DEVELOPMENT FINANCE CENTRE | Graduate School of BUSINESS UNIVERSITY OF CAPE TOWN | MCom

Green Finance and Green Growth: Towards Sustainable Development in South Africa

A Dissertation

presented to

The **Development Finance Centre (DEFIC)**
Graduate School of Business
University of Cape Town

In partial fulfilment
of the requirements for the Degree of
Master of Commerce in Development Finance

by

Ephraim Chinyamunzore

CHNEPH001

January, 2019

Supervisor: Dr. Badri Zolfaghari

Co-supervisor: Professor Lungile Ntsalaze

Plagiarism Declaration

COMPULSORY DECLARATION:

1. I certify that I have read and understand the Commerce Faculty Ethics in Research Policy. http://www.commerce.uct.ac.za/Pages/ComFac-Downloads

2. I certify that I have read the General Rules and Policies Handbook (Handbook 3) regarding Student Rules of Academic Conduct: RCS1.1 to RCS3.2 and Rules Relating to examinations G20.1 to G22.2.

3. I certify that I have read and understand the document, "Avoiding Plagiarism: A Guide for students".

4. This work has not been previously submitted in whole, or in part, for the award of any degree in this or any other university. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works of other people has been attributed, and has been cited and referenced.

5. I authorise the University of Cape Town to reproduce for the purpose of research either the whole or any portion of contents in any manner whatsoever.

Student number:
chneph001
Student name:
Ephraim
Chinyamunzore
Signature of
Student:

Signed by candidate

Date:
31/01/2019

Abstract

The economic progress that the world has achieved so far, has come at a steep price to the environment and social justice. There is a general global rise in environmental degradation and social inequality, mainly due to unsustainable habits of production and consumption. Greenhouse gas emissions, primarily from burning fossil fuels, are on the rise; causing global warming, climate change, and the resultant extreme weather conditions. This global trend is also manifesting itself in South Africa; where the current economic model has failed to adequately address unemployment, poverty, and inequality. Several studies have recommended that countries should implement the Green growth strategy as a solution, because it will move economies towards sustainable development. Greening economies require investments in low-carbon infrastructures, such as Renewable Energy (RE) technology, and supportive policies. The purpose of this study is to explore South Africa's RE policy instrument and the country's progress towards green growth. To this end, correlation analysis was used to investigate the relationship between green finance and South Africa's RE policy instrument; descriptive statistical analysis was employed to investigate South Africa's progress towards green growth. Other BRICS countries as well as Germany were included in order to benchmark South Africa's progress. The study found a positive correlation between green finance and the RE policy instrument. The implication of this finding is that reductions in tariffs paid to RE producers, due to the auction process, may result in decreased levels of green finance invested in the RE sector. A policy recommendation would be to include other financial incentives to attract investments in the RE sector, such as favourable tax rates for producers and the use of subsidies. Another finding is that there was a tendency for private finance invested in these projects to decrease as the level of public finance increases, suggesting crowding out. Policy recommendations are that public finance should be restricted to small projects; play a subordinated role in big projects; and address investment difficulties faced by private investors. The following are some of the findings with regard to South Africa's progress towards green growth. South Africa was the second worst CO2 emitter per capita; recorded high levels of air pollution; was one of the least energy-efficient countries; regressed on forests management and had the lowest percentage of RE consumption. The implications are negative for the country's progress towards green growth. The suggested solutions are to promote energy efficiency and increase RE consumption by accelerating green investments in the RE sector. There is hope though, that South Africa is making good progress towards sustainable development, as depicted by the growth rates of most of the country's green growth indicators.

Acknowledgements

I give thanks and praises to the Most High for sustaining my health and strength throughout my studies and this research process.

I want to express my gratitude to my supervisor Dr Badri Zolfaghari for reviewing my work and giving appropriate advice. To my co-supervisor, thank you Professor Lungile Ntsalaze for reviewing my work and providing invaluable feedback, without which I would not have completed this dissertation. I have learnt a lot from both of you and am eternally grateful.

I also gratefully acknowledge advice and support from Ms Candice Marais, Dr Abdul Latif Alhassan, and the Librarians at the GSB Library. Lastly, but not least, I am grateful for the support I received from my queen, Bakang.

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

AfDB	African Development Bank
BMI	Business Monitor International
BRICS	Brazil, Russia, India, China, and South Africa
CO2	Carbon dioxide
COP	Conference of the Parties
CPI	Climate Policy Initiative
DBSA	Development Bank of Southern Africa
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DFI	Development Finance Institution
DoE	Department of Energy
EIB	European Investment Bank
EKC	Environmental Kuznets Curve
EKC	Eksport Kredit Fonden
EU	European Union
FDI	Foreign Direct Investment
FIP	Feed-In-Premium
FIT	Feed-In-Tariff
FMO	Financierings-Maatschappij voor Ontwikkelingslanden
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWh	Gigawatt hour
IDC	Industrial Development Corporation
IDFC	International Development Finance Club
IEA	International Energy Agency
IFC	International Finance Corporation
IPAP	Industrial Policy Action Plan
IPPPP	Independent Power Producers Procurement Programme
IRENA	International Renewable Energy Agency
IRP	Integrated Resource Plan
KfW	Kreditanstalt Für Wiederaufbau

kWh	kilowatt hour
LCR	Low-carbon Climate Resilient
Mtoe	Million tonne of oil equivalent
Mton	Million tonnes
MW	Megawatt
NCCRWP	National Climate Change Response White Paper
NDP	National Development Plan
NFSD	National Framework on Sustainable Development
NGP	New Growth Path
Norfund	Norwegian Investment Fund
NSSD	National Strategy for Sustainable Development
OECD	Organisation for Economic Cooperation and Development
OPIC	Overseas Private Investment Corporation
PM	Particulate matter
PM2.5	Particulate matter of diameter of less than 2.5 μm in $\mu g/m^3$
PPP	Public-Private Partnership
R&D	Research and Development
RE	Renewable Energy
REFIT	Renewable Energy Feed-In-Tariff
REIPP	Renewable Energy Independent Power Producer
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SDGs	Sustainable Development Goals
StatsSA	Statistics South Africa
toe	Tonnes of oil equivalent
TPES	Total Primary Energy Supply
UN	United Nations
UNEP	United Nations Environment Programme
WCED	World Commission on Environment and Development
WHO	World Health Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNU-IHDP	United Nations University-International Human Dimensions Programme
ZAR	South African Rand

Chapter 1: Introduction

1.1 Background

Sustainable development is a concept which denotes economic growth that does not cause harm to the environment and society (Lorek & Spangenberg, 2014). It represents the convergence of economic growth, social equality and care for the environment (Barbier, 2011). This study takes the position that sustainable development is driven by green growth (Georgeson, Maslin, & Poessinouw, 2017), which in turn is driven by green finance, green infrastructure or technology and enabling public policies (Bhattacharya, Reddy, Ozturk, & Bhattacharya, 2016; Borel-Saladin & Turok, 2013). Figure 1.1 illustrates these interrelationships.

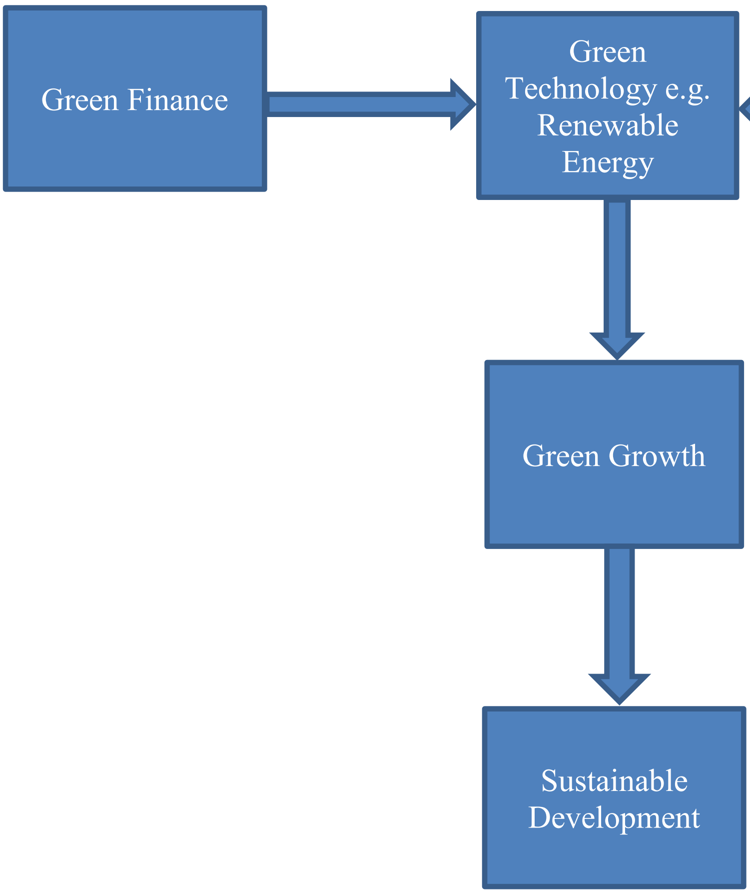


Figure 1.1: The study's main concepts and their interactions.

Source: Author's creation from reviewed literature.

Rapid economic growth has been advanced as the solution to poverty (Bowen & Hepburn, 2014; Kim, Kim, & Chae, 2014). However, the existing model of economic growth is not socially inclusive as it “results in outcomes that create an unfair society” (UNEP, 2015, p. 17) and does not create prosperity for all (Huang & Quibria, 2013; Nhamo, 2014; Omilola, 2014). Furthermore, the current world economic growth has come at a high price to the environment resulting in the disruption of ecosystems and water and air pollution (Huang & Quibria, 2013). Air pollution and greenhouse gas emissions are causing the average global temperature to rise, which in turn is causing climate change thus increasing the rate at which extreme weather events occur (Kim et al., 2014). The UNEP (2015) exhibits a gloomy picture with the ensuing indicators. In 2008, inequality was such that 40 per cent of the global population acquired a mere four per cent of the total global GDP; the world lost approximately $2.1 trillion due to pollution and greenhouse gas (GHG) emissions generated by the top three thousand listed firms; agricultural land loss, due to soil degradation, stood at one to two million hectares per annum; and if climate change is not curbed, it will cause an extra 250,000 deaths annually for the period 2030 to 2050.

Investing in infrastructure still holds the key to the world meeting its development goals (Meltzer, 2016). Africa, for example, needs to invest US$93 billion annually in infrastructure to address poverty (Bradlow & Humphrey, 2016). Yet it is the traditional infrastructure such as coal-fired power stations that produce most of the GHG emissions, which in turn cause global temperature to rise and the resultant climate change (Meltzer, 2016). This indicates that there is a need to move away from the traditional high carbon infrastructure to low–carbon climate resilient (LCR) infrastructure (Meltzer, 2016). Indeed, given this state of the world, Africa needs to change its economic model as well and, according to Bradlow and Humphrey (2016, p. 1), “focus on sustainable infrastructure to establish a long-term foundation for environmentally and socially sustainable growth and prosperity”.

Kim et al. (2014) suggest that each country should integrate into its national development plan, policies to mitigate climate change impacts and embrace green growth. The Organization for Economic Cooperation and Development (OECD) defines green growth as, “fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities." (OECD, 2011, p. 9). To ensure a successful transition of an economy towards green growth, enabling policies and green finance are required (Borel-Saladin & Turok, 2013). Green finance is defined by Yuan and Gallagher (2015, p. 13) as, "investments that contribute to the reduction of GHG emissions and encourage sustainable development" and as "loans that are directly intended to improve the environment, reduce emissions, or help people and ecosystems adapt to changing environments" (p. 26).

The three concepts of green finance, green growth and sustainable development are interconnected in that green finance enables green growth (Borel-Saladin & Turok, 2013) and green growth is the conduit through which sustainable development can be attained (Barbier, 2011; Georgeson et al., 2017). Sustainable development, which is the end goal, is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43).

Increasing the consumption of renewable energy (RE) will help countries shift towards sustainable development (Bhattacharya et al., 2016); hence one of the focus areas of this study is the financing of renewable energy deployment in South Africa. The energy sector is one of the sectors identified by the South African Government as central to the country's achievement of green growth (UNEP, 2013). South Africa is endowed with abundant renewable resources, such as solar and wind, which can enable the country to develop a green energy sector thus positioning the country for a sustainable development transition (Montmasson-Clair, 2012).

Although the South African Government launched the National Framework on Sustainable Development (NFSD) in 2008 (Kaggwa, Mutanga, Nhamo, & Simelane, 2013), a strong commitment to move the country towards sustainable development began to show in 2010. The year 2010 saw the coming together of the private sector, Government, and labour at a conference called the Green Economy Summit where a resolution was made to channel efforts towards a low-carbon economy (Musango, Brent, & Bassi, 2014). The Green Economy Summit laid the foundation for other green economy initiatives and programmes in South Africa and recognised the Green economy as a means to achieve sustainable development (Musango et al., 2014).

In this study, South Africa's progress towards green growth will be compared to Germany and other BRICS countries' progress. Germany is considered to be a country that leads the way in green policies (Christian, Roland, & Thomas, 2015) and is successfully transforming into a clean energy economy (UNU-IHDP and UNEP, 2014). Germany is, therefore, an example of a country South Africa may emulate. South Africa is a member of a group of emerging countries called BRICS (Brazil, Russia, India, China, and South Africa) (Zaman et al., 2016). These countries' economies are similar to South Africa's economy in terms of the relative size and challenges that they face (Zaman et al., 2016). Therefore, it is appropriate to compare South Africa's performance to these other emerging economies. The following section presents the problem statement.

1.2 Problem Statement

The world has witnessed rising environmental degradation and social inequality mainly due to unsustainable means of production and consumption, which characterise the current global economic model (Huang & Quibria, 2013). This model mainly relies on GHG-emitting energy which exacerbates global warming, resulting in climate change and extreme weather conditions such as droughts and floods (UNEP, 2015). South Africa has this fossil-fuel based economy (Borel-Saladin & Turok, 2013), with 70% of its energy being supplied from coal (Eberhard, Kolker, & Leigland, 2014).

The contemporary economic model dominant worldwide has failed to create prosperity for all and is contributing to environmental degradation (Huang & Quibria, 2013); and for South Africa, developmental problems of poverty, unemployment, and inequality, still persist (Montmasson-Clair, 2012). The number of South Africans living under the national poverty line increased from 53.2% in 2010 to 55.5% of the total population in 2016; the unemployment rate has remained on an upward trend recording 24.57% in 2013 and 27.72% in 2017 (World Bank, 2018a). Gini coefficient, a measure of households' income deviation from equal distribution, for South Africa ranks amongst the highest in the world at 0.7 (UNEP, 2013).

The above-mentioned figures illustrate that the existing economic model has failed to adequately address South Africa's triple challenges. This is further supported by the fact that in the years of economic growth in the country, no corresponding significant declines were noted in the mentioned challenges. South Africa posted an average economic growth of 4.8% between 2004 and 2008; yet unemployment, although slightly declined, remained high at an average of 27.28% over the same period (World Bank, 2018b). Income inequality increased to 0.7 (Gini coefficient) in 2008 from 0.68 in 2000; over the same period, urban poverty increased to 60% from 55% (Leibbrandt, Woolard, Finn, & Argent, 2010). With the aid of social grants, combined (rural and urban) poverty marginally declined over that period (Leibbrandt et al., 2010).

Several studies have demonstrated that the green growth strategy has the potential to solve these problems because of its ability to combine economic development, jobs creation, social inclusiveness, and the protection of the environment (Huang & Quibria, 2013; Montmasson-Clair, 2012; Omilola, 2014; UNEP, 2015). South Africa is endowed with abundant renewable resources, such as solar and wind, which can enable the country to develop a green energy sector thus positioning the country for a sustainable development transition (Montmasson-Clair, 2012). The Government has identified the RE sector as one of the sectors central to the country's achievement of green growth (UNEP, 2013) and has initiated several policies, especially those that induce financial flows into the clean energy sector.

Empirical evidence shows that government intervention in the form of public policy and public finance can induce private finance in the RE sector and thus stimulate progress in green growth (Rodríguez, Haščič, Johnstone, Silva, & Ferey, 2014). Consistent growth and employment creation were observed, as a result of green efforts, in Germany, Italy, and the United Kingdom (Balcilar, Ozdemir, Ozdemir, & Shahbaz, 2018), EU (Jänicke, 2012), BRICS (Zaman et al., 2016), Asia-Pacific Economic Cooperation (Zafar, Shahbaz, Hou, & Sinha, 2019), Africa (Cantore, Nussbaumer, Wei, & Kammen, 2017), and South Africa (Borel-Saladin & Turok, 2013).

According to the reviewed literature, there is no study conducted to investigate the relationship between Green finance and the RE policy in South Africa using correlation analysis; in order to understand the influence of the policy on green financial investments in South Africa's RE sector. Furthermore, according to the author's knowledge and the literature reviewed, there is no study that has assessed South Africa's green growth progress using descriptive statistical analysis. This study is an attempt to fill these gaps in the literature and in doing so, make a contribution to the body of knowledge. This study analyses secondary data using correlation and descriptive statistical analysis to meet these objectives.

1.3 Purpose and Significance of the research

The purpose of this study is to investigate the relationship between Green finance and Public policy in the RE sector of South Africa. This study also investigates South Africa's progress towards green growth. Since the South African economy is highly carbon-energy dependent and the country is vulnerable to climate change effects such as droughts (McNicoll, Jachnik, Montmasson-clair, & Mudombi, 2017), it is necessary to evaluate the country's progress towards a green economy by assessing enablers such as finance and policies meant to support this transition. The deployment of RE in South Africa, as part of the Green growth strategy, is important. This is because it carries the potential to significantly reduce the country's dependency on fossil-fuels, GHG emissions, and the concomitant climate change impacts. In addition, investing in renewable energy creates green jobs thus helping to alleviate unemployment and economic inequalities.

The findings of this study may benefit policymakers in government since they will be able to ascertain to what extent South Africa has implemented green growth and the effectiveness of public policies in encouraging investments in the clean energy sector as a means to achieve sustainable development. Additionally, this study will highlight information that policy developers may find valuable when formulating green growth strategies in general and clean energy policies in particular. It is hoped that the findings of this study may generate suggestions of policy combinations that are able to attract investments to the renewable energy sector.

In addition, the findings of this study should also be of significance to the business community since it could provide them with a deeper understanding of how public policy impacts their investments in the renewable energy sector. This study may give the business community an enhanced appreciation of their important role in moving South Africa towards sustainable development. Additionally, this study intends to contribute to the body of knowledge pertaining to the relationship between green finance and policy in South Africa, and the country's progress towards green growth.

.

1.4 Research questions and objectives

The study set out to answer the following research questions:

(i) What is the relationship between Green finance and the RE Policy in South Africa?
(ii) What has been South Africa's progress towards Green growth as compared to other BRICS countries and Germany?

The objectives that provided scope and guidance for this study are:

(i) To investigate the relationship between Green finance and the RE policy in South Africa
(ii) To investigate South Africa's progress towards green growth in comparison to other BRICS countries and Germany

1.5 Limitations of the study

The first limitation of this study stems from the nature of the data available to investigate the relationship between Green finance and the RE policy and how this data is spread over the years of analysis. The available data is neither pure cross-sectional nor pure time series. The projects and hence data points are sparsely distributed between the years 2012, 2013, 2014, and 2018, meaning that data points lack continuity within years and between years. The nature and the amount of available data limited the analysis to correlation as the most appropriate data analysis technique. This meant that other techniques that are available to study relationships and at the same time establish causation, such as econometric modelling, could not be used.

The nature of this data and its limited availability can be explained as follows: RE is a relatively new phenomenon in South Africa and the industry for this type of energy is still nascent and emerging. The policy instrument designed to attract financial investments in the RE sector in South Africa, the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), was implemented in 2011 and only about 112 projects have attained financial close, as at end of March 2018. Of these 112 projects, only 44 projects have complete data available from the databases accessed.

Another limitation of the study is in its use of convenience sampling. Convenience sampling is a non-probability type of sampling, which means that the sample will not be representative enough to allow generalisation of findings to the population (Lyons & Doueck, 2010). However, since this study does not seek to generalise its findings, due to the sample size and data limitations, non-probability sampling will suffice. Therefore, the results from this study should not be interpreted to mean causation and should not be generalised.

1.6 Organization of the research

This dissertation has five chapters, followed by references and ends with appendices. The following is an outline of the five chapters.

Chapter one, which is this chapter, introduced the study. It presented the background and context of the study and explained the research problem. The significance of the study was discussed. It also stated the research questions, objectives, and limitations. Chapter two presents extant literature pertaining to sustainable development, green finance, green growth, theories and renewable energy. The study's methodology is outlined in Chapter three, where the research approach, research data, population and sampling, data analysis techniques, validity and reliability are discussed. Chapter four reports the research findings; the chapter covers descriptive statistics, empirical results and a discussion on the validity and reliability of the findings. In chapter five, a summary and conclusions of the study are communicated, policy recommendations highlighted and finally, avenues for future research are suggested.

Chapter 2: Literature Review

2.1 Introduction

This chapter presents current literature on green finance, green growth, sustainable development and renewable energy. The chapter begins by providing an overview of sustainable development in South Africa followed by theoretical discussions on green finance, green growth, sustainable development, and renewable energy. The chapter also discusses empirical findings in the literature, which are relevant to this study.

2.2 South African context on sustainable development

South Africa is a Southern African country which is classified as an upper-middle income country (UNEP, 2013). As of mid-2018, South Africa's population was estimated to be 57.73 million (StatsSA, 2018). According to the World Bank (2018a), the country's unemployment rate stood at 27.72% in 2017 and in 2016, 55.5% of the population lived under the national poverty line. In terms of income disparities, South Africa's Gini coefficient of 0.7 is one of the highest in the world (UNEP, 2013). The country's energy mix is heavily biased towards fossil fuels (Kaggwa et al., 2013) with approximately 70% of its energy being derived from coal (DEAT, 2008). Such reliance on coal has earned the country the thirteenth position amongst the world's big GHG emitters (Montmasson-Clair, 2012). These figures show that the country is saddled with high unemployment, inequality, and poverty and is heavily dependent on coal for its energy needs thus making it a significant contributor to climate change through GHG emissions.

The discourse on sustainable development portrays the green growth strategy as holding the potential to solve the above-mentioned challenges faced by South Africa because the strategy is able to create economic growth, which is socially inclusive and environmentally friendly (Montmasson-Clair, 2012). Given that renewable resources, such as solar and wind, are in abundance in South Africa, the country can leverage these resources to develop a clean energy sector thus putting the country on a sustainable development path (Montmasson-Clair, 2012).

The South African Government defines sustainable development as, "the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (DEAT, 2008, p. 14). The South African definition of sustainable development takes a systems approach where the economic, social and the environmental systems are integral with each other and joined by a governance system in a regulatory framework. Furthermore, the definition recognises the role of institutions and governance systems in the implementation of sustainable development and to enforce oversight (DEAT, 2008).

In South Africa, the desire to move the economy towards green growth may be said to have been initiated in 2008 when the National Framework on Sustainable Development (NFSD) was launched (Kaggwa et al., 2013). The NFSD sets out South Africa's sustainable development vision to steer the process of developing the national strategy and shows the Government's dedication to pursuing sustainable development (DEAT, 2008). Building on the NFSD, the Green Economy Summit was held in May 2010 and resolved to channel efforts towards a low-carbon economy that creates jobs without wasting resources (Musango et al., 2014; UNEP, 2013). Subsequent to the Green Economy Summit, several strategies and policies were drafted to pursue the country's vision of sustainability. Some of these are Industrial Policy Action Plan (IPAP), New Growth Path (NGP), Integrated Resource Plan (IRP), National Climate Change Response (NCCR), National Strategy for Sustainable Development (NSSD) and the National Development Plan (NDP) (Montmasson-Clair, 2012).

To further demonstrate the Government's commitment to move the economy towards sustainable development, the Green Fund was created in 2012 by the Department of Environmental Affairs (DEA) with an allocation of R800m over three years (Mohamed et al., 2014). The Development Bank of Southern Africa was assigned the task of managing the Fund (Mohamed et al., 2014). The Fund has been tasked to "provide catalytic finance to project initiation and development; policy and research development; and capacity-building initiatives that have the potential to support South Africa's transition to a green economy" (Mohamed et al., 2014, p. 658). Furthermore, to support the New Growth Path (NGP), the Industrial Development Corporation (IDC) created the Green Industries Special Business Unit in 2011 and planned to support investments in the green industry sector amounting to R22 billion over 5 years (Borel-Saladin & Turok, 2013).

2.3 Theoretical considerations

This section discusses theoretical considerations on green finance, green growth, sustainable development and renewable energy.

2.3.1 Relevant Theories

The author believes that the investment theories which are briefly explained below may help to understand what influences the investment behaviour of Renewable Energy Independent Power Producers (REIPPs). This understanding will assist in designing policies that are able to induce green finance in the Renewable Energy (RE) sector. In order to explain the nexus between environmental degradation and economic growth, the Environmental Kuznets Curve (EKC) theory is described. The theories underlying Weak and Strong sustainability concepts are explained thereafter.

Investment Theories

Accelerator theories explain that investors or firms will invest in fixed assets if they expect an increase in demand for their output, meaning investment responds to output growth (Baddeley, 2003). The assumption of the accelerator theories, that factor costs do not have a role in investment decisions, gave birth to Jorgenson's theory, where both changes in output and costs of capital influence investment flow (Baddeley, 2003).

Subsequent neoclassical theories of investment, where capital markets are assumed to be perfect and efficient allocators of resources, expanded on Jorgenson's theory (Ababio, Kumankoma, & Osei, 2018). Policies based on such theories, support innovation of technology and leave the market mechanism to allocate green finance to encourage the adoption of the RE technologies (Hall, Foxon, & Bolton, 2017). The assumption of efficient markets means policymakers may not consider behavioural and structural limitations of investment thus reducing the breadth of policy responses required to address underinvestment in RE (Hall et al., 2017). In addition, such policies are designed to correct market failure, yet policies for RE deployment should also aim to create markets for these technologies (Mazzucato, 2016).

Given these issues arising from neoclassical theory assumptions, the relevant theory that can help design better policies to attract RE investments is the Adaptive Markets Hypothesis (AMH) (Hall et al., 2017). The AMH draws from behavioural finance and "takes into account institutional and structural constraints, behavioural routines, and fundamental uncertainties" (Hall et al., 2017, p. 285). Some of the assumptions of the AMH are that: investors' rationality is considered as bounded, financial markets are adaptive, and the environment for energy investments evolve with time (Hall et al., 2017).

Environmental Kuznets Curve

A theory that is commonly used to explain the relationship between economic growth and the deterioration of the environment is the Environmental Kuznets Curve (EKC) (Kaika & Zervas, 2013). The EKC theory assumes an inverted U-shaped association between income growth and environmental degradation such that, as per capita income increases, the level of environmental degradation initially worsens, peaks and then declines as per capita income continues to grow (Apergis & Ozturk, 2015). There are various indicators of environmental degradation used by researchers to study EKC patterns such as water, soil, and air pollution indicators, with CO2 emissions being the common one (Kaika & Zervas, 2013). Relevant to this study is the CO2 emissions.

