is statistically insignificant.

In terms of the objectives of the study. The first objective was fulfilled because the results showed that the effect of transport infrastructure development on economic growth is negative in the long run. With regards to the second objective, the study showed that the nature of the relationship is long term in nature.

6.3. POLICY RECOMMENDATIONS

In order to justify or motivate the appropriate apportioning of public resources, policy makers need to have an empirical base on which to ground their national development strategies. In light of the study findings on the relationship between transport infrastructure and economic growth, the study suggests that some fiscal interventions, which will indirectly increase the government expenditure on transport infrastructure development be introduced. The following recommendations are further proposed:

□ Fully implementing the public private partnerships (PPPs) in the government capital infrastructure investment. This will allow more infrastructure to be constructed as risk will be shared between the government and the private sector. The government will as well benefit through efficiency of the private sector and land for the private sector. In the long run, this has the potential for economic enhancement.

□ Government should consider increasing its revenue through infrastructure levies to ease the government debt and help the government construct more roads, maintain and improve the current transport structure.

□ Increase government borrowing on the international capital markets through infrastructure funds revenue bonds and commercialising costly public services like transport.

For researchers, these results should be interpreted with caution due to the fact that the data is for the broad category of transport. Future studies should focus on disaggregated data to explicitly model the various components of the transport sector for better policy formulation.

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8. APPENDICES

APPENDIX 1: LANGUAGE EDITING CERTIFICATE



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LANGUAGE & COPY-EDITING CERTIFICATE

28th September 2021

RE: LANGUAGE, COPYEDITING AND PROOFREADING OF MARIA NDAHAMBELELA ANANIAS' THESIS FOR THE MASTER OF SCIENCE IN DEVELOPMENT FINANCE DEGREE OF THE UNIVERSITY OF NAMIBIA

This certificate serves to confirm that I copyedited and proofread MARIA NDAHAMBELELA ANANIAS' Thesis for the MASTER OF SCIENCE IN DEVELOPMENT FINANCE DEGREE entitled: **AN ANALYSIS OF THE IMPACT OF TRANSPORT INFRASTRUCTURE DEVELOPMENT ON ECONOMIC GROWTH IN NAMIBIA**

I declare that I professionally copyedited and proofread the thesis and removed mistakes and errors in spelling, grammar, and punctuation. In some cases, I improved sentence construction without changing the content provided by the student. I also removed some typographical errors from the thesis and formatted the thesis so that it complies with the University of Namibia's guidelines.

I am a trained language and copy editor and have edited many Postgraduate Diploma, Masters' Thesis, Dissertations and Doctoral Dissertations for students studying with universities in Namibia, Zimbabwe, Eswatini, South Africa and abroad. I have also copy-edited company documents for companies in the region and abroad.

Please feel free to contact me should the need arise.

Yours Sincerely,

A handwritten signature in black ink, appearing to read "Dr. Greenfield Mwakipesile".

The Rev. Dr. Greenfield Mwakipesile



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