Sustainable Development Theories

There are two categories of sustainable development, depending on the underlying economic theory, namely: Weak sustainability and Strong sustainability (Loiseau et al., 2016). Weak sustainability stems from the environmental economics theory which states that, "human-made capital and natural capital are substitutable and that no complete change to our economic system is required" (Loiseau et al., 2016, p. 368). Concepts such as resource efficiency (including energy efficiency), reduction of waste and pollution, and cleaner production are examples of weak sustainability approaches (Loiseau et al., 2016).

Strong sustainability is founded on the ecological economics theory which assumes that "human-made capital and natural capital are complementary, but not limitlessly interchangeable" and "the loss of natural capital cannot be offset by gains in the human-made capital" (Loiseau et al., 2016, p. 368). Nature-based solutions, green infrastructure, circular economy and industrial ecology concepts of sustainable development are strong sustainability approaches (Loiseau et al., 2016).

Since South Africa has adopted the Green economy strategy, emphasising energy efficiency and the use of renewable energy (DEA, 2011b; DoE, 2015), it may be concluded that the country is following the weak sustainability model of sustainable development. Having said that, the Green economy strategy is a widely recognised means to sustainable development (UNEP, 2015). The next sections discuss green finance, green growth, and renewable energy.

2.3.2 Green Finance

According to Huang and Quibria (2013), Green finance and Green technology, such as clean energy technology, are key components of green growth and finance is a constraint for this growth in developing countries.

There are various definitions of the term Green finance. For example, The International Development Finance Club (IDFC) defines Green finance as, "financial investments flowing into sustainable development projects and initiatives, environmental products, and policies that encourage the development of a more sustainable economy" (IDFC, 2013, p. 3). Yuan and Gallagher (2015, p. 13) define it as, "investments that contribute to the reduction of GHG emissions and encourage sustainable development" and as "loans that are directly intended to improve the environment, reduce emissions, or help people and ecosystems adapt to changing environments" (p. 26).

The IDFC Green finance tracking methodology splits Green finance into three categories according to the intended purpose (IDFC, 2013). The first category relates to projects intended to produce clean energy and to mitigate greenhouse gas (GHG) emissions. This first category is the focus of this study. Therefore, this study will use the IDFC definition of Green finance and in line with the IDFC's first category of Green finance, in this study Green finance refers to private and/or public financial flows into renewable energy projects. The second category invests in initiatives that make communities adapt to climate change effects. The third category of Green finance targets safe water and sanitation provision and other environmental objectives. The categories of Green finance that involve the mitigation of GHG emissions (first category) and adaptation to climate change effects (second category) fall under climate finance, in other words, climate finance is part of Green finance (IDFC, 2013). Thus Green finance is a broader term that is constituted by climate finance and other environment-related finance (IDFC, 2013).

Related to the first and second categories of green finance, explained above, are investments in low-carbon, climate resilient (LCR) infrastructure. LCR infrastructure is defined as, "a subset of sustainable infrastructure that reduces greenhouse gas emissions and is climate resilient" (Meltzer, 2016, p. 5). It is this type of infrastructure that is key to the mitigation of GHG emissions and the adaptation of societies to climate change; therefore, more financial resources need to be channelled towards LCR infrastructure (Meltzer, 2016). Investment in LCR infrastructure will also enable countries to achieve the global Agenda 2030 Sustainable Development Goals (SDGs), thus making green growth a facilitator for SDGs achievement (Georgeson et al., 2017).

In South Africa, the funding of the Green economy has largely come from the Government (Death, 2014). According to Sandberg (2015), this is a global phenomenon where financial markets have failed to confront the climate change issues and poverty. Sandberg (2015) argues that the financial crisis of 2008 and also the failure of the financial system to address the challenges of climate change and poverty can be explained by the flaws in the dominant view of finance. The dominant view of finance is that financial markets and financial agents exist to maximize wealth for shareholders (Sandberg, 2015). Aligned with this view, Richardson and Cragg (2010) believe that green initiatives that have a meaningful societal impact are too costly to generate profits for financial agents. It is because of this view that the financial system has failed to help solve the world's sustainability problems of climate change and poverty (Sandberg, 2015). However, some researchers argue that financial agents can still make profits from investing in green initiatives (Calvello, 2009; Kronsinsky, 2011).

The International Finance Corporation (IFC) made the following observations. Green sector financing from development finance institutions, although growing, still makes a small percentage of the total financing required, due to the small capital base of these institutions (IFC, 2013). Institutional investors, who control large sums of money, have only a small portion of their money invested in green initiatives (IFC, 2013). However, public funds alone will not be sufficient to meet the financial resource requirements of the Green economy, the private sector will have to increase its involvement (IFC, 2013). Public finance should mostly be used to decrease green projects investment risk in a bid to attract private finance towards green initiatives (Mohamed et al., 2014).

Given this situation, one of the requirements to transition economies towards green growth is that governments have to formulate public policies that induce private financial flows into the green sector of the economy, especially the green energy sector (Cedrick & Long, 2017; Rodríguez et al., 2014). The other requirement is the alignment of the whole financial system with the demands of an inclusive Green economy (UNEP Inquiry, 2016). Having reviewed Green finance in general, sources of financing for renewable energy projects are explored next.

2.3.2.1 Sources of Renewable Energy Finance

There are various sources of financing for renewable energy projects, these include public finance, private finance and Public-Private Partnerships (PPPs). This section provides a discussion of these sources of financing.

2.3.2.1.1 Public Finance

Financing is classified as public if "the funds are provided via direct government spending or state-owned enterprises" (Rodríguez et al., 2014, p. 18) or from public entities abroad (Schmidt-Traub & Sachs, 2015), climate funds, and donor governments and their agencies (IRENA & CPI, 2018). Many authors maintain that the role of public finance should be to mobilise private sector finance for infrastructure undertakings such as renewable energy projects, since public funds, on their own, are not sufficient to close the funding gap (Bielenberg, Kerlin, Oppenheim, & Roberts, 2016; IRENA & CPI, 2018; Mohamed et al., 2014; UNEP, 2015). Public finance should also play the role of reducing uncertainty by investing and showing that the country is a profitable investment destination (Erden & Holcombe, 2006).

Public finance instruments normally take the form of grants, low-interest loans, loan guarantees (Abdmouleh, Alammari, & Gastli, 2015), public equity, mezzanine funds or subordinated equity, and foreign exchange risk mitigation (Cedrick & Long, 2017). Governments also use fiscal incentives as well as channelling public finance towards establishing regulatory instruments (IRENA & CPI, 2018). Usually, state budgets provide grants and the Development

Finance Institutions (DFIs) provide loans (Abdmouleh et al., 2015). In fact, globally, most public financing for renewable energy has been coming from national, bilateral and multilateral DFIs (IRENA & CPI, 2018). In Africa, Climate funds and DFIs have been major sources of RE financing. In South Africa, examples of DFIs providing such loans are the Industrial Development Corporation, the Development Bank of Southern Africa, the European Investment Bank and the World Bank (Baker, 2015).

2.3.2.1.2 Private Finance

Financing is categorised as private, “if the funds are provided by family-controlled enterprises, quoted companies, joint ventures, consortia, partnerships, pre-institutional funding, special purpose vehicles, individual/angel network, subsidiaries and firms funded with private equity or venture capital” (Rodríguez et al., 2014, p. 18). Private financing of renewable energy projects normally comes from banks, venture capital organisations (Abdmouleh et al., 2015), institutional investors, private equity, project developers, commercial financial institutions, corporations, infrastructure funds, and households (IRENA & CPI, 2018). In South Africa, 68% of debt financing for REIPPP projects has come from the following local banks: Standard Bank, Nedbank, ABSA, RMB and Investec (Eberhard & Naude, 2016).

2.3.2.1.3 Public-Private Partnership

A PPP is defined as a “long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance” (World Bank, 2014, p. 14). There is an increase in renewable energy investments globally, and the PPP model has been the dominant financing form for these projects (Cedrick & Long, 2017). In South Africa, the REIPPPP's first three rounds approved 64 projects and 56 of these used the PPP model of financing (Baker, 2015).

The PPP model allows governments to leverage private capital, innovation, and technology while transferring most of the project risk to the private players in the provision of public services (Cedrick & Long, 2017). Furthermore, a country’s perceived policy risk reduces when the government employs PPPs, because public investment in a project, is seen as a sign of government commitment (Bielenberg et al., 2016). In addition, the PPP approach to financing renewable energy projects offers benefits to both the government and the private sector, in that the government is able to provide the public with sustainable, eco-friendly, affordable, and reliable energy whilst the private sector is guaranteed long-term revenue streams (Cedrick & Long, 2017). The following section focuses on green growth.

2.3.3 Green Growth

There are four discourses of the green economy identified by Death (2014), which are: green revolution, green transformation, green growth, and green resilience. Of these four, green growth is the main discourse in South Africa (Death, 2014). However, the concepts green growth and green economy are sometimes used interchangeably (Loiseau et al., 2016). This view is supported by Kumar (2017) who posits that both terms denote an economic system of production and consumption which regards the environment and wherein resources are distributed equitably. This study will use green growth and green economy interchangeably.

Green growth is defined by Huang and Quibria (2013, p. 2) as, "growth which is efficient in its use of natural resources, which minimizes pollution and environmental impacts, and which is resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters". The Organization for Economic Cooperation and Development (OECD) defines Green growth as, "fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities." (OECD, 2011, p. 9).

Green economy is defined as, "an economy that results in improved well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011). The South African Department of Environmental Affairs' (DEA) definition of green economy is, "a system of economic activities related to the production, distribution and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks or ecological scarcities" (DEA, 2012, para. 3). The DEA's understanding of the green economy concept is that it “implies the decoupling of resource use and environmental impacts from economic growth” (DEA, 2011b, p. 25).

Besides its job creation potential, the Green growth strategy will reduce the South African economy’s dependence on fossil fuels by investing in renewable energy projects (Borel-Saladin & Turok, 2013). In other words, the Green growth strategy does not only create growth but also results in low-carbon development (UNEP, 2013). Such growth in income, employment, and low-carbon development in a green economy are driven by "public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services" (Montmasson-Clair, 2012, p. 5). The South African Government has identified four sectors that are central to the country’s achievement of green growth as natural resource management, agriculture, transport, and energy (UNEP, 2013). This study will focus on renewable energy. Below follows a discussion of measurement/indicators of green growth.

2.3.3.1 Measurement/Indicators of Green Growth

Some researchers disagree with the use of Gross Domestic Product (GDP) as a measure of society’s progress (Georgeson et al., 2017; Kumar, 2017; Stiglitz, Sen, & Fitoussi, 2009; UNU-IHDP and UNEP, 2014). The shortcomings of GDP as a measure of welfare, inclusiveness, and the overall progress of a society have been demonstrated (Kumar, 2017). GDP is a quantitative measure that shows the numerical change in economic activity (growth or decline) and does not give an indication of how wealth is being distributed or how goods and services are being produced and consumed (DEAT, 2008; Kumar, 2017). Additionally, GDP does not give an indication of whether production and consumption are sustainable since it does not account for environmental externalities or show the status of the capital stocks, such as natural capital, that is required for production (Kumar, 2017; UNU-IHDP and UNEP, 2014). Furthermore, GDP does not measure wealth, it looks at income thus making it a flow concept where the focus is the flow of goods and services. (UNU-IHDP and UNEP, 2014).

Indeed, economic growth, as indicated by GDP, is not a reflection of society’s wellbeing (Georgeson et al., 2017). In fact, GDP is an ineffectual metric for measuring the social, economic, and environmental aspects of wellbeing (Stiglitz et al., 2009). There are several approaches suggested by different authors on how to measure green growth, such as the OECD framework and the Inclusive Wealth Index. These two measurement approaches are presented below.

The Inclusive Wealth Index

The Inclusive Wealth Index (IWI) is defined as “an instrument designed to measure sustainable development, by assessing and monitoring the evolution of stocks of human capital, produced capital (manufacturing output or GDP), as well as natural capital over time" (Kumar, 2017, p. 49). The concept of Inclusive Wealth can be used to track progress towards sustainable development since income growth and GDP are not good measures of human well-being (Kumar, 2017). Inclusive Wealth “is the social value of an economy’s capital assets. The assets comprise (i) manufactured capital (roads, buildings, machines, and equipment), (ii) human capital (skills, education, health), and (iii) natural capital (sub-soil resources, ecosystems, the atmosphere)” (UNU-IHDP and UNEP, 2014, p. xv).

The IWI is an example of a composite index that seeks to give countries a meaningful picture of their wealth and ability to sustain development in the long-run (Georgeson et al., 2017). However, the IWI has the following weaknesses (Roman & Thiry, 2016): its assumptions, both theoretical and those about the future, are questionable; not all of its required data are available and distributional issues are not accounted for in the framework.

OECD Framework

The OECD created a framework with a set of indicators for measuring green growth (OECD, 2011). The OECD Green growth measurement framework has indicators that are divided into categories representing the main areas of green growth measurement (OECD, 2011). These indicators are, “comprehensive and suitable for national and international comparisons of green growth and sustainable development status” (Kim et al., 2014, p. 39). The OECD (2017) describes the Green growth measurement framework categories as follows:

(1) The environmental and resource productivity of the economy

In this category of Green growth measurement, the indicators show the extent to which consumption and production activities of the economy utilize environmental services, energy, and other natural resources efficiently. The fundamental evidence of whether an economy is becoming resource-efficient and less carbon-fuel dependent are captured by this category of indicators. These indicators are: (1) Carbon and energy productivity, which measure the output produced for every unit of CO2 emitted or for every unit of Total Primary Energy Supply (TPES); (2) Resource productivity, which measures the produced output for every unit of materials or natural resources utilised; and (3) Multifactor productivity which is "adjusted for the use of natural resources and environmental services" (OECD, 2017, p. 15).

(2) The natural asset base

The natural asset base indicators show the extent to which the assets provided by nature are being maintained within "sustainable thresholds in terms of quantity, quality or value" (OECD, 2017, p. 15). They give an indication of the risk posed to future growth, arising from the deterioration of the natural asset base.

(3) The environmental dimension of quality of life

This group of indicators show the following: (a) how environmental conditions and risks affect people's well-being and quality of life, (b) how human well-being is supported by the services provided by natural capital, and (c) whether income growth is bringing about an improvement of well-being.

(4) Economic opportunities and policy responses

The indicators in this category reflect green growth economic opportunities and assist in monitoring the effectiveness of green growth policies.

(5) The socio-economic context and the characteristics of growth

These indicators show the impact of policies designed to deliver green growth on development and growth. They also provide a link between social goals, such as poverty alleviation, and green growth indicators.

Georgeson et al. (2017) argue that the OECD framework has the following flaws. Some of the framework's indicators are based on GDP and the framework presents information on economic, social and environmental factors without indicating the interaction between them. In spite of these flaws, and due to the IWI's more pronounced limitations, especially the issue of data availability, this study will use the OECD Framework to measure green growth. Besides, this study will not use all of the OECD Framework variables, only seven will be selected for analysis. Of the seven OECD Framework variables selected for analysis in this study, only Real GDP per capita is based on GDP. Having discussed green growth, the next section looks at renewable energy.

2.3.4 Renewable Energy

The use of renewable energy is one of the pillars of green growth (Loiseau et al., 2016) and one of the channels that can be used to reduce dependency on fossil fuels and thus reducing environmental risks (DoE, 2015). Renewable energy, also called Clean energy or Renewables is defined as, "forms of energy that are not exhaustible, as are fossil fuels" (Goldemberg, 2012, p. 46). Examples of clean energy sources are solar, geothermal, biomass, wind, and hydro (Cedrick & Long, 2017).

If South Africa's economy is to grow (in order to create jobs) while protecting the citizens' health and the environment and meeting the country's international GHG emissions commitments, then the provision of affordable clean energy is a necessity (Henneman, Rafaj, Annegarn, & Klausbruckner, 2016). Renewable energy investments assist countries to meet rising demand for energy, mitigate climate change impacts, and also "enable sustainable development and growth with significant socioeconomic, environmental and health benefits" (IRENA, 2016, p. 19).

Renewable energy (RE) has a central role to play in the transition of a country towards sustainable development because most sustainable development issues are related to the use of energy (da Silva, Cerqueira, & Ogbe, 2018). For example, environmentally, global warming and climate change are energy consumption related issues (da Silva et al., 2018). These issues are caused by burning GHG emitting fossil fuels and the most effectual means to reduce GHG emissions is renewable energy deployment (Zeng, Liu, Liu, & Nan, 2017). This is because renewable energy hardly produces carbon dioxide and therefore will not aggravate climate change (Schwerho & Sy, 2017). In South Africa, in its first year of operation, the Boshof Solar Park in the Free State province was estimated to have displaced 140 000 tons of GHG emissions (Cedrick & Long, 2017).

Socially, renewable energy helps to combat air pollution-related diseases (Henneman et al., 2016) and creates green jobs (Borel-Saladin & Turok, 2013). The above mentioned Boshof Solar Park employed 280 people when it was being constructed and its operation has indirectly created 1000 jobs (Cedrick & Long, 2017). Furthermore, since its delivery can be decentralised, renewable energy can be used to improve the quality of life in remote areas (DoE, 2015; Schwerho & Sy, 2017) and thus help achieve social inclusion (DoE, 2015).

Economically, renewable energy reduces dependence on imported fuel thus improving a country's energy security and reliability (Schwerho & Sy, 2017). Winkler and Marquand (2009) found that in South Africa, the energy issue is the converging point at which developmental and climate change mitigation goals can be met. Undeniably, energy impacts major aspects of life such as health, education and nutrition (Nakumuryango & Inglesi-lotz, 2016). Renewable energy policies are presented next.

2.3.4.1 Global Renewable Energy Policies

Compared to the traditional energy infrastructure, renewable energy projects have higher initial investment costs (Abdmouleh et al., 2015). There are also generally considered riskier undertakings because their technology is relatively new (Abdmouleh et al., 2015) which means realising environmental goals demands huge financial resources (Rodríguez et al., 2014). Therefore, an important role that governments can play is to implement public policies that can attract private finance for investment in the green sector (Rodríguez et al., 2014) and promote the consumption of renewable energy (Cedrick & Long, 2017). A view shared by Mundaca and Markandya (2016) as they argue that there is an urgent need for policies aimed at reducing carbon-fuel usage and promote green energy. Generally, the types of policy employed by governments to encourage renewable energy investments are as follows:

(i) Feed-in system

This is a price-based support for renewable energy producers (Zhao, Tang, & Wang, 2013) referred to as a Feed-In-Tariff (FIT) if the producers are paid a fixed price for each unit of electricity supplied; Feed-In-Premium (FIP), if a premium above the electricity price is paid to the producers (Schallenberg-Rodriguez, 2017). The FIT/FIP arrangement provides RE producers with a fixed guaranteed price for a number of years but utilises public funds in that the end-user or the government pays for the extra costs (Abdmouleh et al., 2015; Schallenberg-Rodriguez, 2017). The FIT/FIP systems are the most popular renewable energy policy instruments (Schallenberg-Rodriguez, 2017) with Germany being the first country to successfully implement the FIT policy (Pegels, 2010).

(ii) Quota system/Renewable Portfolio Standard

The Quota system/Renewable Portfolio Standard is a quantity based system, which requires an energy producer to supply a minimum quantity of electricity from renewable sources (Zhao et al., 2013) and leaves price determination to the market (Schallenberg-Rodriguez, 2017). It is a private investment driven system, which follows the market-based approach to increase RE production from suppliers (Abdmouleh et al., 2015).

(iii) Tendering (Competitive bidding) arrangement

In the case of the Tendering (Competitive bidding) arrangement, public tenders are invited to supply a given amount of renewable energy that the power utility will purchase under a long-term power purchase agreement (Abdmouleh et al., 2015). Since the lowest bids are accepted and producers are paid at that low bidding price, there is a risk that the projects may not be implemented and this explains why only a few countries use this system (Schallenberg-Rodriguez, 2017); this is the system used in South Africa (Eberhard & Naude, 2016). South Africa’s competitive bidding policy instrument is called the Renewable Energy Independent

Power Producer Procurement Program (REIPPPP) (Kruger & Eberhard, 2018). The REIPPPP is discussed further in section 2.3.4.2 (iii).

(iv) Fiscal measures

Environmental Taxes are one form of fiscal measures that are aimed at regulating the market by creating fair competition between energy generating technologies through applying a levy on CO2 emissions or on carbon energy use (Abdmouleh et al., 2015). Renewable energy appears to be relatively expensive because most of the traditional energy infrastructure was financed through subsidies, have paid off the initial investment outlays, and their costing disregards external costs (Abdmouleh et al., 2015). An environmental tax could serve the purpose of internalising such external costs (Winker, 2009) and thus address the anomaly of power generation costing between non-renewable and renewable technologies (Abdmouleh et al., 2015). An exploration of South Africa's policy environment ensues.

2.3.4.2 South African Renewable Energy Policies

South Africa ratified climate change treaties such as the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (Klausbruckner, Annegarn, Henneman, & Rafaj, 2016). At the UNFCCC Conference of the Parties (COP) 15 in 2009 in Copenhagen, the South African President outlined the country's commitment to "reduce its emissions by 34% by 2020, progressing to 42% by 2025 (compared to the 'business as usual' emissions baseline)" (DoE, 2015, p. 2). To honour these international commitments, South Africa has implemented several strategies and policies to encourage renewable energy deployment and decrease the country's reliance on carbon-fuels and subsequently, its GHG emissions.

The IEA/IRENA (2018) lists several of South Africa's renewable energy policies such as: the White Paper on Renewable Energy (2003), Integrated Energy Plan (2003), Integrated Resource Plan (2010), National Climate Change Response Policy White Paper (2011) and the Renewable Energy Independent Power Producer Procurement Programme (2011) which replaced the Renewable Energy Feed-In Tariff (REFIT) of 2009. The REFIT programme was terminated because its provisions were deemed to flout the South African public and procurement regulations (DoE, 2015). The following are policies deemed to be relevant to this study.

(i) Integrated Resource Plan (IRP) (2010)

The IRP is the South African Government's main energy document that lays out the country's 2010 to 2030 electricity generation blueprint (DoE, 2015). It focuses on, among other targets, increasing solar and wind energy production to reduce GHG emissions (Nakumuryango & Inglesi-lotz, 2016). The IRP is designed to help meet the national pledge to transform South Africa to a low-carbon economy (DoE, National Treasury, & DBSA, 2018). Its stated target for renewable energy proportion in total electricity generation is 14% by 2030 (Henneman et al., 2016). Another objective of this policy is to reduce annual emissions resulting from electricity generation to 275 Million tonnes (Montmasson-Clair, 2012). Implementation of the IRP is done through Ministerial Determinations which represent the beginning of procurement and provide assurance to investors (DoE, 2015). These Ministerial determinations publish the required capacity level and the technology type to be procured (Kruger & Eberhard, 2018).

(ii) National Climate Change Response White Paper (NCCRWP) (2011)

The NCCRWP emphasises energy efficiency, renewable energy, GHG emissions reduction, public health concerns of pollution and the implementation of programmes designed to mitigate climate change (DEA, 2011a). The NCCRWP describes the South African Government's response to climate change issues and how the country will contribute to global endeavours to reduce greenhouse gas emissions. (DoE et al., 2018). Some of the other objectives of the NCCRWP are to limit job losses in the brown economy and to grow the green economy by stimulating investments in people and productive assets (DEA, 2011a).

(iii) Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) (2011)

The REIPPPP was initiated by the South African Government in August 2011, to procure 17.8 GW of electricity generated from solar, wind, biogas, biomass, and hydropower by 2030 (Walwyn & Brent, 2015). The idea of implementing an Independent Power Producers Procurement Programme (IPPPP) dates back to November 2010, when the National Treasury and the Department of Energy (DoE) signed a Memorandum of Agreement with DBSA to execute the IPPPP (DoE et al., 2018). The REIPPPP is part of efforts to give effect to the IRP

(DoE et al., 2018). The REIPPPP procures the Ministerial Determination RE capacity (DoE et al., 2018).

The IPPPP office under DoE has been using the REIPPPP to obtain RE generated electricity from the private sector following the termination of the REFIT policy instrument (DoE et al., 2018). The REFIT programme was ended because it was seen as not being in line with the requirements of the South African public and procurement regulations (DoE, 2015) and its implementation lacked political support (Rennkamp, Haunss, Wongsa, Ortega, & Casamadrid, 2017).

The REIPPPP is designed to foster competitive bidding, where producers bid for government contracts, to supply a given quantity of renewable energy, with 1 MW being the required minimum capacity (Msimanga & Sebitosi, 2014). Through competitive bidding rounds called Bid Windows (BWs), Independent Power Producers (IPPs) tender bids for small hydro, onshore wind, concentrated solar power (CSP), solar photovoltaic, biogas or biomass projects (Eberhard & Naude, 2016). So far, five BWs (1, 2, 3, 3.5, and 4) have been concluded for large projects and two for small projects (Smalls BW1 and smalls BW2) since the inception of the REIPPPP (DoE et al., 2018).

The REIPPPP has posted remarkable successes. For instance, the policy has succeeded in attracting Green finance into the renewable energy sector amounting to ZAR 201.8 billion for the years 2011 to 2018; has been delivering renewable energy at internationally comparable decreasing prices; and has reduced South Africa's CO_2 emissions by 25.3 Million tonnes (Mton) of CO_2 (DoE et al., 2018).

The REIPPPP has incentives to encourage investors to enter the renewable energy market. For example, it gives successful bidders 20-year Power Purchase Agreement (PPA) contracts where Eskom is obliged to purchase their output and the Government guarantees these payments through implementation agreements (DoE, 2015). To cover the lenders from default risk, a direct agreement is signed between the lenders, DoE, Eskom, and the IPP, to allow lenders step-in rights if a default occurs (Eberhard & Naude, 2016). This creates a favourable risk-return profile thus attracting investors.

However, the REIPPPP has been facing resistance from the national utility, ESKOM, which has been arguing that it is more expensive to procure electricity through this programme, compared with nuclear and coal-fired power plants procurement costs (Rennkamp et al., 2017). ESKOM has even gone to the extent of delaying the signing of Power Purchase Agreements (PPAs) in later bid rounds (Kruger & Eberhard, 2018). This resistance is in spite of evidence to the contrary. For instance, Kruger and Eberhard (2018) found that as at Bid Window 4, the average cost of supply for solar PV and wind energy has become cheaper than ESKOM's. In their IPPPP overview, DoE et al. (2018) concluded that the actual average contracted price that ESKOM has been paying to the IPPs has progressively been decreasing over successive BWs as shown in Figure 2.1.

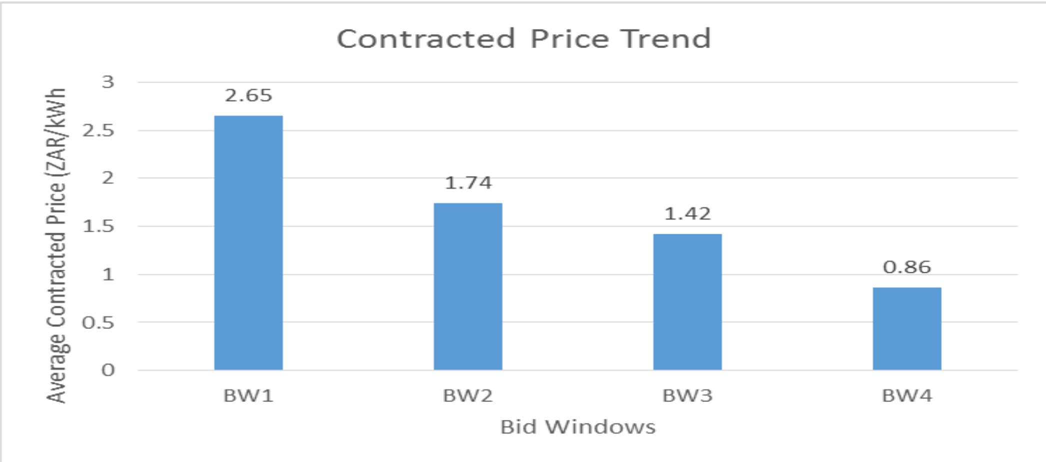


Figure 2.1: BW1 to BW4 Average Contracted Prices
Source: Adapted from DoE et al. (2018, p. 16)

In addition, introducing private electricity generation in the sector comes with other benefits such as supply diversification, new skills insertion and comparable pricing and performance (DoE et al., 2018). The REIPPPP is also used as an instrument to promote social equality as investors are required to engage in socio-economic initiatives in the areas surrounding their operations (DoE, 2015). In fact, all REIPPPP bids are subjected to a price criterion (70% of the scoring) and socio-economic development criteria (30% of the scoring) in order to qualify for selection (Kruger & Eberhard, 2018). This makes the REIPPPP, a policy instrument that is in line with South Africa's ambitions to put the economy on the sustainable development path.

It will be important then, to investigate the nature of the relationship between South Africa's energy policy and Green finance in the hope of coming out with findings which may be used to improve the policy. From the list of energy policies outlined above, this study chose to use the REIPPPP for the analysis of Green financial flows in the renewable electricity generation sector because it is the policy instrument that the DoE uses to attract investments in this sector. Furthermore, the REIPPPP has measurable variables (Average tariff and contracted project capacity) and available data, unlike the other policies.

2.4 Empirical Evidence

This section presents empirical evidence from previous studies.

2.4.1 Green finance and Policy

Rodríguez et al (2014) found that RE projects that are provided with public finance attract private finance and did not find sufficient evidence of public finance crowding out private finance. Erden and Holcombe (2006) arrived at a similar conclusion and found that public finance complements private finance. However, Wall, Grafakos, Gianoli, and Stavropoulos (2018) found that public finance has a negative relationship with Foreign Direct Investment (FDI) in renewables. To avoid the crowding out of private finance, public finance should be used to address investment difficulties that private investors face (IRENA, 2016). One way to achieve this role is by having public finance institutions focus their efforts on risk mitigation and use risk mitigation instruments such as liquidity reserve facilities, currency hedging instruments, and guarantees to attract private investors (IRENA, 2016; Mohamed et al., 2014). Public finance can also be restricted to projects that are not attractive to private investors; for example, small projects (Anbumozhi, Kalirajan, & Kimura, 2018).

Most countries are implementing RE policies which are mostly market-based and using economic incentives to attract investments (Mundaca & Markandya, 2016). Countries are also using tax incentives, such as tax credits or exemptions, to encourage private investors to invest in renewable energy projects (Wall et al., 2018). These policies, though, in their current form, are not producing much impact (Mundaca & Markandya, 2016). Comparing these same policies, Rodríguez et al. (2014) came to a different conclusion and observed that Feed-in tariffs and tax reliefs (credits) have a positive effect on private finance flows into renewable energy projects.

In their study, IRENA and CPI (2018) found that, levels of investment are highly influenced by any changes to a country's energy policy. Indeed, high levels of policy uncertainty create an environment where an increase in tariffs paid to IPPs is not matched by an expected increase in investment flows (Dalby, Gillerhaugen, Hagspiel, Leth-Olsen, & Thijssen, 2018). Investors would rather invest in countries where tariffs are low if there are low levels of policy uncertainty and long contracts are offered (Dalby et al., 2018). Policy uncertainty and regulatory risk were found by Polzin, Migendt, Täube, and Flotow (2015), to be major concerns for institutional investors. Germany is an example of a country where addressing policy uncertainty and regulatory risk issues, has helped to attract RE investments (Anbumozhi et al., 2018). Germany has done this by ensuring that the rights of projects remain protected, even when governments change (Anbumozhi et al., 2018).

Ultimately, rather than the type of policy, it is the design of a given policy that determines its efficacy in attracting investors (Cedrick & Long, 2017; Rodríguez et al., 2014). Public policies aimed at stimulating private finance for RE projects should be designed so as to create demand for renewable energy and to "address the specific difficulties of raising funds for such investment projects" (Rodríguez et al., 2014, p. 5). Upon comparing the inducement effect of public policy and public finance interventions on private finance, Haščič, Rodríguez, Jachnik, Silva, and Johnstone (2015) observed that in developed countries, policies are more effective than public finance. The opposite was observed in developing countries where public finance play a more significant role than policies in attracting private RE investments (Haščič et al., 2015).

Another factor that researchers have found to have an impact on RE investment flows is the interest rates environment. For example, Eyraud, Clements, and Wane (2013) arrived at the conclusion that, green investments tend to decrease when interest rates increase and vice-versa due to the capital-intense nature of RE projects and a reliance on outside financing. Similarly, Ababio et al. (2018) concluded that interest rates have a negative relationship with private investments in Ghana. However, Dakin (2015) found evidence that in South Africa interest rates have no significant effect on investments.

2.4.2 Progress towards Green growth

In a study that analysed 25 African country's green growth indicators, Zoundi (2017) found a negative relationship between CO_2 emissions and renewable energy usage and a positive relationship between CO_2 and income per capita but could not confirm the EKC model. Likewise, in a study of South Africa's emissions between 1911 and 2010, Nasr, Gupta, and Sato (2014) did not find evidence of the EKC pattern. Besides RE consumption, another effective strategy that helps to reduce CO_2 emissions is the promotion of energy efficiency (Winkler & Marquand, 2009).

After investigating the impact of RE adoption on economic growth, Zaman et al. (2016) found that South Africa, Brazil, India, and China, achieved GDP per capita growth after increasing renewable energy consumption. In a study of the same countries, Kutan, Paramati, Ummalla, and Zakari (2018) arrived at the same conclusion as well as that the consumption of RE reduces the countries' CO_2 emissions. Similarly, in the European Union (EU), Jänicke (2012) concluded that green investments lead to economic growth. Jaeger et al. (2011) estimated that a 30% reduction in emissions in the EU between 2010 and 2020, will grow the region's economy by 0.6% annually and add approximately six million jobs.

In Asia-Pacific Economic Cooperation countries, Zafar, Shahbaz, Hou, and Sinha (2019) reported that the use of RE positively impacts economic growth. For the Group of Seven countries, Balcilar, Ozdemir, Ozdemir, and Shahbaz (2018) observed that, from the early 1990s to 2015, the adoption of RE drove economic growth in Germany, Italy, and the United Kingdom but the results varied with time for the rest of the group's countries. In the developing world, there is evidence that RE consumption positively influences economic growth (Ito, 2017). Besides helping the economy to grow, adopting RE plays a critical role in the transition towards sustainable development (Bhattacharya et al., 2016). However, in a study of 30 Sub-Saharan African countries, Adams, Kwame, Klobodu, and Apio (2018) concluded that non-renewable energy promotes economic growth more than RE.

With regard to RE deployment and employment creation, Ortega, del Río, Ruiz, and Thiel (2015), found that 584 019 jobs were created in 2012 across the EU, from the deployment of wind and solar technologies. The same study concluded that, in the RE sector in the EU, more jobs are created during manufacturing than during installation and operation stages (Ortega et al., 2015). By contrast, in a study in Brazil's wind technology deployment, Simas and Pacca (2014) found that a substantial number of jobs were created in the sector but more during the installation stage than during manufacturing of components. In a study of the United States of America, Wei, Patadia, and Kammen (2010) concluded that RE diffusion creates more jobs per unit of energy than coal-based technology. Similarly, Cantore, Nussbaumer, Wei, and Kammen (2017) established that the adoption of RE technologies leads to additional jobs in Africa. These jobs then create social dividends (Cantore et al., 2017). Borel-saladin and Turok (2013) concluded the same for South Africa.

2.5 Chapter Conclusion

Chapter two reviewed literature pertaining to the topic: "Green finance and Green growth: Towards Sustainable Development in South Africa". A view of the green growth strategy, as a means to sustainable development, was presented. The literature review showed that green finance and green technology, particularly RE technology, are enablers of green growth. The extant literature also shows that governments have to implement effective policies in order to induce green finance in the green sectors of the economy. The chapter also explored the role of renewable energy in the transition of a country towards sustainable development. There is empirical evidence to show that RE consumption positively impacts economic growth, creates jobs, reduces CO2 emissions, and that RE consumption is necessary for sustainable development.

Lastly, the reviewed literature showed that there is no study that has been conducted to investigate the relationship between Green finance and the RE policy of South Africa using correlation analysis; neither is there a study that has investigated South Africa's progress towards green growth using descriptive statistical analysis. This is the gap that this study seeks to fill and make a contribution to literature. The next chapter describes the research methodology used in this study.

Chapter 3: Methodology

3.1 Introduction

This chapter focuses on the methodology that this study employed to investigate the relationship between Green finance and the RE Policy in South Africa, and to investigate South Africa's progress towards Green growth. The study followed a quantitative, correlation and descriptive design using secondary data. Saunders, Lewis and Thornhill (2016, p. 720) define research methodology as, "the theory of how research should be undertaken, including the theoretical and philosophical assumptions upon which research is based and the implications of these for the method or methods adopted". The chapter presents an outline of different research approaches as well as the one selected for this study, the research data, population and sampling, data analysis techniques, and the validity and reliability of the research.

3.2 Research Approach

Qualitative and quantitative approaches are the broad groups into which methodologies are usually categorised; using a mixture of these two, yields what is called the mixed methods approach (Matthews & Ross, 2010).

3.2.1 The Qualitative Approach

According to Creswell and Creswell (2018, p. 250), qualitative research "is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem." It is an approach that is suitable for studying "experiences, meanings, perceptions and feelings" and the non-numerical data that it collects is not subjected to statistical analysis but rather analysed to identify themes (Kumar, 2011, p. 20). Qualitative research is designed to answer the Why, How and Who type of questions (Lyons & Doueck, 2010). The strength of the qualitative approach lies in its ability to provide a richer understanding of phenomena (Hair, Celsi, Money, Samouel, & Page, 2011). As its demerit, this approach is susceptible to potential bias since its data analysis is subjective (Leedy & Ormond, 2015).

3.2.2 The Quantitative Approach

The quantitative approach to research seeks to test theories by analysing relationships between measurable variables (Creswell & Creswell, 2018). It addresses the How much, How many and What type of research questions (Lyons & Doueck, 2010). This makes quantitative designs appropriate for studies seeking to quantify change (Kumar, 2011). The data collected to answer the research questions are numerical and are analysed using statistical procedures (Kumar, 2011). The main strengths of the quantitative approach, of providing relative objectivity and representativeness, stems from its use of statistical procedures (Hair et al., 2011). However, this approach is not able to explore the depth of an issue being studied (Hair et al., 2011).

3.2.3 Mixed methods

A research approach which combines both qualitative and quantitative approaches is called mixed methods (Saunders et al., 2016). This approach collects both quantitative and qualitative data which are then integrated; the end result is a deeper comprehension than would have been provided by either qualitative or quantitative data only (Creswell & Creswell, 2018). This gives the mixed methods approach an advantage over both quantitative and qualitative approaches, when used separately (Leedy & Ormond, 2015).

3.2.4 Choice of the research approach

According to Matthews and Ross (2010) the choice of a research approach, quantitative or qualitative, should be guided by the research questions and the type of data to be gathered and the related analysis. This study poses the “what” type of questions, which are quantitative research questions (Lyons & Doueck, 2010). The study collected quantitative data which were analysed using statistical techniques. Such type of approach is classified as quantitative (Collis & Hussey, 2009). Using this reasoning the research design for this study is quantitative. A quantitative approach was appropriate for this study since it allowed the researcher to quantify the relationship between the study’s variables, which a qualitative approach will not permit

(Creswell & Creswell, 2018). That is to say, the quantitative approach allowed the researcher to answer the research questions and meet the research objectives.

3.3 Research Data

This section discusses issues pertaining to the research data. Data is defined as, "A collection of facts (or other information, such as opinions or values) which can be analysed and from which conclusions can be drawn" (Matthews & Ross, 2010, p. 43).

3.3.1 Type of data

Data can be categorised according to source as primary if collected by a researcher to answer their own particular research questions; secondary, if used by a researcher after it has been gathered by others for their own purposes (Matthews & Ross, 2010). This study gathered and analysed secondary data. Secondary data offered this study the advantage that it is less expensive and made the longitudinal study of South Africa's progress towards green growth feasible (Saunders et al., 2016) within the time constraints of a dissertation. According to Saunders et al. (2016), secondary data can either be numeric (quantitative) or non-numeric (qualitative). Numeric data can further be classified as interval or ratio data (Saunders et al., 2016). Secondary data used in this study is numeric, with a ratio level of measurement.

3.3.2 Data collection instrument

The means through which data are gathered are called data collection instruments (Matthews & Ross, 2010). Examples of these instruments are questionnaires, structured interviews, and structured observations for quantitative research; qualitative research commonly uses participant observation and unstructured or semi-structured interviews (Kumar, 2011). These instruments collect data from primary sources. This study collected data from secondary sources, which are discussed next.

3.3.3 Data sources and description of variables

The following paragraphs indicate the sources from which data were collected and describe the study's variables.

(a) Green Finance and Policy Variables

For Green finance (Private and Public finance) variables and RE projects' capacity, secondary data were obtained from the Business Monitor International (BMI)'s Renewables Key Projects database, IJGlobal Project finance and Infrastructure database, websites and financial reports of participating DFIs (AfDB, DBSA, EIB, EKF, FMO, IDC, IFC, KfW IPEX-Bank, Norfund and OPIC). Data were collected for the years 2012, 2013, 2014, and 2018 based on available data as contained in the mentioned sources. These years, form the periods of analysis for Green finance. There were no publicly available green finance data for the years 2015, 2016, and 2017. 2012 is the year in which the first RE projects under REIPPPP reached financial close (Eberhard et al., 2014).

BMI's Renewables Key Projects Database covers 3000 RE projects from 196 countries, showing project value and capacity and other project variables (BMI, 2018). IJGlobal Project finance and Infrastructure database is a database of project finance and infrastructure deals, which stores more than 20000 transactions (IJGlobal, 2018). This database has been used by other scholars, for example, Bielenberg et al. (2016) in their study on attracting private finance for sustainable development.

Average tariffs data and long-term interest rates data were also used in the analysis, from experts' published paper and the OECD Data respectively (Kruger & Eberhard, 2018; OECD, 2018a). The following are the variables on which data were collected to investigate the relationship between Green finance and the REIPPPP.

1. Private Finance

This variable refers to amounts, in South African Rands (ZAR), invested by private players per renewable energy project, under REIPPPP. Not all private finance amounts invested in these projects are publicly available. However, total investment and public finance investment amounts per project are available from BMI and IJGlobal databases and participating DFIs listed above. Therefore, for projects where private finance amounts are not available, the following calculation was performed:

Private Finance = Total investment – Public Finance

Where: Total investment = Private + Public investment amounts per project

2. Public Finance

This variable represents investment amounts (ZAR) made per REIPPPP project by public entities. In the case of South Africa’s REIPPPP projects, these public entities are Development Finance Institutions (DFIs).

3. Average Tariff

The Average Tariff, in ZAR, captures the average tariff per technology per bid window. It is the contracted price at which the Renewable Energy Independent Power Producers (REIPPs) are paid by the national utility, ESKOM, per kWh of electricity supplied. The tariff variable was used in this study to measure policy effect; in other words, Average Tariff is the proxy for policy in this study. Renewable energy tariffs have been used before by other studies to measure policy effect on private finance (Haščič et al., 2015; Rodríguez et al., 2014).

4. Project Capacity

This variable represents project capacity in megawatts (MW) and was used in this study as a control variable to control for project size. In their study on how to induce private finance in clean energy projects, Rodríguez et al. (2014) also included project capacity as a control variable.

5. Long-term Interest Rates

Long-term interest rates are rates on 10-year government bonds (OECD, 2018a). In this study, these are South African Government 10-year bond rates measured in percentages. Interest rates affect borrowing costs and therefore, influence investment decisions (Xu, Lei, Ge, & Ma, 2017). RE projects incur huge initial costs which are mostly financed through borrowing thus making the projects “sensitive to interest rates” (Eyraud et al., 2013, p. 858). Long-term interest rates are the relevant rates since investments in these projects are long-term by nature (Eyraud et al., 2013). In their study on the influence of policy on RE investments, Polzin, Migendt, Täube, and Flotow (2015) used long-term interest rates as a control variable. For these reasons, long-term interest rate variable was included in the analysis of the relationship between Green finance and Policy to control for its effects.

(b) Green Growth Variables

Secondary data to analyse South Africa’s progress towards Green growth was extracted from OECD Green Growth Indicators database (OECD, 2018b). The OECD database has been used by several researchers including Rodríguez et al. (2014) and Kim et al. (2014). OECD data is available up to 2015 for all variables except for Forests which goes up to 2014. Table 3.1 shows the OECD Green growth measurement categories, indicators, and variables that this study used to assess progress towards green growth.

Table 3.1 *Green Growth Categories, Indicators and Green Growth Research Variables*.

Category	Indicator	Variables selected for this study
1. The environmental and resource productivity of the economy	1. Carbon and energy productivity 2. Resource productivity 3. Multifactor productivity	1. CO2 intensity 2. CO2 emissions 3. Energy intensity 4. Renewable electricity
2. The natural asset base	1. Renewable natural resource stocks 2. Non-renewable natural resource stocks 3. Biological diversity and ecosystems	5. Forests

3. The environmental dimension of quality of life	1. Human exposure to pollution and environmental risks 2. Public access to environmental services and amenities	6. Population exposure to air pollution (PM2.5)
4. Economic opportunities and policy responses	1. Technology and innovation 2. Investment and financing 3. Production of environmental goods and services 4. Prices, taxes and transfers that provide signals to producers and consumers 5. Education, training and skills development	
5. The socio-economic context and the characteristics of growth	1. Economic growth and structure 2. Real GDP per capita 3. Labour markets and income 4. Socio-demographic patterns	7. Real GDP per capita

Source: Author's compilation from OECD (2011), OECD (2017), and from OECD (2018b)

OECD (2017) describes the seven variables selected for this study as follows:

1. CO_2 intensity

CO_2 intensity indicates a country's energy-related carbon dioxide emitted per capita. It is measured in tonnes.

2. CO_2 emissions

CO_2 emissions is an indicator that denotes production-based carbon dioxide emitted by a given country. These are carbon dioxide emissions from the use of energy. It is measured in million tonnes.

3. Energy intensity

Energy intensity refers to total primary energy supply (TPES) per capita. It is measured in tonnes of oil equivalent (toe).

4. Renewable Electricity (R.Electricity)

R.Electricity indicates the percentage of total electricity generation that is generated from renewable sources in a country.

5. Forests

This variable shows forests that are under sustainable management certification, measured as a percentage of the total forest area of the country.

6. PM2.5

PM2.5 is the average population exposure to air pollution caused by fine particulates. It is measured in micrograms per cubic metre. This pollution is mainly from the processes of transforming energy and its subsequent use.

7. Real GDP per capita

Real GDP per capita indicates the population’s economic wealth and provides a link between Green growth indicators and the attainment of social goals such as poverty reduction. Real GDP per capita is in constant 2010 US dollars.

The main reason for selecting these variables is that they are part of a group of indicators that OECD (2017) recommends as indicators of green growth. The other reasons are as follows: As mentioned in the literature review, energy efficiency and renewable energy are some of the focus areas of the South African's Green growth strategy. Besides, according to the DoE (2015), the increased use of renewable energy is one of the channels that can be used to reduce dependency on fossil fuels and the resultant environmental risks. Energy intensity and the proportion of total electricity generation coming from renewable sources are good indicators of the sustainability of a country's economic growth (OECD, 2017). Therefore, in view of the foregoing CO2 intensity, CO2 emissions, Energy intensity, and Renewable electricity were chosen to allow for the analysis of dependency on fossil fuels, energy efficiency, and renewable energy adoption.

The variable Forests was chosen because forests provide ecological services such as carbon sequestration (UNU-IHDP and UNEP, 2014). PM2.5 was chosen because, according to WHO (2016, p. 15), "Air pollution is used as a marker of sustainable development, as sources of air pollution also produce climate-modifying pollutants (e.g. CO2 or black carbon)." Levels of PM2.5 are a good indicator of environmental health risks (WHO, 2016). Real GDP per capita provides a link between Green growth indicators and the attainment of social goals, such as poverty reduction (OECD, 2017), hence the inclusion of the variable in this study. In addition, Real GDP per capita, by measuring the population's economic wealth (OECD, 2017), gives an indication of the standard of living of the population. Furthermore, Real GDP per capita, when viewed together with CO2 intensity and CO2 emissions, shows how sustainable the country's economic growth has been. GDP per capita, CO2 emissions, and share of renewable energy in a country's total energy supply were also used to study green growth by other researchers. For example, Bilgili et al. (2016), Zaman et al. (2016), and Zoundi (2017).

3.4 Population and sampling

The totality of cases that can potentially be involved in a study as subjects is called a population; the process of selecting only some of these cases for studying is referred to as sampling (Matthews & Ross, 2010). According to DoE et al. (2018), as at 31 March 2018, 112 REIPPPP projects have reached financial closure. These projects form the population from which a sample was drawn in order to investigate the relationship between Green finance and the RE

Policy. Out of the 112 projects, only 44 have complete data as contained in the BMI and IJ Global databases and from participating DFIs' websites and financial reports. These are the projects that were selected to form the sample. The second research objective is focused on the entire South Africa to examine the country's progress towards green growth.

There are two general categories of sampling procedures which are probability sampling namely: simple random, stratified, cluster, and multistage sampling and non-probability sampling namely: quota, convenience, purposive and snowball sampling (Lyons & Doueck, 2010).

Convenience sampling

To investigate the relationship between Green finance and RE Policy, Convenience non-probability sampling was employed to select a sample as described above. With this type of sampling there is little or no effort on the part of the researcher to make the sample representative and, "samples are selected because they are accessible" (Lyons & Doueck, 2010, p. 122). The secondary data that was analysed in this study is all that was available, hence convenience sampling's appropriateness. This is one of the advantages of convenience sampling, that it allows the selection of the available sample (Lyons & Doueck, 2010). Its disadvantage is that it does not allow generalisation of the findings since the sample is not always representative of the population (Lyons & Doueck, 2010). However, this study did not set out to generalise its findings, due to data limitations outlined in section 1.5. To investigate South Africa's progress towards Green growth, the whole population of data available from OECD for South Africa for the period of analysis was selected for analysis.

3.5 Data analysis techniques

This section describes how the collected data were analysed to answer the research questions. Data for Green finance and Policy variables were processed and analysed using the software IBM SPSS Statistics version 25. Prior to the final analysis, data quality assessments were performed using frequencies and descriptive statistics, specifically minimum and maximum values, arithmetic means, and standard deviations. OECD data were analysed using Microsoft Excel for Windows.

3.5.1 Correlation Analysis

The investigation of the relationship between Green finance (as measured by Private and Public finance amounts) and the RE policy (as measured by Average tariffs) was conducted by employing correlation analysis. Correlation analysis is a statistical technique that " is used to establish whether a change in one variable is accompanied by a change in another" (Saunders et al., 2016, p. 564). It is a data analysis technique that is employed if the research objective is to investigate and measure the relationship between two quantifiable variables or between pairs in a collection of variables (Koop, 2013). Correlation analysis allows the researcher to determine whether there is co-variation between the variables but does not allow ascribing of causation (Bryman, 2012). Since the first objective of this research was to investigate the relationship between Green finance and South Africa's renewable energy policy instrument, without attempting to establish causation, correlation analysis was the appropriate choice of data analysis technique.

Spearman's rank correlation coefficient, Pearson product-moment coefficient, and the Partial correlation coefficient were calculated to evaluate the relationship between Green finance and the RE policy. Spearman's coefficient was included in the analysis to confirm the consistency of Pearson's coefficient. Partial correlation was used to control for the effects of possible influencing variables in order to get an uncontaminated picture of the relationship between Green finance and the RE policy. The probabilities of these coefficients arising due to chance only (*p*-values) (Saunders et al., 2016) were also calculated and the statistical significance level applied was the traditional $p < 0.05$ (Pallant, 2011).

The magnitude of any coefficient indicates the strength of the association between the variables; the association's direction is indicated by the positive or negative sign (Pallant, 2011). For example, -1 shows a perfect negative correlation between the variables, where an increase in the values of one variable are associated with a decrease in the values of the other variable (Pallant, 2011). Table 3.2 gives Saunders et al. (2016)'s guidelines for interpreting the calculated coefficients.

Table 3.2 *Correlation coefficient interpretations*

Coefficient value	Interpretation
0 - +/- 0.2	No correlation
+/- 0.2 to +/- 0.35	Weak correlation
+/- 0.35 to +/- 0.6	Moderate correlation
+/- 0.6 to +/- 0.8	Strong correlation
+/- 0.8 to +/- 1	Very strong correlation
+/- 1	Perfect correlation

Source: Reproduced from Saunders et al. (2016, p. 564)

Spearman correlation, Pearson product-moment correlation, and Partial correlation are described next.

3.5.1.1 Spearman correlation

Spearman's rank correlation coefficient (Spearman's rho) is defined as a "statistical test that assesses the strength of the relationship between two ranked data variables" (Saunders et al., 2016, p. 728). It is used to analyse nominal or ordinal data, or interval/ratio data that do not meet the required assumptions to perform a parametric test (Weiers, 2011). Spearman's rho is a nonparametric test of correlation, which means it does not make the assumption that the sample's population is normally distributed (Weiers, 2011). Therefore, Spearman's correlation coefficients were calculated using the original untransformed variables. According to Thirumalai, Madhan, and Chandhini (2017), Spearman's rho is calculated as follows:

$$\rho = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n(n^2 - 1)}$$

where ρ = Spearman' rho,

n = sample's pairs of observations, and

d = each pair's difference in ranks.

3.5.1.2 Pearson correlation

Pearson's product moment correlation coefficient (Pearson's r) is defined as, "a method for examining relationships between interval/ratio variables" (Bryman, 2012, p. 341). According to Thirumalai et al. (2017), the coefficient (r) is calculated using the following formula.

$$r = \frac{n(\sum_{i=1}^{n} x_i y_i) - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{[n\sum_{i=1}^{n} x_i^2 - (\sum_i^n x_i)^2][n\sum_{i=1}^{n} y_i^2 - (\sum_i^n y_i)^2]}}$$

where x and y represents a pair of variables.

Pearson's coefficient assumes that the variable's underlying population is normally distributed (Pallant, 2011). Therefore, before conducting Pearson's correlation analysis, normality checks on the Green finance and RE Policy variables were performed first, and these are described below.

Normality Tests

Visual methods such as the histogram, Q-Q plots, and boxplots were used to assess normality of variables' distributions (Ghasemi & Zahediasl, 2012). A variable is said to be normally distributed if its histogram is bell-shaped and the Q-Q plot showing plots around or close to a diagonal line (Öztuna, Elhan, & Tüccar, 2006; Pallant, 2011). Some of the points may plot slightly away from this diagonal line (Tabachnick & Fidell, 2014). Boxplots show outliers and their location (Pallant, 2011). Since the Q-Q plots appear to provide the best visual assessment of normality (Öztuna et al., 2006) and are more useful than histograms (Tabachnick & Fidell, 2014); where the visual methods showed conflicting results, Q-Q plots results were relied upon to decide whether a variable is from a normal or non-normal distribution.

To supplement these visual methods, Kolmogorov-Smirnov and Shapiro-Wilk normality tests were carried out. According to Ghasemi and Zahediasl (2012), both the Kolmogorov (K-S) and the Shapiro-Wilk (S-W) test the null hypothesis that the variable is normally distributed. If the statistic has a p-value such that $p < 0.05$, then one should reject the null hypothesis, and conclude that the distribution of the variable is NOT normally distributed (Ghasemi &

Zahediasl, 2012). For those variables that showed to be from non-normal distributions, steps were taken to ensure normality.

In order to achieve normality, Tabachnick and Fidell (2014) recommend deleting the outliers or transforming the variables or performing both steps, if required, and carrying out normality tests after every such step. Examples of methods that can be used to transform variables are inverse, logarithm, and square root transformations (Tabachnick & Fidell, 2014). Before deleting the outliers, Pallant (2011) suggests comparing the mean and the 5% trimmed mean of the variable in question. If these two means' values are close to each other then it means the outliers are not influencing the mean and therefore deleting them will not significantly improve normality (Pallant, 2011).

3.5.1.3 Partial correlation

Partial correlation is a correlation method that allows exploration of the relationship between two variables while controlling for other variables' effects (Pallant, 2011). It is an expansion of Pearson correlation (Pallant, 2011). Thus the first step in computing the partial correlation is to calculate Pearson's *r* (Bryman & Cramer, 2005). When correlation tests are conducted without statistically holding any variable constant, as is the case with Pearson correlation, the resultant coefficients are called zero-order coefficients (Field, 2013). Partial correlation produces first-order coefficients when one variable is kept constant, second-order coefficients when two variables are kept constant, and so on (Field, 2013). According to Hardy and Bryman (2009), the first-order partial correlation coefficient is calculated as follows:

$$r_{x,y,c} = \frac{r_{x,y} - r_{x,c} r_{y,c}}{\sqrt{\left(1 - r_{x,c}^2\right)\left(1 - r_{y,c}^2\right)}}$$

where $r_{x,y,c}$ is the first-order partial correlation coefficient,

x and y are the variables of interest,

c is the control variable

The reason for using partial correlation is that the relationship of interest may be occurring indirectly through other variables (Hardy & Bryman, 2009). In the case of this study, Policy (as measured by tariffs) cannot possibly be the only variable that investors of green finance look at when making the decision to invest. Therefore, the effect of other possible influencing variables needs to be removed statistically (Hardy & Bryman, 2009) in order to obtain a picture of the uncontaminated relationship between Green finance and Policy. In other words, there is a need to remain with only that portion of the relationship which is not influenced by the other variables (Pallant, 2011). Mundaca and Markandya (2016) used a similar approach to analyse progress made by the world's regions towards green energy economy. They employed the Pearson correlation, Partial correlation, and regression in that order. The study managed to draw important findings from the calculations of partial correlations.

3.5.2 Descriptive statistical analysis

In order to investigate South Africa's progress towards green growth, OECD green growth indicators data were analysed using descriptive statistical analysis. According to Pallant (2011), among other uses, descriptive statistics can be used to answer research questions. In addition, growth rates of the indicators per period were computed to compare the rates of change of these indicators between periods. Other BRICS countries and Germany were brought into the analysis to benchmark South Africa's performance on the green growth indicators.

The period of analysis (data collection period) was 2004 to 2015 and is explained as follows: OECD data are available up to 2015. As indicated in the literature review, 2010 is the year when the South African Government hosted the first Green Economy Summit with all the economy's stakeholders in attendance. A resolution was made at this summit to place the economy on a Green growth path. Therefore, 2010 to 2015 would have been the period to analyse South Africa's progress towards Green growth. However, the author decided that there was a need to have a reference or comparison period and the appropriate choice would be the years before the 2010 decision year. Therefore, another period of an equal number of years (2004 to 2009) was created and was used for comparison purposes.

Growth rates of the indicators per period per country were computed. Since the values of the green growth indicators are cumulative from year to year (Mazzucato & Semieniuk, 2018), the Compound Annual Growth Rate formula was used to calculate these growth rates. This formula was also used by World Bank (2017) to calculate growth rates for indicators such as GDP per capita. The formula is as follows:

$$g = \left(\frac{X_t}{X_0}\right)^{1/n} - 1$$

where g = growth rate

X_0 = Initial year value

X_t = End year value

n = number of years.

The growth rates were then compared to allow observation of any changes to growth rates of green growth indicators between these periods. Kutan et al. (2018) also used growth rates to compare progress made in Brazil, India, China, and South Africa on energy consumption, CO2 emissions, and per capita income.

3.6 Validity and Reliability

Validity and reliability are concepts related to data collection instruments which collect primary data (Kumar, 2011). This study used secondary data. However, Saunders et al. (2016) suggest the following ways to address validity and reliability concerns of secondary data, which this study followed. Firstly, measurement validity can be assumed to be present if the data is suitable to answer the research questions and meet the research objectives. Secondly, reliability and measurement bias can be addressed by checking data suitability for analysis. Thirdly, validity and reliability of secondary data can also be verified if other researchers have used the same data to address similar research objectives. Finally, Validity and reliability can also be assessed by examining the source of the data. Data from big reputable organisations tend to be reliable since they tend to adhere to internationally recognised standards and have reputations to protect.

3.7 Chapter Conclusion

This chapter discussed the methodological approach that was used in answering the research questions in line with the objectives of this study. The primary aspects discussed under the chapter included the research approach, research data, population and sampling, data-analysis techniques, and validity and reliability. The next chapter discusses the study's findings.

Chapter 4: Discussion of Findings

4.1 Introduction

This chapter reports the findings from the data analysis carried out to investigate the relationship between Green finance and the RE policy in South Africa. The findings of the data analysis conducted to investigate South Africa's progress towards green growth are also presented. The chapter begins with descriptive statistics, then proceeds to present the findings and finally covers validity and reliability. In the following discussions of the findings, Policy refers to the Renewable Energy Independent Power Producer Program (REIPPPP) of South Africa and Green finance means the private and public finance amounts invested in the REIPPPP sample of projects during the years: 2012, 2013, 2014 and 2018.

4.2 Descriptive Statistics

This section gives a summary of the study variables' descriptive statistics, beginning with those of Green finance and Policy and ending with those of Green growth.

4.2.1 Green Finance and Policy Variables

Table 4.1 shows a summary of descriptive statistics for Green finance and Policy variables. The rest of the descriptive statistics are found in Appendix A. Table 4.1 shows that, for the 44 renewable energy projects that this study set out to analyse, private finance averaged ZAR 1498.93 million whilst public finance invested in these projects averaged ZAR 939.89 million over the years 2012, 2013, 2014 and 2018. For the same projects, contracted capacity averaged 77.08 MW and the average tariff was ZAR 1.68 per kWh with the long-term interest rates averaging 7.94% for the mentioned years.

Table 4.1 *Descriptive statistics for Green Finance and Policy Variables*

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Private Finance (ZAR million)	44	111	7147	1498.93	1483.789
Public Finance (ZAR million)	44	0	7750	939.89	1465.440
Project Capacity (MW)	44	5.00	258.00	77.0827	50.31594
Average Tariff (ZAR)	44	.72	2.76	1.6811	.84658
Long-Term Interest Rates (%)	44	7.23	8.93	7.9417	.40790
Valid N (listwise)	44				

4.2.2 Green Growth Variables

Table 4.2 summarizes green growth variables' descriptive statistics for South Africa over the period 2004-2015 (up to 2014 for Forests, due to lack of data). The rest of the descriptive statistics are found in Appendix C.

Table 4.2 *Descriptive statistics for South Africa's green growth variables (2004-2015)*

	CO2 intensity	CO2 emissions	Energy intensity	R. Electricity	Forests	PM2.5	Real GDP/capita
Mean	7.81	402.58	2.69	0.90	17.68	20.35	11524.21
Standard Deviation	0.23	21.81	0.11	0.51	2.81	2.17	638.84
Minimum	7.52	372.30	2.57	0.44	11.64	17.45	10154.70
Maximum	8.40	434.60	2.93	2.26	23.28	26.10	12139.09

A discussion on these descriptive statistics in Table 4.2 is presented in section 4.3.2 together with the descriptive analysis of the green growth variables used to investigate South Africa's progress towards green growth.

4.3 Empirical Results

This section presents results from the correlational analysis that was used to investigate the relationship between Green finance and the RE Policy. The results from the descriptive statistical analysis used to investigate South Africa's progress towards green growth are reported thereafter.

4.3.1 Green Finance Correlation Analysis Results

The following section discusses normality tests results after that, correlation analysis results are reported.

Normality Test

Appendix B presents results for the normality tests which were conducted for the following stages: before deleting outliers, after deleting outliers, and after transformation of some variables. As indicated by histograms and normal Q-Q plots in Appendix B(1), the variables are indicating to be non-normal. The boxplots also indicate outliers for some of the variables. Table 4.3 shows the results of Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) normality tests that were carried out before removing outliers.

Table 4.3 *K-S and S-W normality tests results*

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Private Finance (ZAR million)	.179	44	.001	.776	44	.000
Public Finance (ZAR million)	.270	44	.000	.622	44	.000
Project Capacity (MW)	.106	44	.200*	.918	44	.004
Average Tariff (ZAR)	.239	44	.000	.787	44	.000
Long-Term Interest Rates (%)	.245	44	.000	.854	44	.000

As can be observed in Table 4.3, the K-S and the S-W normality tests produce different *p*-values. This study used K-S results since, according to Ghasemi and Zahediasl (2012), it is the popular one amongst scholars. Table 4.3 highlights that there are issues with normality as all the variables with the exception of Project Capacity, had significant K-S test values ($p < 0.05$). Therefore, only Project Capacity is from a normal distribution as tested by the K-S normality test.

Comparing each variable's mean to its 5% trimmed mean, as given in Appendix A, showed that, these two mean values are almost equal to each other, for variables Average Tariff and Long-term Interest Rates; far from each other, for Private Finance and Public Finance. This indicates that outliers are not influencing the respective means for Average Tariff and Long-term Interest Rates and therefore, deleting them was not going to significantly improve normality (Pallant, 2011). This is not the case for Private Finance and Public Finance. Consequently, six outlier cases which were from Private Finance and Public Finance variables were removed from the cases to be analysed.

Subsequent to the foregoing step, another normality test was carried out (see Appendix B(2)). All the newly identified outliers for all variables were found not to be influencing the respective means (means and 5% trimmed means compared). Project Capacity and Private Finance variables' visual assessments, especially Q-Q plots, show reasonable normality. In addition, both variables' K-S normality test values are non-significant ($p > 0.05$), implying normality. As for Public Finance and Average Tariff, none of the tests shows normality. Long-term Interest Rates show normality on the visual tests but its K-S test value is significant. It is best to use both the K-S and the visual tests to obtain converging evidence to judge normality but visuals give the best evidence (Field, 2013). Since normality of variables enhances analysis, the next step to attain normality, which is the transformation of the variables (Tabachnick & Fidell, 2014), was conducted.

Based on the preceding discussion, the next step was to transform Public Finance and Average Tariff variables, since only these two showed to be non-normal according to visual assessments and K-S normality tests. Different types of transformation have to be tried, until one that renders the distribution normal or close to normal is found (Field, 2013; Tabachnick & Fidell, 2014). Generally, the first transformation to be tried depends on the shape of the distribution (Tabachnick & Fidell, 2014). For example, square root and log transformations are tried first for positively skewed variables (Field, 2013; Tabachnick & Fidell, 2014). Following this guidance, Public Finance variable was square root transformed and Average Tariff was base e log transformed.

After transformation, normality tests were carried out on the new variables (see Appendix B(3)). According to visual assessments and the K-S test, the transformed Public Finance recorded normality. The normal Q-Q plot for Average Tariff shows normality but the K-S test value was significant. However, "Data showing a moderate departure from normality can usually be used in parametric procedures without loss of integrity" (Elliott & Woodward, 2007, p. 26). Based on the normal Q-Q plot visual test (Field, 2013), the new Average Tariff variable achieved reasonable normality. After establishing normality of the variables, correlation analyses were conducted and are discussed next.

Correlations Results

This section discusses the results of the Spearman's rho, Pearson product-moment coefficient, and Partial correlations conducted to investigate the relationship between Green finance and Policy variables in South Africa's RE sector. Tables 4.4 to 4.12 show the results of these correlations.

Table 4.4 *Spearman Correlations*

Correlations

			Private Finance (ZAR million)	Public Finance (ZAR million)	Project Capacity (MW)	Average Tariff (ZAR)	Long-Term Interest Rates (%)
Spearman's rho	Private Finance (ZAR million)	Correlation Coefficient	1.000	.081	.651**	-.232	-.061
		Sig. (2-tailed)	.	.628	.000	.161	.715
		N	38	38	38	38	38
	Public Finance (ZAR million)	Correlation Coefficient	.081	1.000	.449**	-.206	-.024
		Sig. (2-tailed)	.628	.	.005	.216	.887
		N	38	38	38	38	38
	Project Capacity (MW)	Correlation Coefficient	.651**	.449**	1.000	-.646**	.264
		Sig. (2-tailed)	.000	.005	.	.000	.109
		N	38	38	38	38	38
	Average Tariff (ZAR)	Correlation Coefficient	-.232	-.206	-.646**	1.000	-.271
		Sig. (2-tailed)	.161	.216	.000	.	.100
		N	38	38	38	38	38
	Long-Term Interest Rates (%)	Correlation Coefficient	-.061	-.024	.264	-.271	1.000
		Sig. (2-tailed)	.715	.887	.109	.100	.
		N	38	38	38	38	38

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.5 *Pearson Correlations*

Correlations

		Private Finance (ZAR million)	SqrtPubFinancep	Project Capacity (MW)	LnTariffp	Long-Term Interest Rates (%)
Private Finance (ZAR million)	Pearson Correlation	1	-.023	.642**	-.224	.029
	Sig. (2-tailed)		.891	.000	.177	.863
	N	38	38	38	38	38
SqrtPubFinancep	Pearson Correlation	-.023	1	.422**	-.148	-.158
	Sig. (2-tailed)	.891		.008	.375	.345
	N	38	38	38	38	38
Project Capacity (MW)	Pearson Correlation	.642**	.422**	1	-.609**	.189
	Sig. (2-tailed)	.000	.008		.000	.256
	N	38	38	38	38	38
LnTariffp	Pearson Correlation	-.224	-.148	-.609**	1	-.179
	Sig. (2-tailed)	.177	.375	.000		.281
	N	38	38	38	38	38
Long-Term Interest Rates (%)	Pearson Correlation	.029	-.158	.189	-.179	1
	Sig. (2-tailed)	.863	.345	.256	.281	
	N	38	38	38	38	38

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.6 *Private Finance and Public Finance Partial Correlation*

Correlations

Control Variables			Private Finance (ZAR million)	SqrtPubFinancep
Project Capacity (MW) & LnTariffp & Long-Term Interest Rates (%)	Private Finance (ZAR million)	Correlation	1.000	-.537
		Significance (2-tailed)	.	.001
		df	0	33
	SqrtPubFinancep	Correlation	-.537	1.000
		Significance (2-tailed)	.001	.
		df	33	0

Table 4.7 *Private Finance and Project Capacity Partial Correlation*

Correlations

Control Variables			Private Finance (ZAR million)	Project Capacity (MW)
LnTariffp & Long-Term Interest Rates (%) & SqrtPubFinancep	Private Finance (ZAR million)	Correlation	1.000	.772
		Significance (2-tailed)	.	.000
		df	0	33
	Project Capacity (MW)	Correlation	.772	1.000
		Significance (2-tailed)	.000	.
		df	33	0

Table 4.8 *Private Finance and Average Tariff Partial Correlation*

Correlations

Control Variables			Private Finance (ZAR million)	LnTariffp
Long-Term Interest Rates (%) & Project Capacity (MW) & SqrtPubFinancep	Private Finance (ZAR million)	Correlation	1.000	.383
		Significance (2-tailed)	.	.023
		df	0	33
	LnTariffp	Correlation	.383	1.000
		Significance (2-tailed)	.023	.
		df	33	0

Table 4.9 *Private Finance and Long-Term Interest Rates Partial Correlation*

Correlations

Control Variables			Private Finance (ZAR million)	Long-Term Interest Rates (%)
Project Capacity (MW) & SqrtPubFinancep & LnTariffp	Private Finance (ZAR million)	Correlation	1.000	-.274
		Significance (2-tailed)	.	.112
		df	0	33
	Long-Term Interest Rates (%)	Correlation	-.274	1.000
		Significance (2-tailed)	.112	.
		df	33	0

Table 4.10 *Public Finance and Project Capacity Partial Correlation*

Correlations

Control Variables			SqrtPubFinancep	Project Capacity (MW)
LnTariffp & Long-Term Interest Rates (%) & Private Finance (ZAR million)	SqrtPubFinancep	Correlation	1.000	.657
		Significance (2-tailed)	.	.000
		df	0	33
	Project Capacity (MW)	Correlation	.657	1.000
		Significance (2-tailed)	.000	.
		df	33	0

Table 4.11 *Public Finance and Average Tariff Partial Correlation*

Correlations

Control Variables			SqrtPubFinancep	LnTariffp
Long-Term Interest Rates (%) & Private Finance (ZAR million) & Project Capacity (MW)	SqrtPubFinancep	Correlation	1.000	.310
		Significance (2-tailed)	.	.070
		df	0	33
	LnTariffp	Correlation	.310	1.000
		Significance (2-tailed)	.070	.
		df	33	0

Table 4.12 *Public Finance and Long-Term Interest Rates Partial Correlation*

Correlations

Control Variables			SqrtPubFinancep	Long-Term Interest Rates (%)
Project Capacity (MW) & LnTariffp & Private Finance (ZAR million)	SqrtPubFinancep	Correlation	1.000	-.356
		Significance (2-tailed)	.	.036
		df	0	33
	Long-Term Interest Rates (%)	Correlation	-.356	1.000
		Significance (2-tailed)	.036	.
		df	33	0

The investigation of the relationship between Green finance and Policy variables yielded the following findings. Using the Spearman' rho, Table 4.4 indicates that there was no correlation between Private Finance and Public Finance since the correlation coefficient is approximately zero, *rho* = 0.081, n = 38, p = 0.628. An investigation of the relationship between these variables using the Pearson product-moment correlation (see Table 4.5) produced similar results, r = -0.023, n = 38, p = 0.891.

When partial correlation was applied to further explore this relationship between Public Finance and Private Finance whilst controlling for Project Capacity, Average Tariffs and Long-term Interest Rates, a negative, moderate, significant partial correlation between the two variables emerged, r = -0.537, n = 33, p = 0.001 (Table 4.6). Since the magnitude of r improved from -0.023 to -0.537, the relationship between Public Finance and Private Finance is not explained by Project Capacity, Average Tariff, and Long-term Interest rates. Partial correlation has shown that these variables were actually suppressing the negative relationship between Public Finance and Private Finance. From the coefficient of determination ($r^2 = -0.537^2 = 0.288$), Public Finance alone can help to explain approximately 29% of the variance in Private Finance.

This means that, for the projects analysed, there was a tendency for private finance invested to decrease as public finance increased. High levels of public finance are associated with lower levels of private finance. This may be suggesting crowding out of private finance by public finance. This would seem to be close to a finding by Wall et al. (2018) that public finance has a negative relationship with FDI in renewables. However, this would be in contradiction to the findings of the majority of scholars. Rodríguez et al. (2014) found out that renewable energy projects that are provided with public finance attracted private finance and did not find sufficient evidence of public finance crowding out private finance. Erden and Holcombe (2006) arrived at a similar conclusion that public finance complements private finance.

Tables 4.4, 4.5, 4.7, and 4.10 show that there was a strong, positive correlation between Green finance (Private and Public Finance) and Project Capacity, regardless of the correlation technique used. This was expected since the larger the project, in terms of the megawatts of electricity generated, the larger the amounts that would have been invested. Project Capacity was included in this study as it was expected to have a relationship with Average Tariff and would influence the relationship between Green finance and Policy (measured by tariffs). This relationship between Project Capacity and Average Tariff was confirmed, as indicated in Table 4.4, *rho* = -0.646, *n* = 38, $p < 0.001$.

Spearman correlation test results as given in Table 4.4 point out that, there was a weak, negative non-significant correlation between Private Finance and Average Tariff, *rho* = -0.232, *n* = 38, *p* = 0.161. The same weak, negative and non-significant correlation was obtained between these variables when the Pearson correlation test was conducted, as Table 4.5 shows. Similar results manifested when the relationship between Public Finance and Average tariff was examined using Spearman and Pearson correlation tests. Spearman results show *rho* = -0.206, *n* = 38, *p* = 0.216 and Pearson results indicate *r* = -0.148, *n* = 38, *p* = 0.375. These findings were not expected. The expectation was that Green financial flows would increase with an increase in tariffs; since higher tariffs translate into higher revenue amounts for the projects, and possibly higher profits for investors. Therefore, higher tariffs should be associated with higher levels of Green finance.

The relationships between Average Tariff and Green finance components (Private and Public Finance) was then explored using partial correlation. Table 4.8 shows that upon controlling for Long-term Interest Rates, Project Capacity, and Public Finance, the relationship between Private Finance and Average Tariff showed a positive, moderate, significant partial correlation, *r* = 0.383, *n* = 33, *p* = 0.023. This means that there was a moderate tendency for private finance flows to increase as tariffs increased and vice-versa; this is aligned with the results of other studies. For example, Haščič et al. (2015) and Rodríguez et al. (2014) found that tariffs have a positive relationship with private finance. The calculation of the coefficient of determination ($r^2 = 0.383^2 = 0.147$) reveals that the variation in tariffs alone assists in explaining nearly 15% of the variability in private finance invested in the sample of RE projects.

As Table 4.11 depicts, while controlling for Long-term Interest Rates, Private Finance, and Project Capacity, there was a weak, positive, partial correlation between Public Finance and Average Tariff, *r* = 0.310, *n* = 33, *p* = 0.07. This correlation did not attain statistical significance at *p* = 0.05 level, although the *p*-value is close to 0.05. However, according to Pallant (2011, p. 135), "The level of statistical significance does not indicate how strongly the two variables are associated (this is given by r or rho), but instead it indicates how much confidence we should have in the results obtained."

Therefore, the application of partial correlation indicates that there is evidence to show that there was a tendency for Green finance invested in the RE projects to decrease as tariffs paid to these projects by ESKOM decreased and vice-versa. This was more the case with private finance than with public finance.

The results in Tables 4.4 and 4.5 show that when Spearman and Pearson correlation tests were employed to investigate the relationship between Private Finance and long-term Interest Rates, there was no meaningful correlation between the variables. The relationship was then examined using partial correlation whilst controlling for Project Capacity, Public Finance, and Average Tariff. As indicated in Table 4.9, a weak, negative partial correlation was recorded, r = -0.274, n = 33, p = 0.112. The correlation did not reach statistical significance and this is almost in line with Dakin's (2015) finding, that in South Africa interest rates have no effect on private investments.

An investigation of the relationship between Public Finance and Long-term Interest Rates produced similar results. According to the Spearman' rho, there was no meaningful relationship between the variables, *rho* = -0.024, n = 33, p = 0.887 (see Table 4.4). Pearson correlation result in Table 4.5 shows that, there was a weak, negative correlation between the variables, r = -0.158, n = 33, p = 0.345. Both correlations did not attain statistical significance.

Partial correlation was then used to control for Project Capacity, Average Tariff, and Private Finance, as indicated in Table 4.12. There was a moderate, negative partial correlation between Public Finance and Long-term Interest Rates, r = -0.356, n = 33, p = 0.036. This confirmed the expected negative association between green investments and interest rates. RE projects financing is expected to decrease when interest rates increase and vice-versa, due to reliance on external financing (Eyraud et al., 2013). Using the coefficient of determination, $r^2 = -0.356^2 = 0.127$, the changes in interest rates can help to explain approximately 13% of the variation in Public Finance. These results suggest that there was a weak to a moderate tendency for Green finance to increase or decrease when interest rates decrease or increase, respectively. This was more the case with public finance than with private finance. This may be explained by the way DFIs fund their activities (for the projects in this study, public finance came from DFIs). DFIs raise funds, for onward lending, from capital markets (Humphrey, 2017). Therefore, low interest rates motivate DFIs to borrow using bonds, for example. This then makes it easy for DFIs to lend out the raised funds at lower rates to their clients (Humphrey, 2017).

Summary of findings on the relationship between Green finance and the RE Policy in South Africa

The above correlation analyses show that, for the sample of renewable energy projects that were studied, Spearman' rho and Pearson coefficient correlations showed no significant relationship between Green finance (as measured by private and public finance amounts invested) and the REIPPPP policy, when the policy influence was measured by tariffs paid to RE producers. However, while controlling for other possible intervening variables, a moderate, positive, correlation was observed between Green finance and the REIPPPP policy. This suggests that there was a tendency for green financial flows invested in the projects to increase, or decrease, as tariffs paid increase or decrease, respectively.

This study also found evidence of a tendency by private finance flows to decrease with an increase in public finance invested in the projects, suggesting a possible crowding out of private finance by public finance. In addition, there was also evidence of a weak to moderate, negative association, between Green finance and Long-term Interest rates.

4.3.2 Green Growth Descriptive Analysis Results

Table 4.2 shows descriptive statistics for South Africa's green growth variables. The same variables' descriptive statistics for other BRICS countries and Germany are presented in Appendix C. Table 4.13 and 4.14 show the growth rates for the variables. The growth rates were calculated by using the compound growth rate formula as given in section 3.5.2.

Table 4.13 *Green growth indicators growth rates (2004-2009)*

	CO2 intensity	CO2 emissions	Energy intensity	R. Electricity	Forests	PM2.5	Real GDP/capita
Germany	-2.01%	-2.19%	-1.60%	11.65%	1.01%	0.22%	0.76%
Brazil	-0.15%	0.93%	1.65%	0.68%	33.08%	-4.16%	2.46%
Russia	-0.52%	-0.65%	0.12%	-1.42%	68.28%	3.41%	4.05%
India	6.42%	8.03%	4.37%	1.58%	-	-0.60%	6.74%
China	7.65%	8.26%	6.69%	1.95%	-	1.52%	10.83%
South Africa	0.15%	1.25%	1.27%	6.43%	-0.95%	0.33%	2.41%

Source: Author's calculations using data from OECD (2018b)

Note: India and China had missing values for Forests

Table 4.14 *Green growth indicators growth rates (2010-2015)*

	CO2 intensity	CO2 emissions	Energy intensity	R. Electricity	Forests	PM2.5	Real GDP/capita
Germany	-0.98%	-0.78%	-1.34%	11.81%	1.73%	-5.51%	1.45%
Brazil	3.06%	4.00%	1.38%	-2.68%	-0.04%	-2.64%	0.16%
Russia	-0.90%	-0.80%	0.51%	-0.33%	9.92%	-3.30%	1.39%
India	4.03%	5.32%	2.92%	-0.89%	-	2.34%	5.27%
China	2.69%	3.24%	2.67%	5.14%	-	0.67%	7.29%
South Africa	-0.38%	1.01%	-1.31%	18.91%	-8.95%	-1.88%	0.81%

Source: Author's calculations using data from OECD (2018b)

Note: India and China had missing values for Forests

CO2 Emissions and CO2 Intensity

Table 4.2 shows that between 2004 and 2015, South Africa's annual average of CO2 emissions due to the burning of fossil fuels was 402.58 million tonnes (Mton) of CO2. South Africa's average was lower than the German's and other BRICS nations except for Brazil which had an average of 374.63 Mton. The other countries' figures are found in Appendix C. Figure 4.1 shows a comparison of the amounts of CO2 emitted by these countries per year.

When these emissions were measured per capita (CO2 intensity), South Africa, with an annual average of 7.81 tonnes per capita, was the second worst CO2 emitter per person among BRICS nations. Russia occupied the pole position with a yearly average of 10.57 tonnes of CO2 per capita. India was the lowest CO2 emitter per person recording 1.24 tonnes, followed by Brazil (1.91 tonnes per capita) and China (5.39 tonnes per capita). Germany emitted an annual average of 9.33 tonnes of CO2 per capita. Figure 2 shows the trends of CO2 intensity for these countries.

If growth rates of these indicators are considered, Tables 4.13 and 4.14 reveal that between 2004 and 2009, South Africa's CO2 intensity grew by 0.15% per year but decreased by 0.38% annually during the 2010-2015 period. The country's CO2 emissions growth rates showed a similar encouraging trend. Table 4.13 shows that these emissions grew by 1.25% annually in the initial period, but slowed down to a yearly rate of 1.01% over the 2010-2015 period. When these rates are compared to estimates in other BRICS countries, South Africa outperformed the rest except for Russia, which recorded negative growth rates of CO2 intensity and CO2 emissions for both periods. These results are similar to those reported by Kutan et al. (2018).

In their study of Brazil, India, China, and South Africa, over the years 1990 to 2012, China recorded the highest CO2 emissions growth rate and South Africa recorded the lowest figure (Kutan et al., 2018).

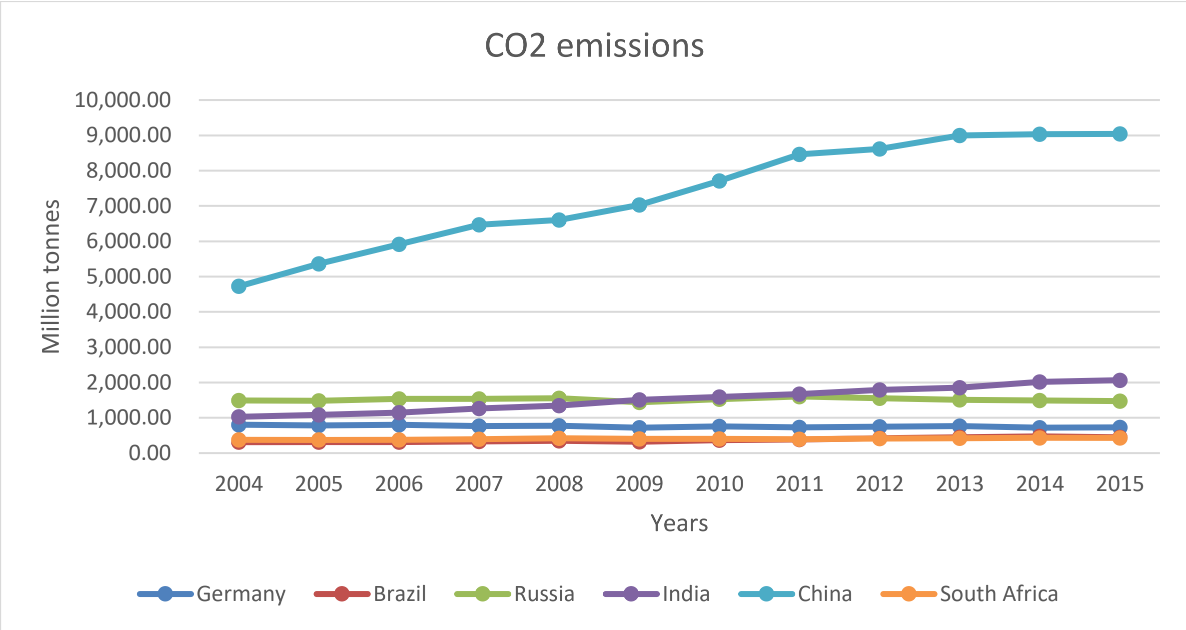


Figure 4.1: CO2 emissions trends

Source: Generated by the author using data from OECD (2018b)

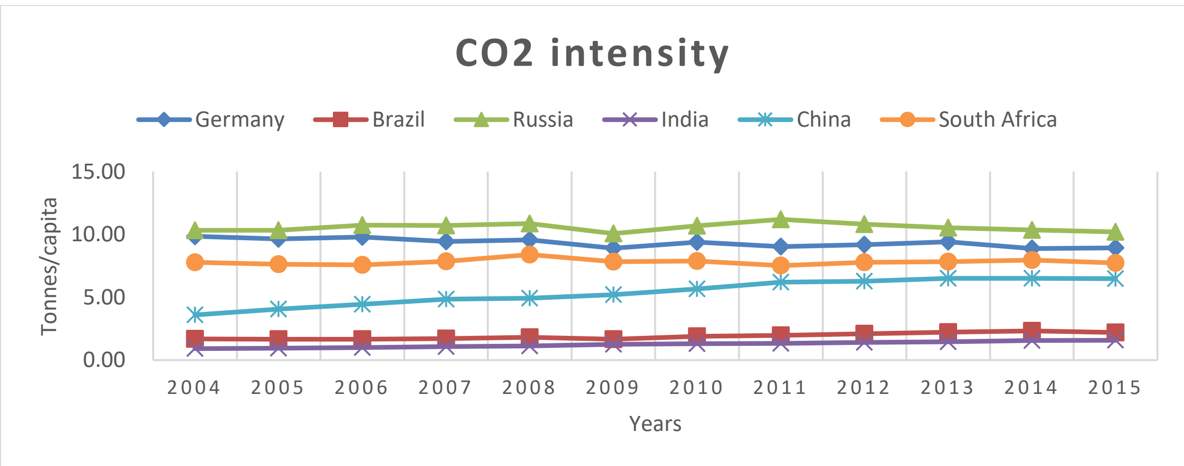


Figure 4.2: CO2 intensity trends

Source: Generated by the author using data from OECD (2018b)

Energy Intensity and Renewable Electricity

Table 4.2 shows that South Africa's TPES per capita averaged 2.69 toe, over the years 2004 to 2015. As depicted in Appendix C(3), between 2004 and 2015, South Africa's economy was more energy intense than India and China combined (2.3 toe) and only Russia, at 4.81 toe annual average, was more energy intense than South Africa in the BRICS block of nations. Figure 4.3 compares the energy intensity of these countries. However, Tables 4.13 and 4.14 show that, at an annual average growth rate of 1.27%, South Africa's energy intensity grew at a slower rate than other BRICS countries with the exception of Russia, which recorded a yearly average of 0.12%, over the 2004-2009 period. South Africa further improved its energy intensity during the 2010-2015 period. The country's energy intensity decreased at an annual rate of 1.31% over that period, thus recording the best performance among the BRICS nations and coming close to Germany's rate of -1.34%. This indicates that although South Africa showed to be a high energy-intense country, it was becoming more energy efficient over the analysed period.

With regard to the share of electricity generated from renewable sources, South Africa's 0.9% was the lowest percentage. Brazil scored the highest with an average of 83.28% of its electricity coming from renewable sources. India, Russia, Germany, and China averaged between 16.39 and 18.42% (see Appendix C(4)). This indicates a relatively heavy dependence of the South African economy on fossil fuels. An illustration of the share of electricity generated from renewables per country per year is shown in Figure 4.4. As indicated in Tables 4.13 and 4.14, at an average annual growth rate of 6.43%, South Africa mainstreamed renewable electricity at a faster rate than any other BRICS country over the years 2004-2009. South Africa even surpassed Germany's renewable energy adoption rate during the 2010-2015 period to achieve an annual adoption rate of 18.91%. These results are similar to findings by Kutan et al. (2018). Kutan et al. (2018) found that in a sample of these countries, excluding Russia and Germany, Brazil and South Africa recorded high RE consumption growth rates between 1990 and 2012.

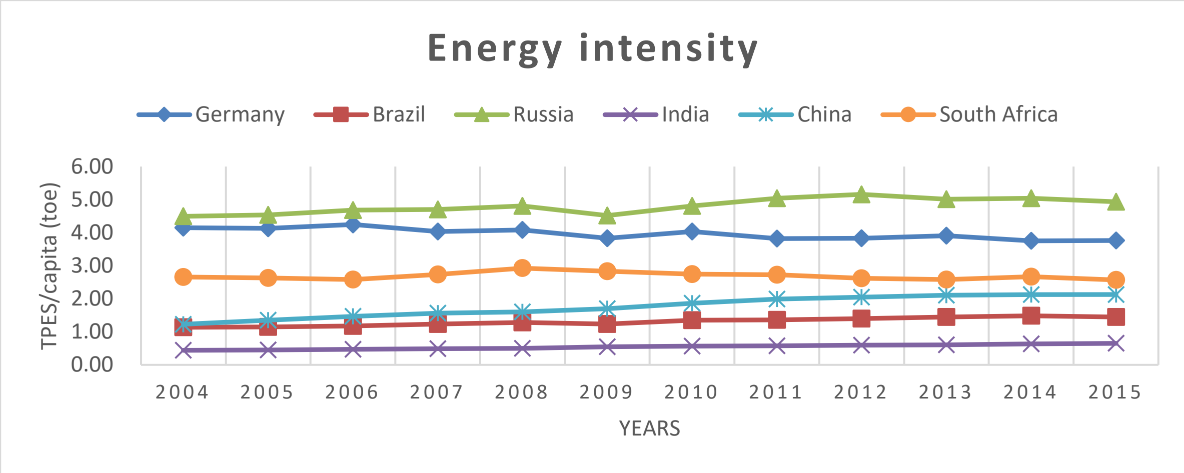


Figure 4.3: Energy intensity trends

Source: Generated by the author using data from OECD (2018b)

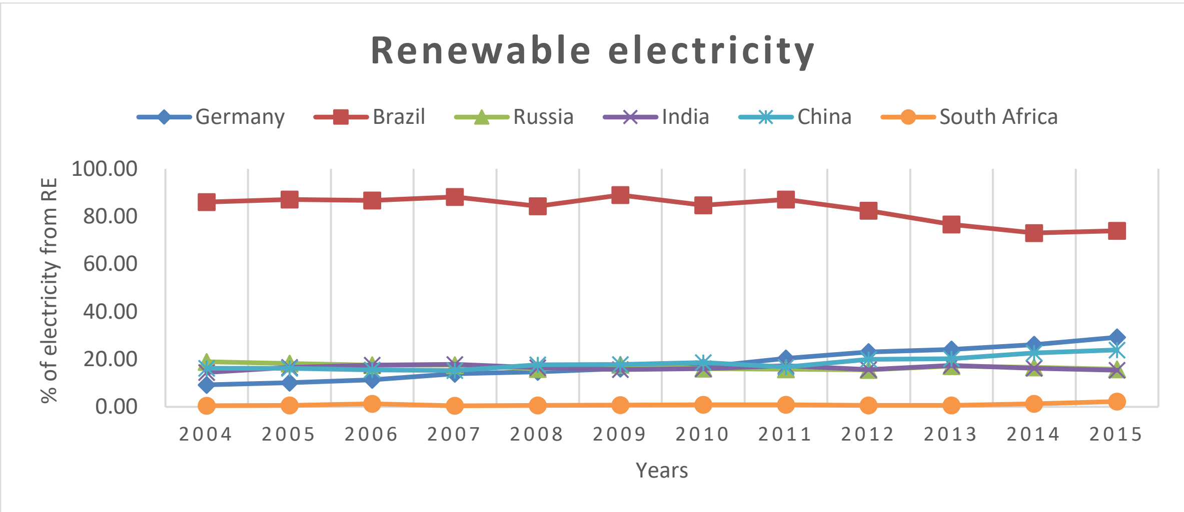


Figure 4.4: The share of renewable electricity in total electricity generation

Source: Generated by the author using data OCED (2018b)

Forests

Table 4.2 indicates that South Africa's forests under sustainable management reached an annual average of 17.68% of the country's total forest area, during the period 2004 to 2014. On this indicator, South Africa performed better than all the other BRICS countries, as Appendix C(5) shows. Only Germany with an annual average of 68.16% recorded a higher figure than South

Africa. Figure 4.5 illustrates the trends of forests under sustainable management over the period of analysis.

As is evident from Tables 4.13 and 4.14, South Africa recorded a negative annual growth of 0.95% for the number of forests under sustainable management during the years 2004-2009. This rate reduced even faster to -8.95% annually during the subsequent years up to 2014. This made the country the worst performer when compared to Brazil, Russia, and Germany. Data was not complete for China and India. The results show that South Africa is losing previous gains on this indicator of green growth.

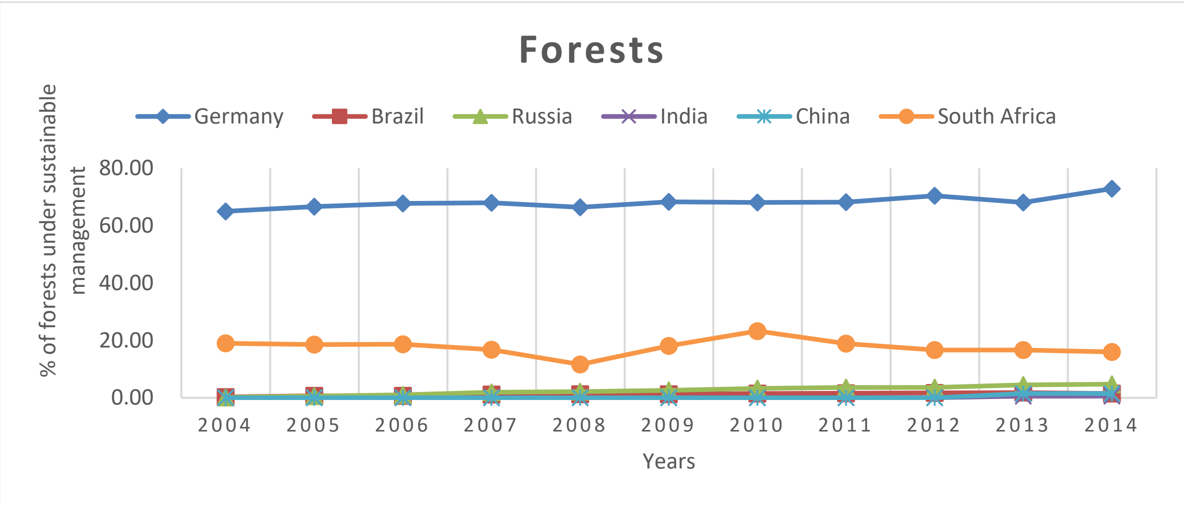


Figure 4.5: Forests under sustainable management trends

Source: Generated by the author using data from OECD (2018b)

Air Pollution (PM2.5)

South Africans' exposure to air pollution in the form of particulates averaged 20.35 micrograms per cubic metre annually, as shown in Table 4.2. This is gravely above the recommended WHO figure of 10 micrograms per cubic metre (WHO, 2016). Compared to other BRICS countries (figures in Appendix C(6)), South Africa performed better than India (51.15) and China (48.46) but worse than Brazil (10.17) and Russia (15.33). Germany recorded an annual average of 14.26 micrograms of particulates per cubic metre. The trends of air pollutions are shown in Figure 4.6. As indicated in Tables 4.13 and 4.14, air pollution in South Africa grew at an annual rate of 0.33% from 2004 to 2009 but decreased at a yearly rate of 1.88% over the period 2010-2014. This shows that, despite high levels of air pollution recorded by South Africa, there is evidence that air pollution was declining during the second period of analysis. This seems to connect with the observed decreasing CO2 emissions. The country performed better than India and China but worse than Germany, Russia and Brazil.

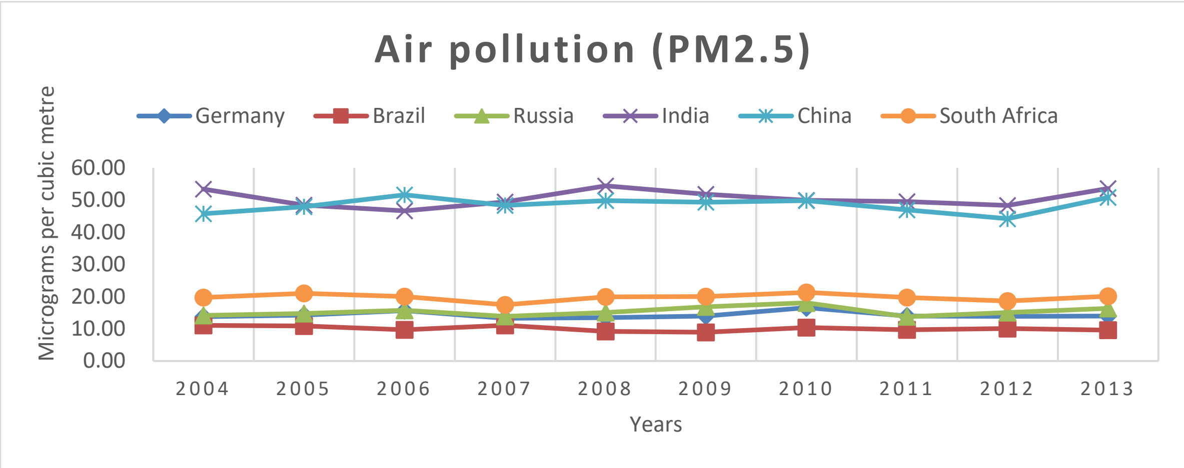


Figure 4.6: Air pollution trends

Source: Generated by the author using data from OECD (2018b)

Real GDP per capita

Over the years 2004 to 2015, as denoted in Table 4.2 and Appendix C(7), South Africa's annual average for real GDP per capita was USD 11524.21 making the country's average real GDP per capita figure the third highest in the BRICS group. The standard of living was higher in South Africa than in China and India but lower than in Germany, Russia and Brazil. Figure 4.7 shows the real GDP per capita per year for these countries, over the period of analysis.

Even though South Africa recorded a higher annual average for real GDP per capita than China and India from 2004 through to 2015, the country recorded the lowest rate of growth for this measure of living standard among the BRICS countries between 2004 and 2009 (Table 4.13). This rate of growth even dropped to 0.81% annually over the years 2010 to 2015, doing better than only Brazil (0.16%) in the BRICS block (Table 4.14). This shows that South Africans became relatively poorer during the years 2004 to 2015, thus negatively impacting the country's performance on this socio-economic indicator of sustainable development. A Summary of the findings on South Africa's progress towards green growth is given in Table 4.15.

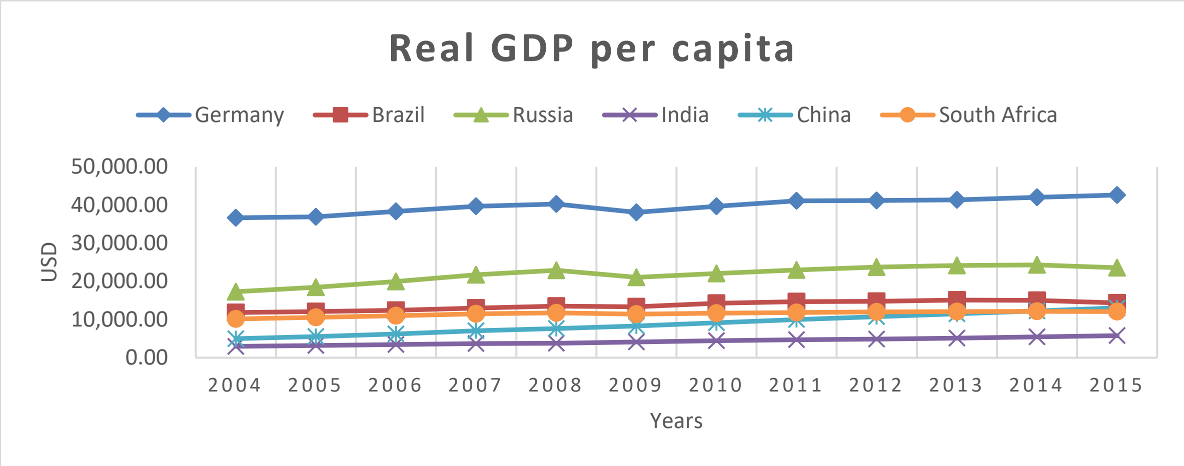


Figure 4.7: Real GDP per capita trends

Source: Generated by the author using data from OECD (2018b)

Table 4.15 *Summary of findings on South Africa's progress towards Green growth*

Indicator	**Progress towards Green growth**
CO2 emissions	- South Africa's CO2 total emissions annual growth rate declined from 1.25% between 2004 and 2009 to 1.01% over the years 2010 to 2015. - On average, from 2004 to 2015, South Africa emitted less CO2 from burning fossil fuels than China, India, Russia, and Germany. Only Brazil emitted less CO2 than South Africa. Conclusion - South Africa is progressing well on this indicator. The country's CO2 emissions declined over the period analysed.
CO2 intensity	- Between 2004 and 2015, South Africa was the second worst emitter of CO2 per capita among BRICS countries. - South Africa's CO2 intensity declined at an annual rate of 0.38% from 2010 to 2015, outperforming all other BRICS nations except for Russia.

	Conclusion – South Africa has recorded good progress on this indicator. Although it had the second highest CO2 intensity among BRICS countries, a negative rate of growth was recorded.
Energy intensity	- Between 2004 and 2015, South Africa was the second most energy-intensive countries in the BRICS block. However, over the years 2010 to 2015, South Africa's energy intensity declined at an annual rate of 1.31%. Conclusion – Although South Africa showed good progress on this indicator, by recording a negative growth rate between 2010 and 2015, the country was still of one the least energy-efficient BRICS countries.
Renewable electricity	- At an annual RE adoption rate of 18.91% between 2010 and 2015, South Africa mainstreamed renewable electricity faster than all other BRICS countries and Germany. However, at 0.9%, South Africa recorded the lowest average percentage share of electricity generated from renewables over the period 2004 to 2015, indicating a heavy reliance on CO2 emitting fossil fuels. Conclusion – South Africa is making good progress to increase its percentage of electricity generated from RE. However, the country is coming from a very low base.
Forests	- Over the years 2004 to 2014, South Africa recorded the highest annual average percentage of forests under sustainable management (17.68% of total forest area) among BRICS nations. Germany recorded 68.16%. - Between 2004 and 2009 the area of forests under sustainable development in South Africa declined at an annual rate of 0.95% and at an annual rate of 8.95% from 2010 to 2014. The country recorded the worst performance relative to Brazil, Russia, and Germany. Conclusion – South Africa started off very well on this indicator but showed to be regressing, as the number of forests under sustainable development was declining.
Air pollution	- South Africa's air pollution due to particulates (PM2.5) reached an annual average of 20.35 micrograms per cubic metre (WHO

	recommends 10 micrograms per cubic metre) between 2004 and 2015. - PM2.5 reached an annual growth rate of 0.33% between 2004 and 2009. It decreased at an annual rate of 1.88% over the years 2010 to 2014. South Africa performed better than India and China but worse than Germany, Russia, and Brazil. Conclusion – Though South Africa recorded a comparatively high level of air pollution, it achieved a negative growth rate of air pollution.
Real GDP per capita	- At an average Real GDP per capita of USD 11524.21 between 2004 and 2015, South Africa's standard of living was higher than that of China and India but lower than in Germany, Russia, and Brazil. - The growth rate of this indicator dropped from an annual rate of 2.41% between 2004 and 2009 to an annual rate of 0.81% over the years 2010 to 2015. Only Brazil recorded a lower figure than South Africa during the period 2010 to 2015. Conclusion – South Africa performed poorly on this indicator.

Source: Author's compilation

4.5 Validity and Reliability

Since this study used secondary data, validity and reliability could not be addressed in the traditional sense as they would have been dealt with for primary data collection instruments (Kumar, 2011). However, this study followed suggestions by Saunders et al. (2016) on ways to address validity and reliability concerns of secondary data. Firstly, measurement validity was assumed to be present because the data was suitable to answer the research questions and meet the research objectives. Secondly, reliability was addressed by checking data suitability for analysis. Finally, validity and reliability were assumed to be present because the secondary data was sourced from reputable organisations indicated in chapter three. Data from big reputable organisations tend to be reliable since they have a reputation to protect for them to continue to exist and these organisations tend to follow international best practices of reporting.

4.6 Chapter Conclusion

This chapter discussed the findings of the correlation and descriptive statistical analyses that were carried out in order to answer the research questions. The next chapter concludes the study by giving a summary of the study, policy recommendations of the findings, and avenues for future research.

Chapter 5: Conclusions and Recommendations

5.1 Introduction

The objectives of this study were to: investigate the relationship between Green finance and the RE Policy in South Africa and to investigate South Africa's progress towards Green growth. This chapter covers the summary and conclusions of the study, policy recommendations of the findings and suggests avenues for future research.

5.2 Summary and conclusions of the study

Correlation analysis was employed to investigate the relationship between Green finance (as measured by private finance and public finance amounts invested) and the REIPPPP (as measured by tariffs paid to RE producers). The study's findings indicate that: there was a general tendency for green finance invested in the RE projects to increase or decrease with an increase or decrease in tariffs, respectively. In other words, there was a positive correlation between the REIPPPP and the amounts of green finance invested in the sample of RE projects over the period reviewed. This positive association was more pronounced in the case of private finance than with public finance. This may be due to the differences in investment motives between these two sources of finance. Private investors follow profits and public investments can be done for other reasons other than profits. For example, DFIs may invest to achieve social development outcomes (Gumede, Govender, & Motshidi, 2011).

The implications of these findings are: reductions in tariffs paid to REIPPs, due to the auction process, may result in decreased levels of green finance invested in the RE sector. This is contrary to one of the goals of the REIPPPP, which is to induce investments in the RE sector and thus increase RE consumption. Consumption of RE is a necessary component of the process of moving towards sustainable development (Bhattacharya et al., 2016). The observed positive association may also mean that to attract more financial flows, especially private, into South Africa's RE sector, tariffs have to increase. However, this may result in high end-user prices of electricity.

The study also found that there was a tendency for private financial flows, invested in the analysed projects, to decrease as the level of public finance increases and vice-versa. This suggests there was crowding out of private finance by public finance in the projects studied; implying that these two sources of finance were not complementing each other. Lastly, an additional result from the correlation analysis was that long-term interest rates showed a weak to moderate negative correlation with green finance. Weak in the case of private finance and moderate in the case of public finance. The relationship was statistically significant only in the case of public finance. This suggests that DFIs favour a low-interest rates environment.

Descriptive statistical analysis was used to investigate South Africa's progress towards green growth and the findings indicate that: on the CO2 emissions and CO2 intensity indicators, although South Africa was among the highest CO2 emitters per capita, the country has been making some encouraging progress on these indicators. The rate of growth of South Africa's CO2 emissions has been slowing down over the period analysed and also the country's CO2 intensity has actually been declining from 2010 to 2015. These are good signs that, if the trends are maintained, South Africa may be on its way to meet its global commitments on reducing CO2 emissions and progressing towards sustainable development.

The foregoing findings appear to have a link to, or may be explained by, the findings on energy intensity and RE mainstreaming. Over the period of analysis, South Africa's energy intensity declined and the country outperformed all BRICS nations and Germany with regard to the rate of RE mainstreaming. These findings may be pointing to the success of the REIPPPP in inducing investments in the renewable energy sector. The country has begun to record world-class performance with regard to mainstreaming renewable energy. If the observed average annual renewable energy adoption rate of 18.91% is maintained or improved, then South Africa's reliance on fossil fuels will eventually decrease. This will reduce CO2 emissions, thus helping the country achieve more green growth and transition towards sustainable development. Notwithstanding such progress, South Africa still remained one of the less energy-efficient BRICS countries, between 2004 and 2015. This has negative implications for the country's progress towards green growth since energy efficiency is one of the drivers of green growth (Winkler & Marquand, 2009).

On the Forests indicator of sustainable development, the findings indicate that South Africa initially performed very well to a point of recording the best performance among BRICS nations. However, the number of forests under sustainable management in South Africa has been declining, which means that the country is regressing on this indicator of green growth, thus impacting negatively on progress towards sustainable development.

With regard to air pollution, South Africa recorded approximately twice the WHO recommended level. This is a concern, considering that air pollution is responsible for three million deaths annually around the world (WHO, 2016). However, the country made good progress to reduce air pollution as evidenced by a negative growth rate of PM2.5 between 2010 and 2015.

South Africa's standard of living has been declining steadily, over the years 2004 to 2015, as is evident from declining rates of growth of real GDP per capita. This poor performance by South Africa on this indicator has negative implications on the country's aspirations to reduce poverty and socio-economic inequalities.

5.3 Policy Recommendations of the Findings

The primary objective of the REIPPPP is to induce investment flows into the RE sector, so as to reduce South Africa's dependency on coal-generated energy, thus helping to reduce CO2 emissions. Literature reviewed show that the tariffs ESKOM is paying to the REIPPs are on a downward trend, which is good for the consumer as this will help to keep the price of electricity down. However, according to the finding of this study that Green finance showed a positive correlation with tariffs, this downward trend of tariffs may lead to a decrease in the level of Green finance invested in the RE sector. This may signify that the REIPPPP would have to include other financial incentives to attract investments in the RE sector. For example, favourable tax incentives for REIPPs on one hand and environmental taxes for fossil-fuel based energy, on the other hand, are possible interventions. The tax amounts levied on carbon energy can then be used to subsidise RE consumption.

Tax incentives, such as reduced tax rates for REIPPs, were found to have a positive influence on investment flows in the RE sector (Wall et al., 2018). Increasing tax levies on fossil-fuel based energy or cutting subsidies on them, assist in encouraging RE investments (Eyraud et al., 2013). Similarly, subsidies have been used to encourage production and consumption of RE;

Germany is one country where this intervention has succeeded in attracting RE investments (Anbumozhi et al., 2018).

Given the other finding that there was a tendency for private finance invested in the REIPPPP projects to decrease as public finance flows increase, suggesting possible crowding out, the role being played by public finance may need to be refined. For example, public finance should be used to address investment difficulties that private investors face (IRENA, 2016). Public finance should mainly be used for risk mitigation (IRENA, 2016; Mohamed et al., 2014). Another possible policy intervention would be to restrict public finance to small projects, as is the case in Germany where government banks finance is restricted to small projects (Anbumozhi et al., 2018). Alternatively, public finance can be restricted to a subordinated role in big projects, as is the case with European Investment Bank loans in the European RE sector (Anbumozhi et al., 2018).

Looking at the findings that South Africa was the second worst CO2 emitter per capita; recorded high levels of air pollution; and was one of the least energy efficient countries, points to the need to further reduce the country's dependence on coal energy and to promote energy efficiency. Several studies have reported that RE consumption and promoting energy efficiency, considerably reduce a country's CO2 emissions (Kutan et al., 2018; Meltzer, 2016; OECD, 2011; Winker, 2009). The WHO posits that increasing the consumption of RE and improving energy efficiency helps to reduce air pollution and generates benefits for human health and sustainable development. One of the findings of this research has been that South Africa's rate of mainstreaming renewable electricity has been impressive to a point of outperforming all BRICS nations from 2004 to 2015. However, at less than 1%, South Africa recorded the lowest percentage of RE consumption, relative to other BRICS nations. Therefore, more needs to be done to accelerate investment flows into the RE sector in order to increase RE consumption and remain on track with the implementation of the green growth strategy.

A possible action that could be taken by the Government to induce more financial flows in the RE sector, is to deliberately refine the master energy policy for South Africa, the IRP, so as to place more emphasis on the use of renewable energy sources of electricity over coal-fired power plants that the state-owned power utility, ESKOM, continue to invest in. That is to say, the policy should be designed to intentionally create a market for RE (Mazzucato, 2016); this has been proven to work in countries such as Germany. The Renewable Energy Sources Act in

Germany has been designed to prioritise RE thus creating a market for it (Anbumozhi et al., 2018). The goal should be to move progressively towards having renewable energy dominate the country's energy mix. This will assist the country in achieving its international CO2 emissions obligations. The current situation where renewable energy plays a comparatively marginal role is, in the long run, not sustainable. The IRP should clearly set RE policy targets and instruments that will accelerate RE adoption.

The argument has been that electricity procured from RE independent power producers through the REIPPPP policy is expensive. However, this assertion has proven to be wrong by several studies, for example, Kruger and Eberhard (2018) found out that as at REIPPPP Bid Window 4, the average cost of supply for solar PV and wind energy has become cheaper than ESKOM's. In their IPPPP overview, DoE et al. (2018) concluded that the actual average contracted price that ESKOM has been paying to the Independent Power Producers (IPPs) has progressively been decreasing over successive Bid Windows. In any case, the findings of this study that South Africa recorded the highest rate of adoption of renewable energy and the slowing down of the country's CO2 emission, between 2010 and 2015, points to the success of the REIPPPP policy in helping to reduce the country's reliance on carbon energy. Given these findings, the South African Government should remain resolute in its implementation of the REIPPPP and not give in to pressure from ESKOM and the labour movement to discontinue the policy instrument. Thus the findings may inform the REIPPPP policy debate on whether to terminate or continue with the policy.

The finding that the number of forests under sustainable management in South Africa is declining points to the need for policy intervention to deliberately encourage the planting of trees and increase the number of forests being managed sustainably. The poor real GDP per capita growth rates recorded by South Africa, indicate that the economy is not growing fast enough to keep pace with the growing population. Supporting the development of a domestic RE equipment manufacturing industry has created jobs in other countries. For example, in Germany, such an industry has created 333 000 jobs in 2015 (Anbumozhi et al., 2018). Therefore, supporting local production of RE equipment in South Africa should help grow the economy and create jobs. Growth can also come from further greening of the economy. This can be done by replicating the relevant elements of the REIPPPP, that has made it succeed in growing the RE sector, in other sectors of the economy such as transport, agriculture, and natural resource management. These sectors were already identified by the South African Government as central to driving the country's green growth.

5.4 Avenues for future research

Given that this study ventured into a relatively new research area and faced data limitations, one suggestion for future research is to conduct a similar study in the future using a different data analysis technique such as regression, when more data is available. This will allow the investigation of causality between Green finance and the REIPPPP policy. Availability of more data in the future will also permit the use of probability sampling which will, in turn, allow for the generalisation of findings. Another possible future research question that may be pursued is: What are the determinants of Green finance investment in the renewable energy sector of South Africa? The Green finance investment function in South Africa's renewable energy sector can then be estimated using econometric modelling as more data become available.

Reference List

Ababio, J. O., Kumankoma, E. S., & Osei, K. A. (2018). Financing cost and private investment in Ghana. *Advances in Economics and Business*, *6*(2), 99–113.

Abdmouleh, Z., Alammari, R. A. M., & Gastli, A. (2015). Review of policies encouraging renewable energy integration & best practices. *Renewable and Sustainable Energy Reviews*, *45*, 249–262.

Adams, S., Kwame, E., Klobodu, M., & Apio, A. (2018). Renewable and non-renewable energy, regime type and economic growth. *Renewable Energy*, *125*, 755–767.

Anbumozhi, V., Kalirajan, K., & Kimura, F. (Eds.). (2018). *Financing for low-carbon energy transition: Unlocking the potential of private capital*. Singapore, Singapore: Springer Nature Singapore Pte Ltd.

Apergis, N., & Ozturk, I. (2015). Testing Environmental Kuznets Curve hypothesis in Asian countries. *Ecological Indicators*, *52*, 16–22.

Baddeley, M. C. (2003). *Investment: Theories and analysis*. New York, NY: Palgrave Macmillan.

Baker, L. (2015). The evolving role of finance in South Africa's renewable energy sector. *Geoforum*, *64*, 146–156. https://doi.org/10.1016/j.geoforum.2015.06.017

Balcilar, M., Ozdemir, A. Z., Ozdemir, H., & Shahbaz, M. (2018). The renewable energy consumption and growth in the G-7 countries: Evidence from historical decomposition method. *Renewable Energy*, *126*, 594–604. https://doi.org/10.1016/j.renene.2018.03.066

Barbier, E. (2011). The policy challenges for green economy and sustainable economic development. *Natural Resources Forum*, *35*(3), 233–245. https://doi.org/10.1111/j.1477-8947.2011.01397.x

Bhattacharya, M., Reddy, S., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy*, *162*, 733–741. https://doi.org/10.1016/j.apenergy.2015.10.104

Bielenberg, A., Kerlin, M., Oppenheim, J., & Roberts, M. (2016). *Financing change: How to mobilize private-sector financing for sustainable infrastructure*. McKinsey Center for Business and Environment. Retrieved from http://www.indiaenvironmentportal.org.in/files/file/Financing_change_How_to_mobilize_private-sector_financing_for_sustainable_infrastructure.pdf

Bilgili, F., Koçak, E., & Bulut, Ü. (2016). The dynamic impact of renewable energy consumption on CO2 emissions : A revisited Environmental Kuznets Curve approach. *Renewable and Sustainable Energy Reviews, 54,* 838–845. https://doi.org/10.1016/j.rser.2015.10.080

BMI. (2018). *BMI Renewables key projects database: User guide and methodology*. Business Monitor International Research, London, UK. Retrieved from https://bmo-bmiresearch-com.uplib.idm.oclc.org/

Borel-Saladin, J. M., & Turok, I. N. (2013). The impact of the green economy on jobs in South Africa. *South African Journal of Science, 109*(9/10), 1–4.

Bowen, A., & Hepburn, C. (2014). Green growth: An assessment. *Oxford Review of Economic Policy, 30*(3), 407–422. https://doi.org/10.1093/oxrep/gru029

Bradlow, D., & Humphrey, C. S. (2016). *Sustainability and infrastructure investment: National development banks in Africa*. (No. 002. 10/2015). GEGI Working paper, Global Economic Governance Initiative, Boston University. https://doi.org/10.2139/ssrn.2802713

Bryman, A. (2012). *Social research methods* (4th ed.). New York, NY: Oxford University Press.

Bryman, A., & Cramer, D. (2005). *Quantitative Data Analysis with SPSS 12 and 13*. New York, NY: Routledge.

Calvello, A. A. (Ed.). (2009). *Environmental Alpha: Institutional investors and climate change*. Hoboken, New Jersey: John Wiley&Sons.

Cantore, N., Nussbaumer, P., Wei, M., & Kammen, D. M. (2017). Promoting renewable energy and energy efficiency in Africa: A framework to evaluate employment generation and cost effectiveness. *Environmental Research Letters*, *12*, 1–11.

Cedrick, B. Z. E., & Long, P. W. (2017). Investment motivation in renewable energy: A PPP approach. *Energy Procedia*, *115*, 229–238. https://doi.org/10.1016/j.egypro.2017.05.021

Christian, L., Roland, Z., & Thomas, D. (2015). *Measuring transformation towards a green economy in Germany*. (No. 2015/3). GWS Working paper, Institute of Economic Structures Research, Osnabrück. Retrieved from http://hdl.handle.net/10419/121459

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Harlow, England: SAGE Publications, Inc. https://doi.org/10.1016/j.math.2010.09.003

da Silva, P., Cerqueira, P. A., & Ogbe, W. (2018). Determinants of renewable energy growth in Sub-Saharan Africa: Evidence from panel ARDL. *Energy*, *156*, 45–54.

Dakin, N. J. (2015). *The effects of interest rates on investment spending: An empirical analysis of South Africa*. (Masters' thesis, Rhodes University, South Africa).

Dalby, P. A. O., Gillerhaugen, G. R., Hagspiel, V., Leth-Olsen, T., & Thijssen, J. J. J. (2018). Green investment under policy uncertainty and Bayesian learning. *Energy*, *161*, 1262–1281. https://doi.org/10.1016/j.energy.2018.07.137

DEA. (2011a). *National climate change response white paper*. Pretoria, South Africa: Department of Environmental Affairs. Retrieved from https://www.environment.gov.za/sites/default/files/legislations/national_climatechange_response_whitepaper_0.pdf

DEA. (2011b). *National strategy for sustainable development and action plan (NSSD 1)*. Pretoria, South Africa: Department of Environmental Affairs. Retrieved from www.environment.gov.za

DEA. (2012). *About green economy*. Department of Environmental Affairs, Pretoria, South Africa. Retrieved from https://www.environment.gov.za/projectsprogrammes/greeneconomy/about

DEAT. (2008). *People - planet - prosperity: A national framework for sustainable development in South Africa*. Pretoria, South Africa: Department of Environmental Affairs and Tourism. Retrieved from https://www.environment.gov.za/documents/strategicdocuments/nfsd

Death, C. (2014). The green economy in South Africa: Global discourses and local politics. *Politikon: The South African Journal of Political Studies*, *41*(1), 1–22. https://doi.org/10.1080/02589346.2014.885668

DoE. (2015). *State of renewable energy in South Africa*. Pretoria, South Africa: Department of Energy. Retrieved from www.energy.gov.za

DoE, National Treasury, & DBSA. (2018). *Independent power producers procurement programme: An overview as at 31 March 2018*. Pretoria, South Africa: Independent Power Producer Office. Retrieved from www.ipp-projects.co.za

Eberhard, A., Kolker, J., & Leigland, J. (2014). *South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons*. Washington, DC: Public-Private Infrastructure Advisory Facility. Retrieved from http://www.ee.co.za/article/south-africas-reippp-programme-success-factors-lessons.html

Eberhard, A., & Naude, R. (2016). The South African renewable energy independent power producer procurement programme: A review and lessons learned. *Journal Of Energy In Southern Africa*, *27*(4), 1–14.

Elliott, A. C., & Woodward, W. A. (2007). *Statistical analysis: Quick reference guidebook with SPSS examples*. Thousand Oaks, California: SAGE Publications, Inc.

Erden, L., & Holcombe, R. G. (2006). The linkage between public and private investment: A co-integration analysis of developing countries. *Eastern Economic Journal*, *32*(3), 479–493.

Eyraud, L., Clements, B., & Wane, A. (2013). Green investment: Trends and determinants. *Energy Policy*, *60*, 852–865. https://doi.org/10.1016/j.enpol.2013.04.039

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Thousand Oaks, California: SAGE Publications Ltd.

Georgeson, L., Maslin, M., & Poessinouw, M. (2017). The global green economy: A review of concepts, definitions, measurement methodologies and their interactions. *Geo: Geography and Environment*, *4*((1), e00036), 1–23. https://doi.org/10.1002/geo2.36

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Goldemberg, J. (2012). *Energy: What everyone needs to know*. New York, NY: Oxford University Press, Inc.

Gumede, W., Govender, M., & Motshidi, K. (2011). *The role of South Africa' s state-owned development finance institutions in building a democratic developmental state*. (No. 29). Development Planning Division Working paper, Development Bank of Southern Africa. Retrieved from https://www.dbsa.org/EN/About-Us/Publications/Documents/DPD No29. The role of South Africa's state-owned development finance institutions in building a democratic developmental.pdf

Hair, J. F., Celsi, M., Money, A. H., Samouel, P., & Page, M. J. (2011). *Essentials of business research methods* (2nd ed.). New York, NY: M. E. Sharpe, Inc.

Hall, S., Foxon, T. J., & Bolton, R. (2017). Investing in low-carbon transitions: Energy finance as an adaptive market. *Climate Policy*, *17*(3), 280–298. https://doi.org/10.1080/14693062.2015.1094731

Hardy, M., & Bryman, A. (Eds.). (2009). *The handbook of data analysis* (Paperback). London: SAGE Publications Ltd. https://doi.org/10.4135/9781848608184

Haščič, I., Rodríguez, M. C., Jachnik, R., Silva, J., & Johnstone, N. (2015). *Public interventions and private climate finance flows: Empirical evidence from renewable energy financing*. (No. 80). OECD Environment Working papers, OECD Publishing. Retrieved from https://www.oecd-ilibrary.org/environment/public-interventions-and-private-climate-finance-flows-empirical-evidence-from-renewable-energy-financing_5js6b1r9lfd4-en

Henneman, L. R. F., Rafaj, P., Annegarn, H. J., & Klausbruckner, C. (2016). Assessing emissions levels and costs associated with climate and air pollution policies in South Africa. *Energy Policy*, *89*, 160–170. https://doi.org/10.1016/j.enpol.2015.11.026

Huang, Y., & Quibria, M. G. (2013). *Green growth: theory and evidence*. (No. 2013/056). WIDER Working paper. Retrieved from http://hdl.handle.net/10419/81020

Humphrey, C. (2017). He who pays the piper calls the tune: Credit rating agencies and multilateral development banks. *Review of International Organizations*, *12*, 281–306. https://doi.org/10.1007/s11558-017-9271-6

IDFC. (2013). *Mapping of green finance delivered by IDFC members in 2012*. International Development Finance Club. Retrieved from https://www.idfc.org/Downloads/Publications/01_green_finance_mappings/IDFC_Green_Finance_Mapping_Report_2013_11-01-13.pdf

IEA/IRENA. (2018). *Global renewable energy policies and measures database*. International Energy Agency and International Renewable Energy Agency. Retrieved from http://www.iea.org/policiesandmeasures/renewableenergy/?country=South Africa

IFC. (2013). *Mobilizing public and private funds for inclusive green growth investment in developing countries*. Washington, DC: International Finance Corporation. Retrieved from www.ifc.org/climatebusiness

IJGlobal. (2018). *Transaction data*. IJGlobal Project Finance and Infrastructure Journal. Retrieved from https://ijglobal.com/data/search-transactions

IRENA. (2016). *Unlocking renewable energy investment: The role of risk mitigation and structured finance*. Abu Dhabi: International Renewable Energy Agency. Retrieved from www.irena.org

IRENA, & CPI. (2018). *Global landscape of renewable energy finance*. Abu Dhabi: International Renewable Energy Agency. Retrieved from www.irena.org

Ito, K. (2017). CO2 emissions, renewable and non-renewable energy consumption, and economic growth: Evidence from panel data for developing countries. *International Economics*, *151*, 1–6. https://doi.org/10.1016/j.inteco.2017.02.001

Jaeger, C. C., Paroussos, L., Mangalagiu, D., Kupers, R., Mandel, A., & Tàbara, J. D. (2011). *A New Growth Path for Europe: Generating prosperity and jobs in the low-carbon economy*. Potsdam, Germany: European Climate Forum e.V. Retrieved from https://globalclimateforum.org/fileadmin/ecf-documents/Press/A_New_Growth_Path_for_Europe__Synthesis_Report.pdf

Jänicke, M. (2012). "Green growth": From a growing eco-industry to economic sustainability. *Energy Policy*, *48*, 13–21. https://doi.org/10.1016/j.enpol.2012.04.045

Kaggwa, M., Mutanga, S. S., Nhamo, G., & Simelane, T. (2013). *South Africa's green economy transition: Implications for reorienting the economy towards a low-carbon growth trajectory*. (No. 168). SAIIA Occasional paper, Economic Diplomacy Programme, South African Institute of International Affairs. Retrieved from http://www.saiia.org.za/occasional-papers/south-africas-green-economy-transition-implications-for-reorienting-the-economy-towards-a-low-carbon-growth-trajectory

Kaika, D., & Zervas, E. (2013). The Environmental Kuznets Curve (EKC) theory — Part A: Concept, causes and the CO 2 emissions case. *Energy Policy*, *62*, 1392–1402. https://doi.org/10.1016/j.enpol.2013.07.131

Kim, S. E., Kim, H., & Chae, Y. (2014). A new approach to measuring green growth: Application to the OECD and Korea. *Futures*, *63*, 37–48. https://doi.org/10.1016/j.futures.2014.08.002

Klausbruckner, C., Annegarn, H., Henneman, L. R. F., & Rafaj, P. (2016). A policy review of synergies and trade-offs in South African climate change mitigation and air pollution control strategies. *Environmental Science and Policy*, *57*, 70–78. https://doi.org/10.1016/j.envsci.2015.12.001

Koop, G. (2013). *Analysis of economic data* (4th ed.). Chichester, UK: John Wiley & Sons.

Kronsinsky, C. (Ed.). (2011). *Evolutions in sustainable investing: Strategies, funds and thought leadership*. Hoboken, New Jersey: John Wiley & Sons.

Kruger, W., & Eberhard, A. (2018). Renewable energy auctions in sub-Saharan Africa: Comparing the South African, Ugandan, and Zambian Programs. *Wiley Interdisciplinary Reviews: Energy and Environment*, *7*(4), 1–13. https://doi.org/10.1002/wene.295

Kumar, P. (2017). Innovative tools and new metrics for inclusive green economy. *Current Opinion in Environmental Sustainability*, *24*, 47–51.

Kumar, R. (2011). *Research methodology: A step-by-step guide for beginners* (3rd ed.). London, Great Britain: SAGE Publications Ltd.

Kutan, A. M., Paramati, S. R., Ummalla, M., & Zakari, A. (2018). Financing renewable energy projects in major emerging market economies: Evidence in the perspective of sustainable economic development. *Emerging Markets Finance and Trade*, *54*(8), 1761–1777. https://doi.org/10.1080/1540496X.2017.1363036

Leedy, P. D., & Ormond, J. E. (2015). *Practical research: Planning and design* (11th ed.). Harlow, England: Pearson Education Limited.

Leibbrandt, M., Woolard, I., Finn, A., & Argent, J. (2010). *Trends in South African income distribution and poverty since the fall of Apartheid*. (No. 101). OECD Social, Employment and Migration Working papers, OECD Publishing. https://doi.org/10.1787/5kmms0t7p1ms-en

Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkänen, K., … Thomsen, M. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production*, *139*, 361–371. https://doi.org/10.1016/j.jclepro.2016.08.024

Lorek, S., & Spangenberg, J. H. (2014). Sustainable consumption within a sustainable economy - Beyond green growth and green economies. *Journal of Cleaner Production*, *63*, 33–44. https://doi.org/10.1016/j.jclepro.2013.08.045

Lyons, P., & Doueck, H. J. (2010). *The dissertation: From beginning to end*. New York, NY: Oxford University Press.

Matthews, B., & Ross, L. (2010). *Research methods: A practical guide for the social sciences*. Harlow, England: Pearson Education Limited.

Mazzucato, M. (2016). From market fixing to market-creating: A new framework for innovation policy. *Industry and Innovation*, *23*(2), 140–156. https://doi.org/10.1080/13662716.2016.1146124

Mazzucato, M., & Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting and Social Change*, *127*(June 2017), 8–22. https://doi.org/10.1016/j.techfore.2017.05.021

McNicoll, L., Jachnik, R., Montmasson-clair, G., & Mudombi, S. (2017). *Estimating publicly-mobilised private finance for climate action: A South African case study*. (No. 125). OECD Environment Working paper, OECD Publishing. https://doi.org/doi.org/10.1787/a606277c-en

Meltzer, J. P. (2016). *Financing low carbon, climate resilient infrastructure: The role of climate finance and green financial systems*. (No. 96). Global Economy and Development Program Working paper, Brookings Institution. Retrieved from https://www.brookings.edu/research/financing-low-carbon-climate-resilient-infrastructure-the-role-of-climate-finance-and-green-financial-systems/

Mohamed, N., Maitho, E., Masvikeni, E., Fourie, R., Tilly, M., & Zondi, N. (2014). The Green Fund of South Africa: Origins, establishment and first lessons. *Development Southern Africa*, *31*(5), 658–674. https://doi.org/10.1080/0376835X.2014.935295

Montmasson-Clair, G. (2012). *Green economy policy framework and employment opportunity: A South African case study*. (No. 2012-02). TIPS Working paper, Trade and Industrial Policy Strategies. Retrieved from http://www.sagreenfund.org.za/wp-content/uploads/2015/04/Green-Economy-Policy-Framework-and-Employment-Opportunity-in-South-Africa.pdf

Msimanga, B., & Sebitosi, A. B. (2014). South Africa's non-policy driven options for renewable energy development. *Renewable Energy*, *69*, 420–427. https://doi.org/10.1016/j.renene.2014.03.041

Mundaca, L., & Markandya, A. (2016). Assessing regional progress towards a "Green energy economy." *Applied Energy*, *179*, 1372–1394. https://doi.org/10.1016/j.apenergy.2015.10.098

Musango, J. K., Brent, A. C., & Bassi, A. M. (2014). Modelling the transition towards a green economy in South Africa. *Technological Forecasting & Social Change*, *87*, 257–273. https://doi.org/10.1016/j.techfore.2013.12.022

Nakumuryango, A., & Inglesi-lotz, R. (2016). South Africa's performance on renewable energy and its relative position against the OECD countries and the rest of Africa. *Renewable and Sustainable Energy Reviews*, *56*, 999–1007. https://doi.org/10.1016/j.rser.2015.12.013

Nasr, A. Ben, Gupta, R., & Sato, J. R. (2014). *Is there an Environmental Kuznets Curve for South Africa? A co-summability approach using a century of data*. (No. 2014-66). Department of economics working paper, University of Pretoria. Retrieved from https://www.up.ac.za/media/shared/61/WP/wp_2014_66.zp39458.pdf

Nhamo, G. (2014). From sustainable development through green growth to sustainable development plus. *International Journal of African Renaissance Studies - Multi-, Inter- and Transdisciplinarity*, *9*(2), 20–38. https://doi.org/10.1080/18186874.2014.987953

OECD. (2011). *Towards green growth: Monitoring progress*. Paris: OECD Publishing.

OECD. (2017). *Green growth indicators 2017*. Paris: OECD Publishing. https://doi.org/10.1787/9789264268586-en

OECD. (2018a). *Long-term interest rates (indicator)*. Retrieved from https://data.oecd.org/interest/long-term-interest-rates.htm

OECD. (2018b). *OECD.Stats: Green Growth Indicators*. Retrieved from https://stats.oecd.org/viewhtml.aspx?datasetcode=GREEN_GROWTH&lang=en#

Omilola, B. (2014). *Inclusive green growth in Africa: Rationale, challenges and opportunities Inclusive*. Policy Brief, United Nations Development Programme, South Africa. Retrieved from http://www.za.undp.org/content/dam/south_africa/docs/mdgs/Inclusive Green Growth in Africa-Rationale Challenges and Opportunities1.pdf

Ortega, M., del Río, P., Ruiz, P., & Thiel, C. (2015). Employment effects of renewable electricity deployment: A novel methodology. *Energy*, *91*, 940–951. https://doi.org/10.1016/j.energy.2015.08.061

Öztuna, D., Elhan, A. H., & Tüccar, E. (2006). Investigation of four different normality tests in terms of type 1 error rate and power under different distributions. *Turkish Journal of Medical Sciences*, *36*(3), 171–176.

Pallant, J. (2011). *SPSS survival manual: A step by step guide to data analysis using SPSS* (4th ed.). Crows Nest, Australia: Allen & Unwin.

Pegels, A. (2010). Renewable energy in South Africa: Potentials, barriers and options for support. *Energy Policy*, *38*, 4945–4954. https://doi.org/10.1016/j.enpol.2010.03.077

Polzin, F., Migendt, M., Täube, F. A., & Flotow, P. Von. (2015). Public policy influence on renewable energy investments: A panel data study across OECD countries. *Energy Policy*, *80*, 98–111. https://doi.org/10.1016/j.enpol.2015.01.026

Rennkamp, B., Haunss, S., Wongsa, K., Ortega, A., & Casamadrid, E. (2017). Competing coalitions: The politics of renewable energy and fossil fuels in Mexico, South Africa and Thailand. *Energy Research & Social Science*, *34*, 214–223. https://doi.org/10.1016/j.erss.2017.07.012

Richardson, B. J., & Cragg, W. (2010). Being virtuous and prosperous: SRI's conflicting goals. *Journal of Business Ethics*, *92*, 21–39. https://doi.org/10.1007/s10551-010-0632-9

Rodríguez, M. C., Haščič, I., Johnstone, N., Silva, J., & Ferey, A. (2014). *Inducing private finance for renewable energy projects: Evidence from micro-data*. (No. 67). OECD Environment Working paper, OECD Publishing. Retrieved from http://dx.doi.org/10.1787/5jxvg0k6thr1-en

Roman, P., & Thiry, G. (2016). The inclusive wealth index. A critical appraisal. *Ecological Economics*, *124*, 185–192. https://doi.org/10.1016/j.ecolecon.2015.12.008

Sandberg, J. (2015). *Towards a theory of sustainable finance*. (No. 15/08). Inquiry working paper, UNEP Inquiry, Centre for International Governance Innovation. https://doi.org/10.1016/S0378-3812(01)00677-X

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods For Business Students* (7th ed.). Harlow, England: Pearson Education Limited.

Schallenberg-Rodriguez, J. (2017). Renewable electricity support systems: Are feed-in systems taking the lead? *Renewable and Sustainable Energy Reviews*, *76*, 1422–1439. https://doi.org/10.1016/j.rser.2017.03.105

Schmidt-Traub, G., & Sachs, J. D. (2015). *The roles of public and private development finance*. (May, 2015). SDSN Issue Brief, Sustainable Development Solutions Network. Retrieved from http://unsdsn.org/wp-content/uploads/2015/05/150529-The-Roles-of-Public-and-Private-Development-Finance.pdf

Schwerho, G., & Sy, M. (2017). Financing renewable energy in Africa – Key challenge of the sustainable development goals. *Renewable and Sustainable Energy Reviews*, *75*, 393–401. https://doi.org/10.1016/j.rser.2016.11.004

Simas, M., & Pacca, S. (2014). Assessing employment in renewable energy technologies: A case study for wind power in Brazil. *Renewable and Sustainable Energy Reviews*, *31*, 83–90. https://doi.org/10.1016/j.rser.2013.11.046

StatsSA. (2018). *Statistical release: Mid-year population estimates July 2018*. Statistics South Africa. Retrieved from http://www.statssa.gov.za/publications/P0302/P03022011.pdf

Stiglitz, J. E., Sen, A., & Fitoussi, J. (2009). *Report by the commission on the measurement of economic performance and social progress*. Retrieved from http://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report

Tabachnick, B. G., & Fidell, L. S. (2014). *Using multivariate statistics* (6th ed.). Harlow, England: Pearson Education Limited.

Thirumalai, C., Madhan, V., & Chandhini, S. A. (2017). Analysing the concrete compressive strength using Pearson and Spearman. In *International Conference on Electronics, Communication and Aerospace Technology ICECA 2017* (pp. 215–218). Coimbatore, India: Institute of Electrical and Electronics Engineers, Inc. https://doi.org/10.1109/ICECA.2017.8212799

UNEP. (2011). *Towards a green economy: Pathways to sustainable development and poverty eradication - A synthesis for policy makers*. Retrieved from https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=126&menu=35

UNEP. (2013). *Green economy scoping study: South African green economy modelling report (SAGEM) - Focus on natural resource management, agriculture, transport and energy Sector*. Nairobi, Kenya: United Nations Environment Programme. Retrieved from http://www.unep.org/greeneconomy/portals/88/Modelling Report SA/SAModellingReport.pdf

UNEP. (2015). *Uncovering pathways towards an inclusive green economy: A summary for leaders*. Nairobi, Kenya: United Nations Environment Programme. Retrieved from https://web.unep.org/greeneconomy/sites/unep.org.greeneconomy/files/publications/ige_narrative_summary_web.pdf

UNEP Inquiry. (2016). *Green Finance for developing countries: Needs, concerns and innovations*. Geneva, Switzerland: United Nations Environment Programme. Retrieved from www.unep.org/inquiry

UNU-IHDP and UNEP. (2014). *Inclusive wealth report 2014: Measuring progress toward sustainability*. Cambridge, UK: Cambridge University Press. https://doi.org/10.1108/ijshe.2012.24913daa.006

Wall, R., Grafakos, S., Gianoli, A., & Stavropoulos, S. (2018). Which policy instruments attract foreign direct investments in renewable energy? *Climate Policy*, 1–14. https://doi.org/10.1080/14693062.2018.1467826

Walwyn, D. R., & Brent, A. C. (2015). Renewable energy gathers steam in South Africa. *Renewable and Sustainable Energy Reviews*, *41*, 390–401. https://doi.org/10.1016/j.rser.2014.08.049

WCED. (1987). *Our Common Future*. New York, NY: Oxford University Press.

Wei, M., Patadia, S., & Kammen, D. M. (2010). Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? *Energy Policy*, *38*(2), 919–931. https://doi.org/10.1016/j.enpol.2009.10.044

Weiers, R. M. (2011). *Introduction to business statistics* (7th ed.). Mason, USA: South-Western, Cengage Learning.

WHO. (2016). *Ambient air: A global assessment of exposure and burden of disease*. Geneva, Switzerland: World Health Organisation. Retrieved from http://www.who.int/phe/publications/air-pollution-global-assessment/en/

Winker, H. (2009). *Cleaner energy cooler climate: Developing sustainable energy solutions for South Africa*. Cape Town, South Africa: Human Sciences Research Council.

Winkler, H., & Marquand, A. (2009). Changing development paths: From an energy-intensive to low-carbon economy in South Africa. *Climate and Development*, *1*(1), 47–65. https://doi.org/10.3763/cdev.2009.0003

World Bank. (2014). *Public-private partnership: reference guide version 2.0*. Washington, DC: World Bank. Retrieved from http://documents.worldbank.org/curated/en/600511468336720455/Public-private-partnerships-reference-guide-version-2-0

World Bank. (2017). *World development indicators 2017*. Washington, DC: World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/26447

World Bank. (2018a). *Country profile*. Washington, DC: World Bank. Retrieved from http://databank.worldbank.org/data/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=ZAF

World Bank. (2018b). *World development indicators*. Washington, DC: World Bank. Retrieved from https://databank.worldbank.org/data/source/world-development-indicators

Xu, Q., Lei, Y., Ge, J., & Ma, X. (2017). Did investment become green in China? Evidence from a sectoral panel analysis from 2003 to 2012. *Journal of Cleaner Production*, *156*, 500–506. https://doi.org/10.1016/j.jclepro.2017.04.075

Yuan, F., & Gallagher, K. P. (2015). *Greening development finance in the Americas*. (No. 12/2015). GEGI Working paper, Boston University, Global Economic Governance Initiative. Retrieved from http://www.thedialogue.org/wp-content/uploads/2015/11/GEGI-GreeningAmericas-Final.pdf

Zafar, M. W., Shahbaz, M., Hou, F., & Sinha, A. (2019). From nonrenewable to renewable energy and its impact on economic growth: The role of research & development expenditures in Asia-Pacific Economic Cooperation countries. *Journal of Cleaner Production*, *212*, 1166–1178. https://doi.org/10.1016/j.jclepro.2018.12.081

Zaman, K., Abdullah, A. Bin, Khan, A., Nasir, M. R. B. M., Hamzah, T. A. A. T., & Hussain, S. (2016). Dynamic linkages among energy consumption, environment, health and wealth in BRICS countries: Green growth key to sustainable development. *Renewable and Sustainable Energy Reviews*, *56*, 1263–1271. https://doi.org/10.1016/j.rser.2015.12.010

Zeng, S., Liu, Y., Liu, C., & Nan, X. (2017). A review of renewable energy investment in the BRICS countries: History, models, problems and solutions. *Renewable and Sustainable Energy Reviews*, *74*, 860–872. https://doi.org/10.1016/j.rser.2017.03.016

Zhao, Y., Tang, K. K., & Wang, L. (2013). Do renewable electricity policies promote renewable electricity generation? Evidence from panel data. *Energy Policy*, *62*, 887–897. https://doi.org/10.1016/j.enpol.2013.07.072

Zoundi, Z. (2017). CO2 emissions, renewable energy and the Environmental Kuznets Curve, a panel cointegration approach. *Renewable and Sustainable Energy Reviews*, *72*, 1067–1075. https://doi.org/10.1016/j.rser.2016.10.018

Appendices

Appendix A: Descriptive statistics for Green Finance and Policy Variables

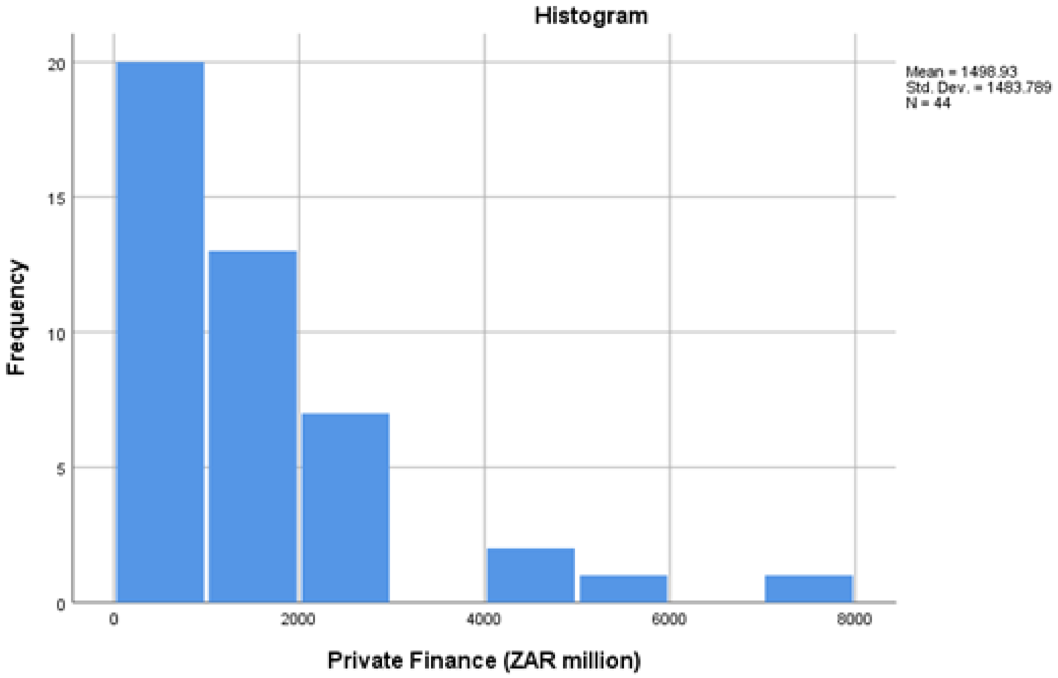
			Statistic	Std. Error
Private Finance (ZAR million)	Mean		1498.93	223.690
	95% Confidence Interval for Mean	Lower Bound	1047.82	
		Upper Bound	1950.04	
	5% Trimmed Mean		1310.51	
	Median		1163.00	
	Variance		2201630.018	
	Std. Deviation		1483.789	
	Minimum		111	
	Maximum		7147	
	Range		7036	
	Interquartile Range		1483	
	Skewness		2.115	.357
	Kurtosis		5.151	.702
Public Finance (ZAR million)	Mean		939.89	220.923
	95% Confidence Interval for Mean	Lower Bound	494.35	
		Upper Bound	1385.42	
	5% Trimmed Mean		701.43	
	Median		452.50	
	Variance		2147513.452	
	Std. Deviation		1465.440	
	Minimum		0	
	Maximum		7750	
	Range		7750	
	Interquartile Range		934	
	Skewness		3.116	.357
	Kurtosis		11.400	.702
Project Capacity (MW)	Mean		77.0827	7.58541
	95% Confidence Interval for Mean	Lower Bound	61.7853	
		Upper Bound	92.3802	
	5% Trimmed Mean		74.5364	
	Median		75.0000	
	Variance		2531.694	
	Std. Deviation		50.31594	
	Minimum		5.00	

			Statistic	Std. Error
	Maximum		258.00	
	Range		253.00	
	Interquartile Range		68.70	
	Skewness		.968	.357
	Kurtosis		2.344	.702
Average Tariff (ZAR)	Mean		1.6811	.12763
	95% Confidence Interval for Mean	Lower Bound	1.4238	
		Upper Bound	1.9385	
	5% Trimmed Mean		1.6740	
	Median		1.2950	
	Variance		.717	
	Std. Deviation		.84658	
	Minimum		.72	
	Maximum		2.76	
	Range		2.04	
	Interquartile Range		1.86	
	Skewness		.338	.357
	Kurtosis		-1.711	.702
Long-Term Interest Rates (%)	Mean		7.9417	.06149
	95% Confidence Interval for Mean	Lower Bound	7.8176	
		Upper Bound	8.0657	
	5% Trimmed Mean		7.9266	
	Median		7.9000	
	Variance		.166	
	Std. Deviation		.40790	
	Minimum		7.23	
	Maximum		8.93	
	Range		1.70	
	Interquartile Range		.35	
	Skewness		.333	.357
	Kurtosis		1.115	.702

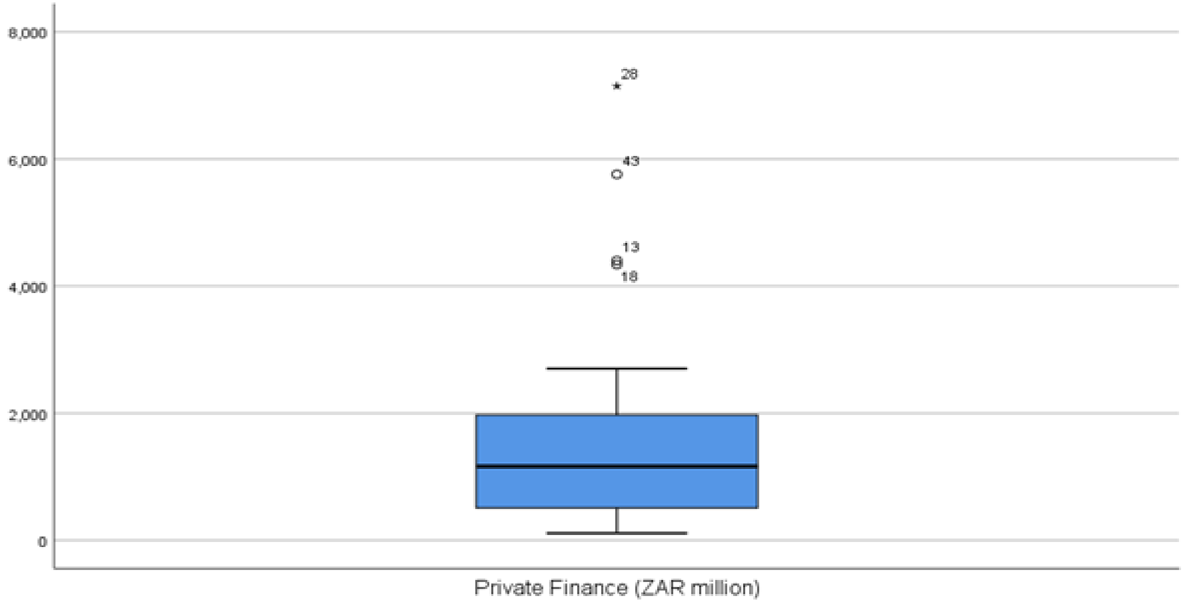
Appendix B: Normality Tests for Green Finance and Policy Variables

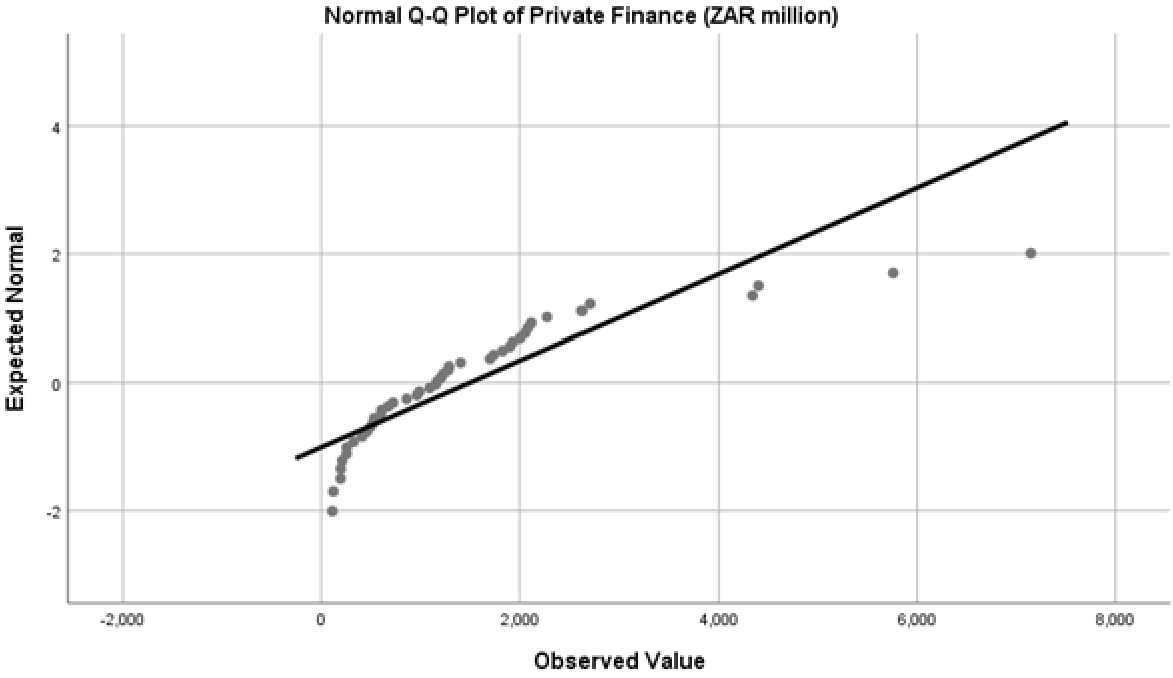
1. Before deleting outliers

Private Finance

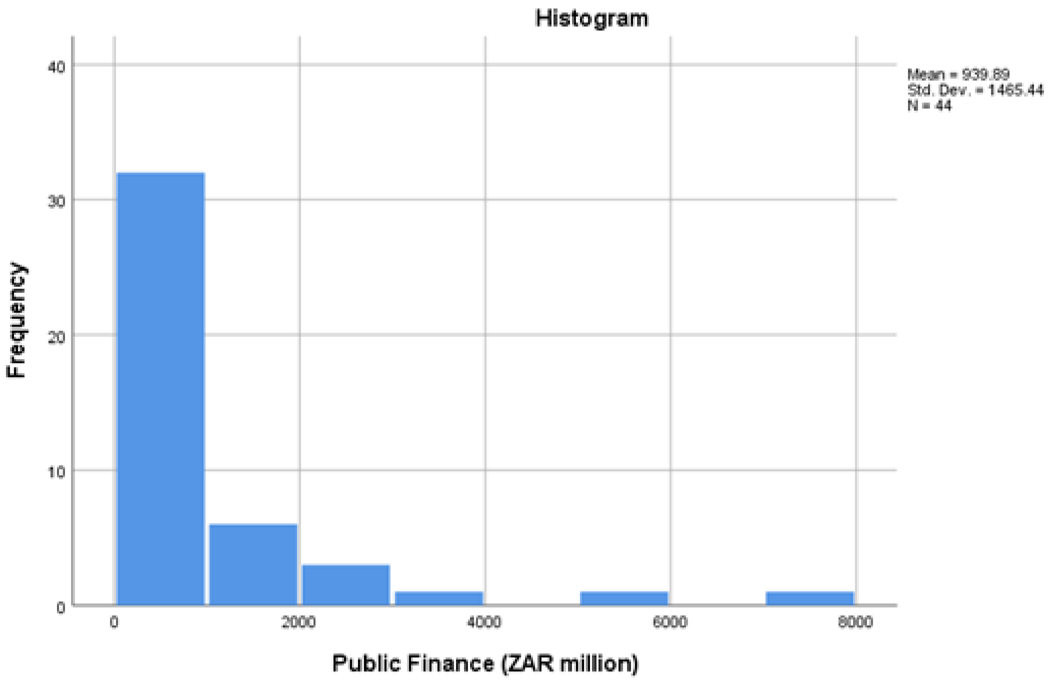


Boxplot

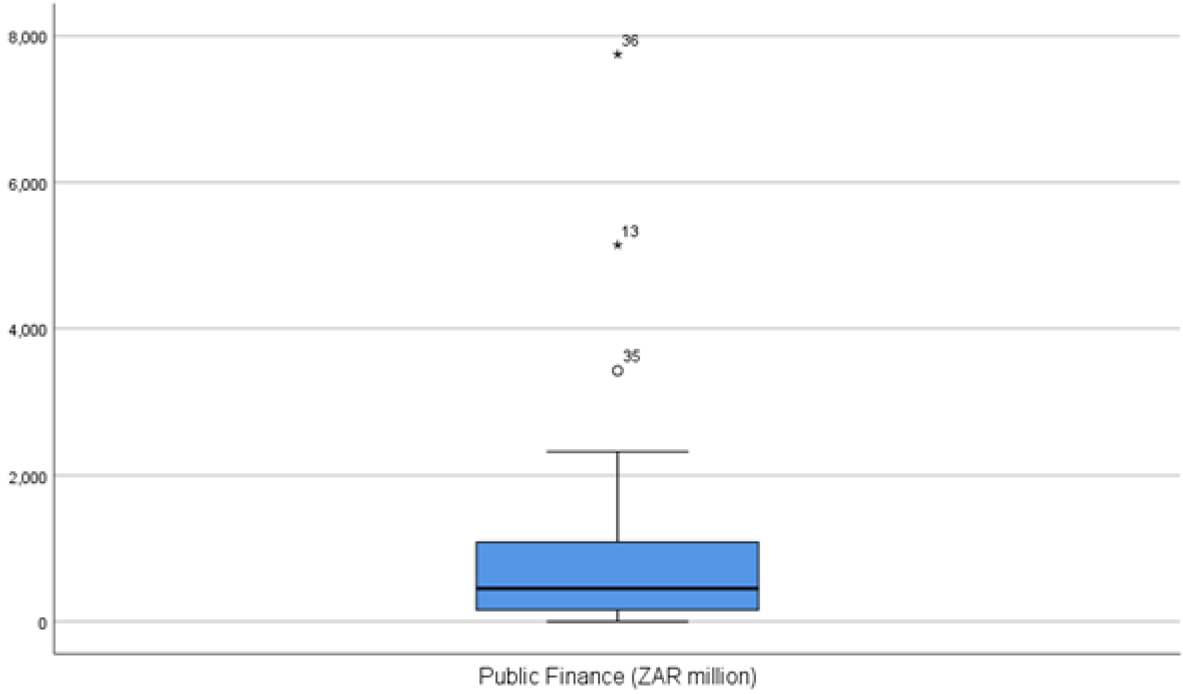




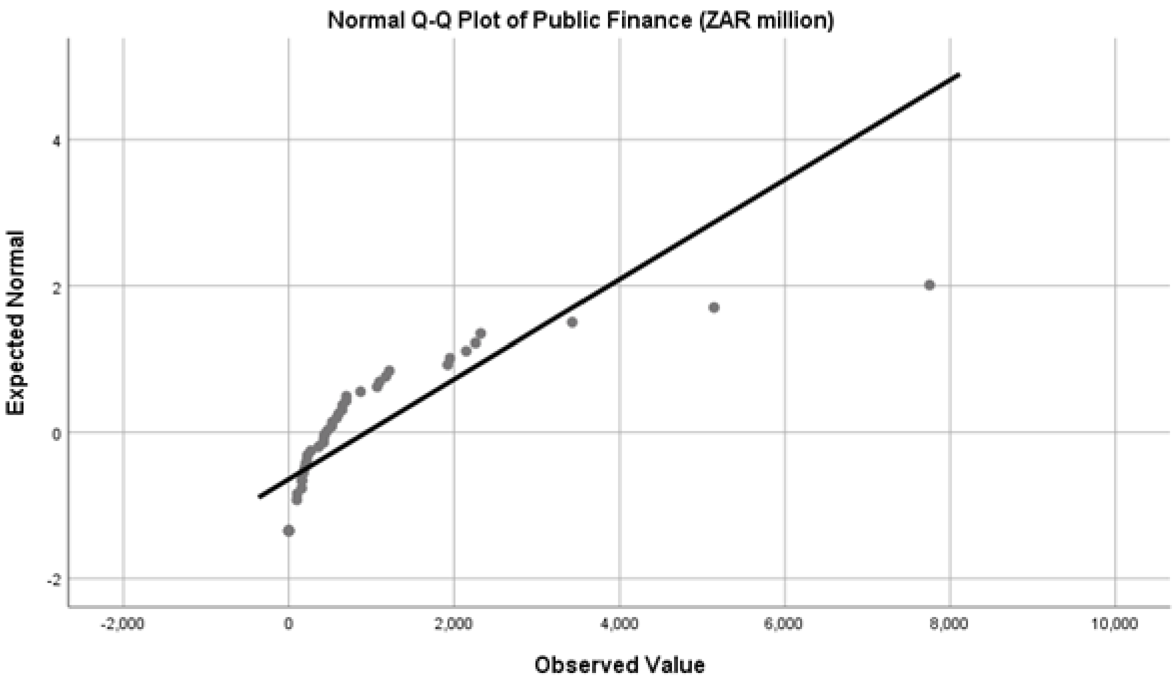
Public Finance



Boxplot

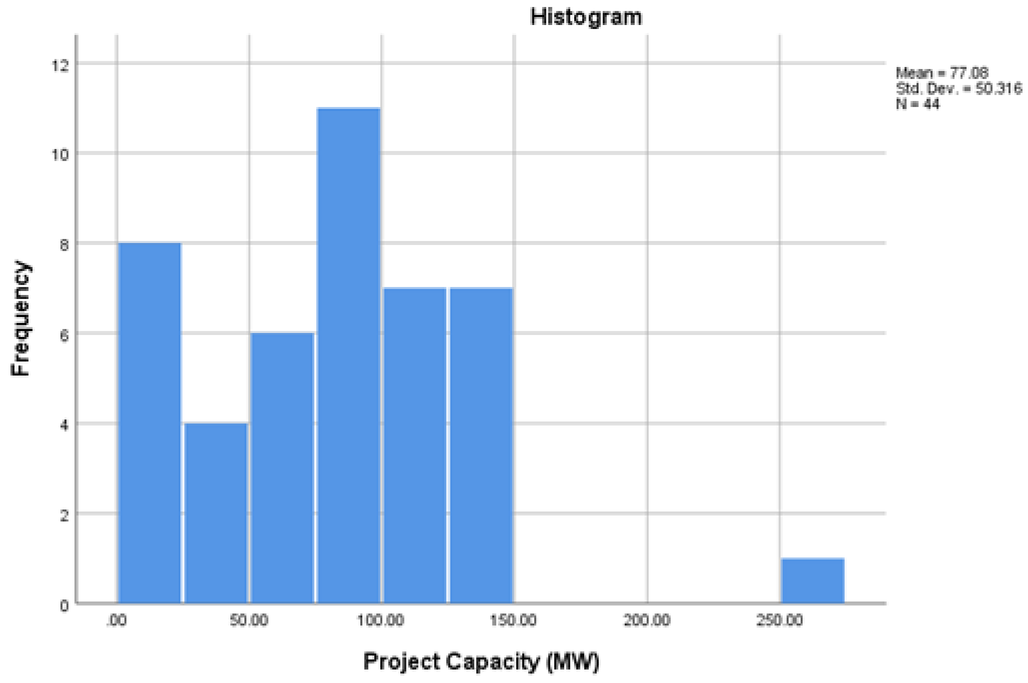


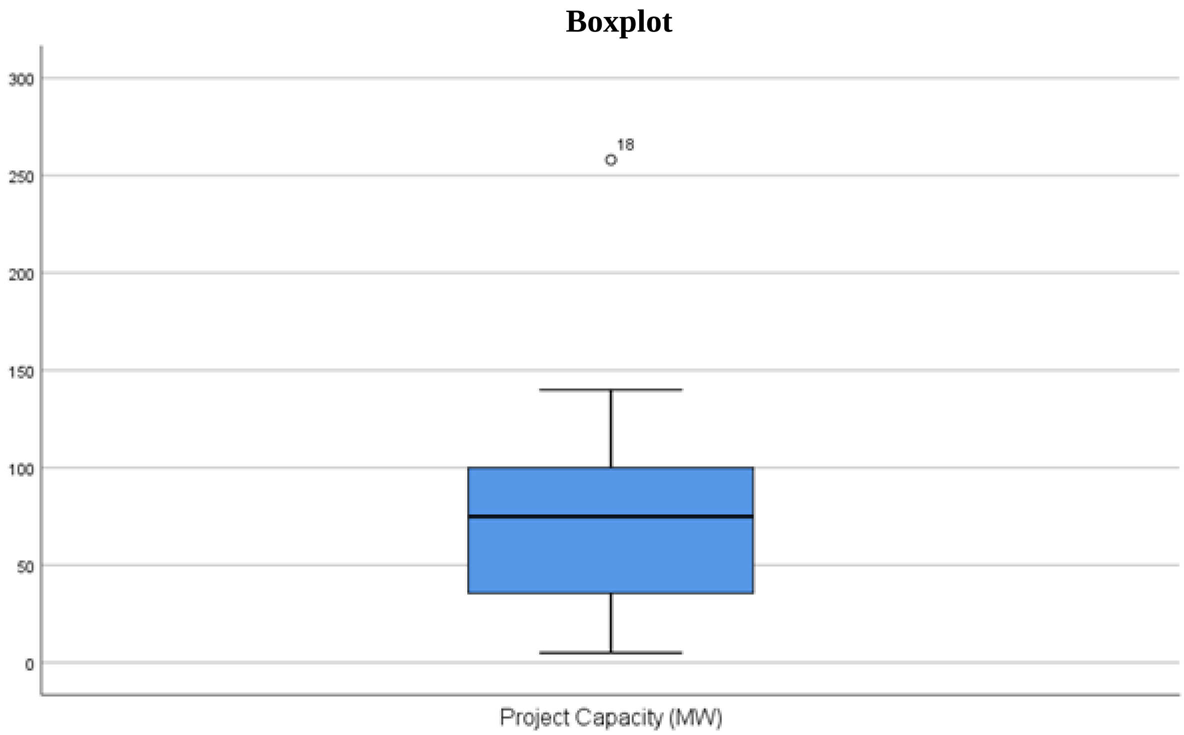
8,000
6,000
4,000
2,000
0
36
13
35
Public Finance (ZAR million)

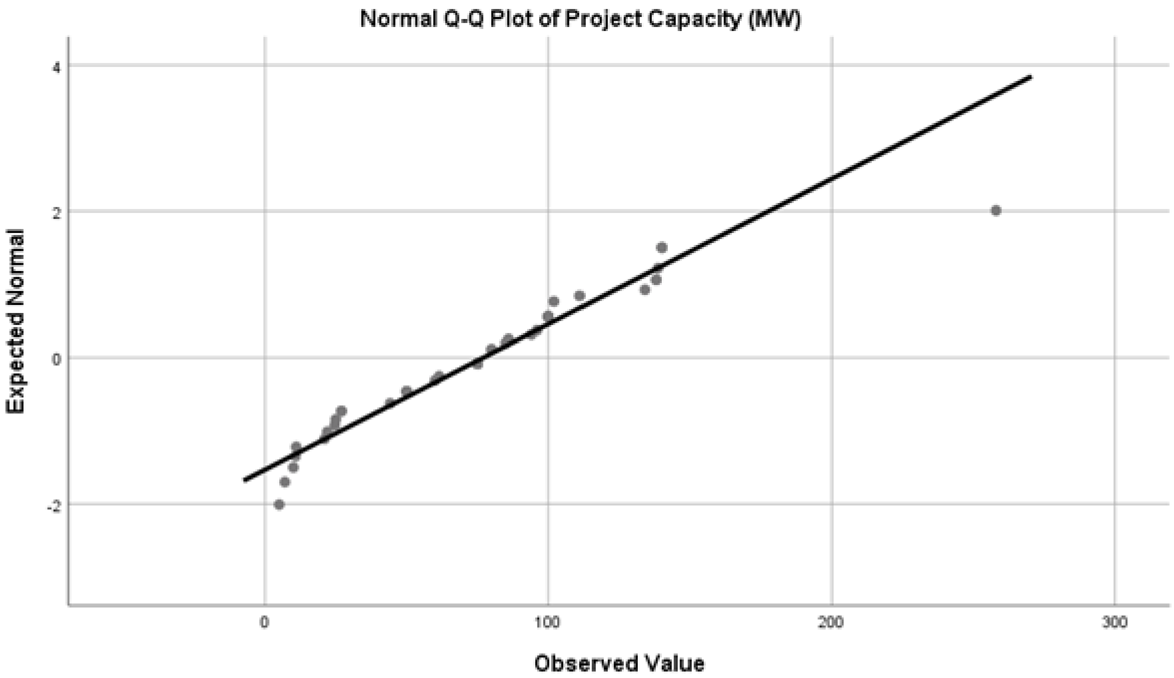


Normal Q-Q Plot of Public Finance (ZAR million)
Expected Normal
4
2
0
-2
-2,000
0
2,000
4,000
6,000
8,000
10,000
Observed Value

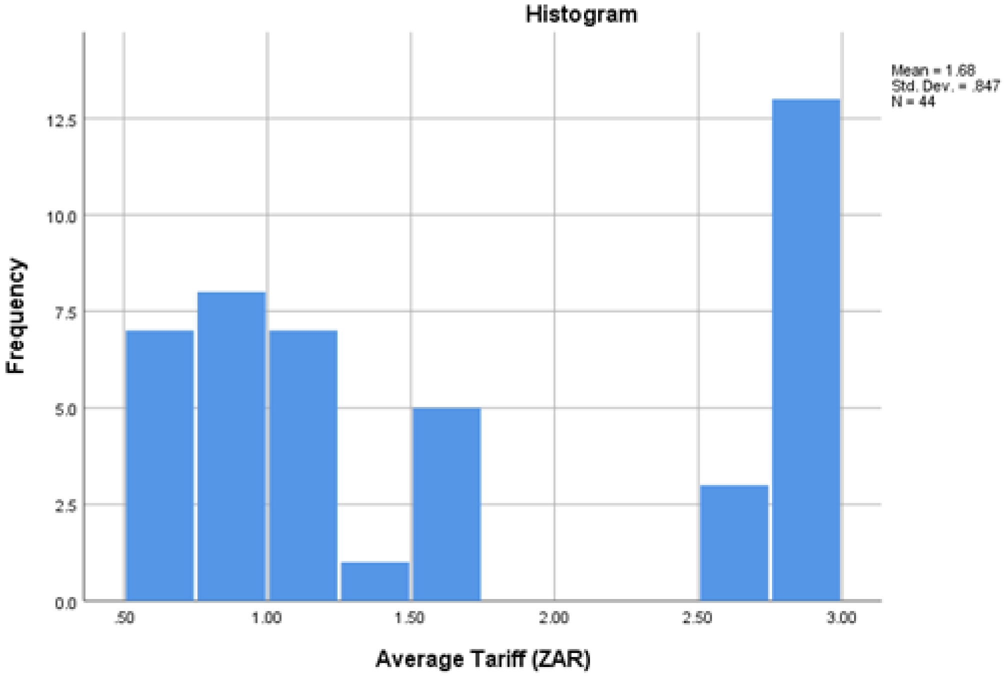
Project Capacity



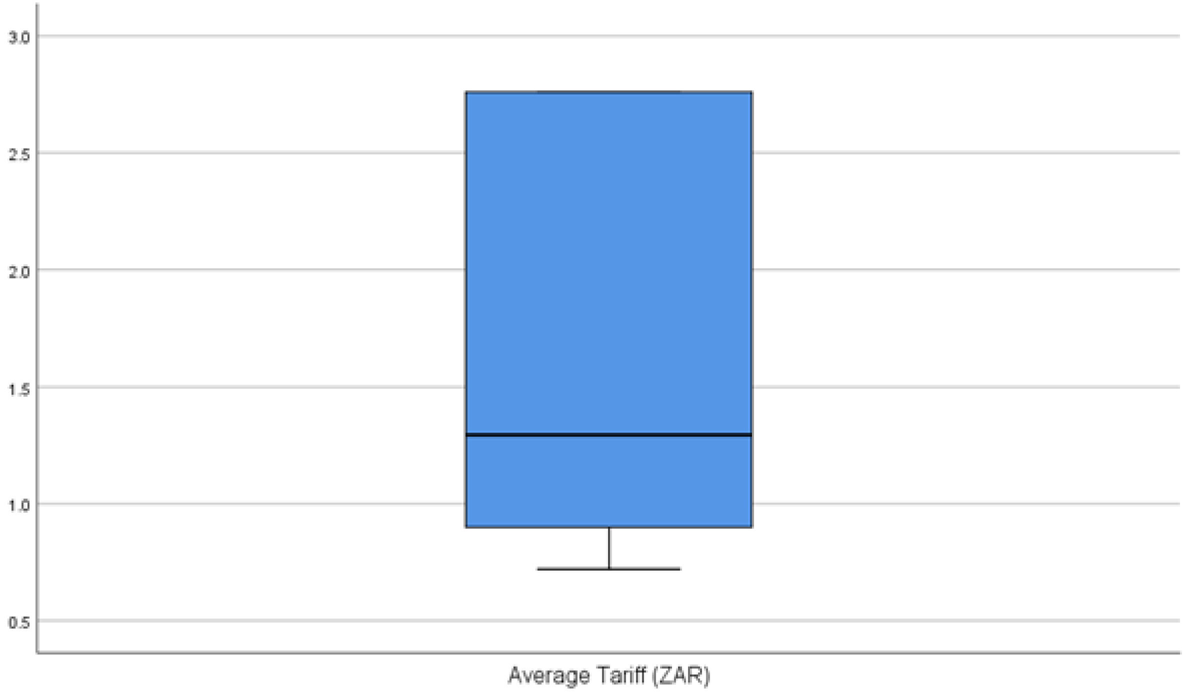


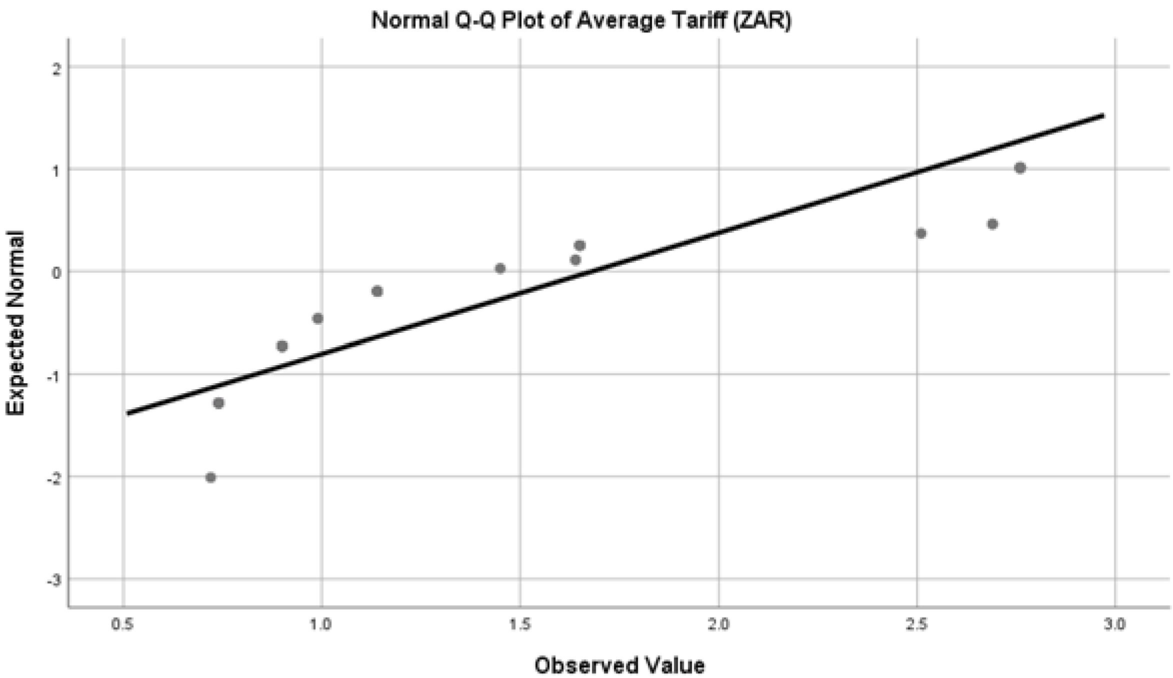


Average Tariff

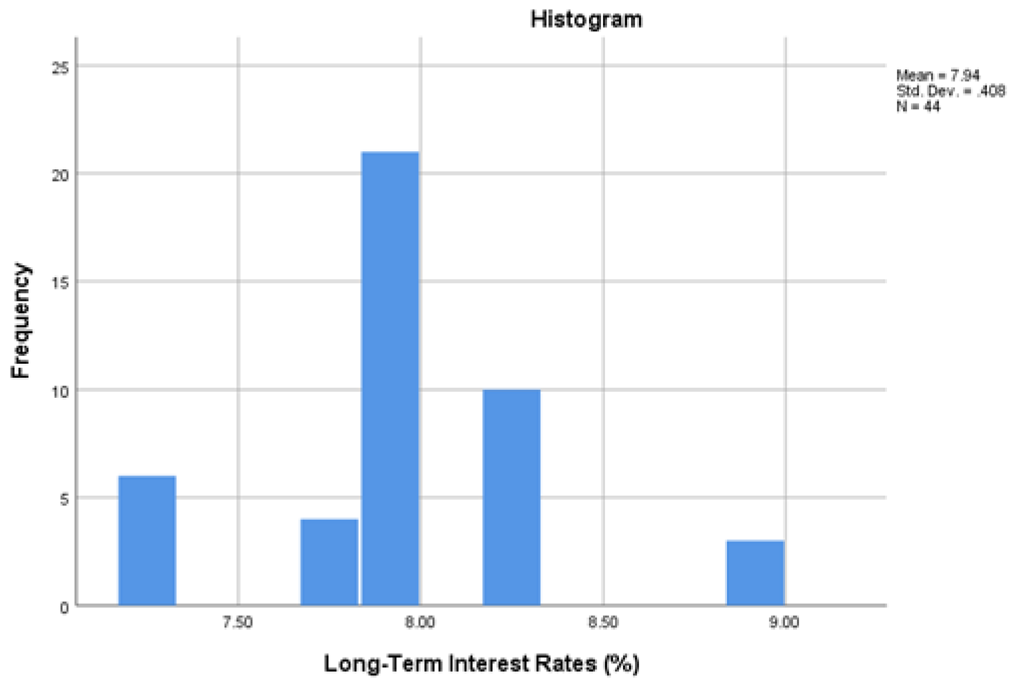


Boxplot

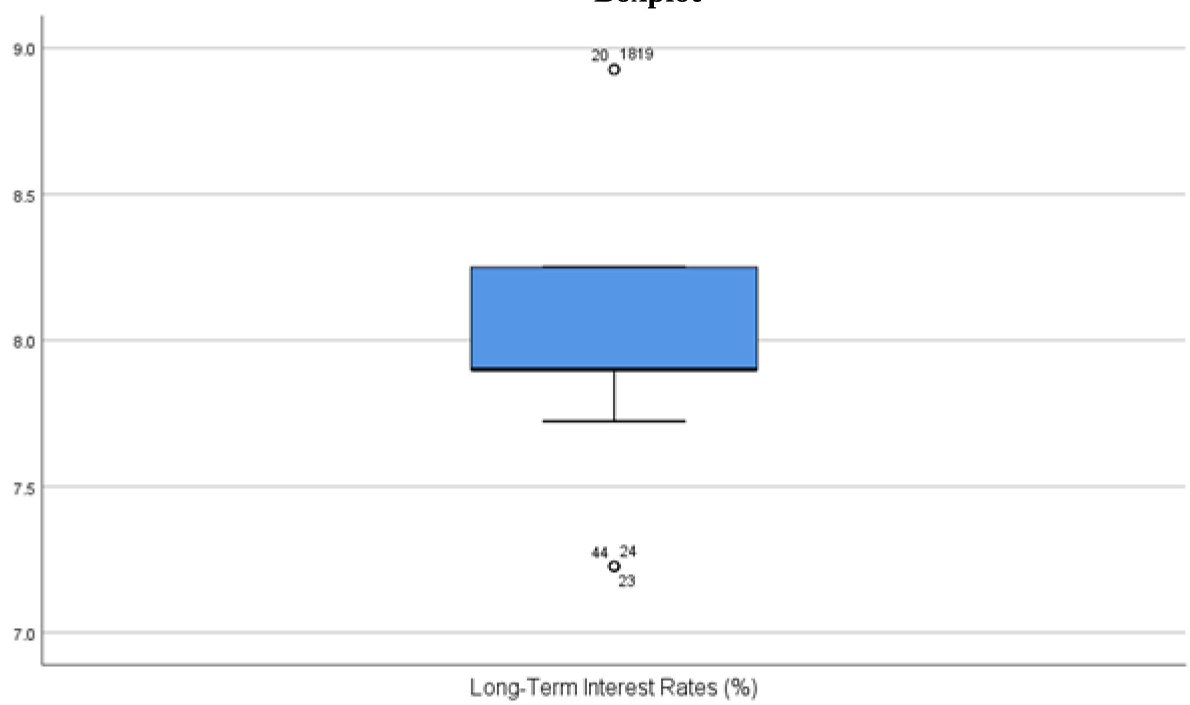

3.0
2.5
2.0
1.5
1.0
0.5
Average Tariff (ZAR)

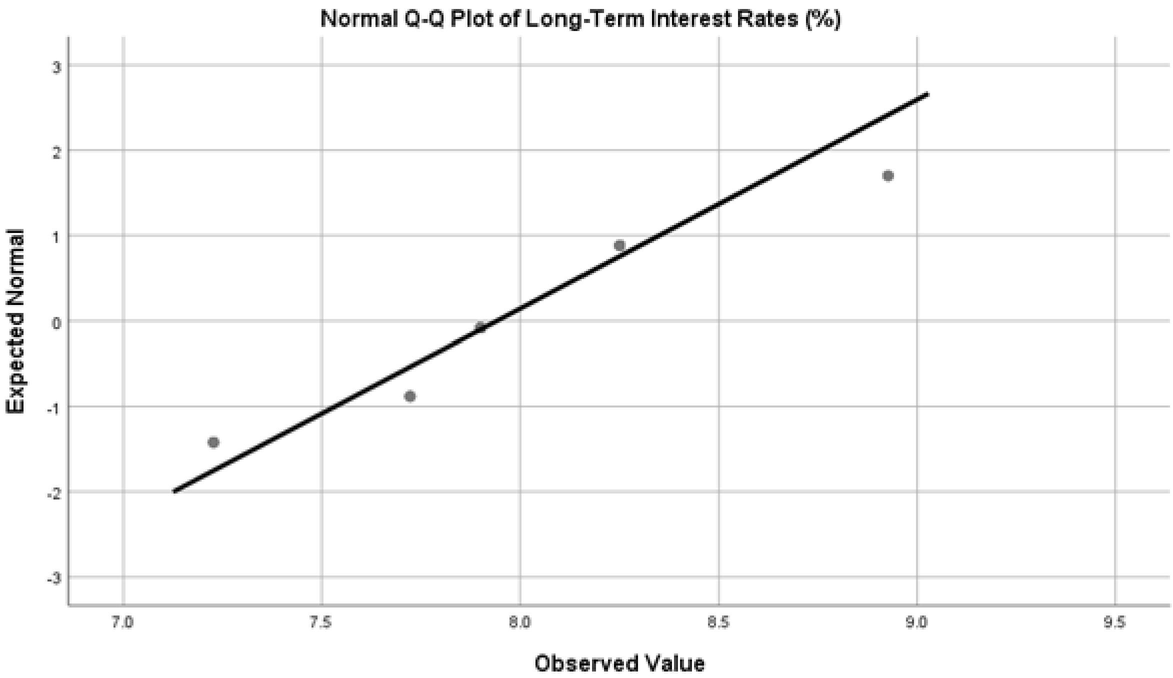

Normal Q-Q Plot of Average Tariff (ZAR)
Expected Normal
2
1
0
-1
-2
-3
0.5
1.0
1.5
2.0
2.5
3.0
Observed Value

Long-term Interest Rates



Boxplot





2. After deleting outliers

Descriptive statistics

			Statistic	Std. Error
Private Finance (ZAR million)	Mean		1136.97	123.262
	95% Confidence Interval for Mean	Lower Bound	887.22	
		Upper Bound	1386.73	
	5% Trimmed Mean		1108.85	
	Median		1124.00	
	Variance		577350.134	
	Std. Deviation		759.836	
	Minimum		111	
	Maximum		2701	
	Range		2590	
	Interquartile Range		1399	
	Skewness		.358	.383
	Kurtosis		-.990	.750
Public Finance (ZAR million)	Mean		584.89	105.892
	95% Confidence Interval for Mean	Lower Bound	370.34	
		Upper Bound	799.45	
	5% Trimmed Mean		522.46	

	Median		394.00	
	Variance		426101.556	
	Std. Deviation		652.765	
	Minimum		0	
	Maximum		2323	
	Range		2323	
	Interquartile Range		597	
	Skewness		1.511	.383
	Kurtosis		1.602	.750
Project Capacity (MW)	Mean		71.9379	7.16020
	95% Confidence Interval for Mean	Lower Bound	57.4300	
		Upper Bound	86.4458	
	5% Trimmed Mean		71.8228	
	Median		75.0000	
	Variance		1948.200	
	Std. Deviation		44.13841	
	Minimum		5.00	
	Maximum		140.00	
	Range		135.00	
	Interquartile Range		74.00	
	Skewness		.086	.383
	Kurtosis		-1.128	.750
Average Tariff (ZAR)	Mean		1.2642	.06763
	95% Confidence Interval for Mean	Lower Bound	1.1272	
		Upper Bound	1.4012	
	5% Trimmed Mean		1.2664	
	Median		1.1400	
	Variance		.174	
	Std. Deviation		.41687	
	Minimum		.72	
	Maximum		1.76	
	Range		1.04	
	Interquartile Range		.86	
	Skewness		.107	.383
	Kurtosis		-1.731	.750
Long-Term Interest Rates (%)	Mean		7.9205	.06233
	95% Confidence Interval for Mean	Lower Bound	7.7942	
		Upper Bound	8.0468	
	5% Trimmed Mean		7.9031	
	Median		7.9000	

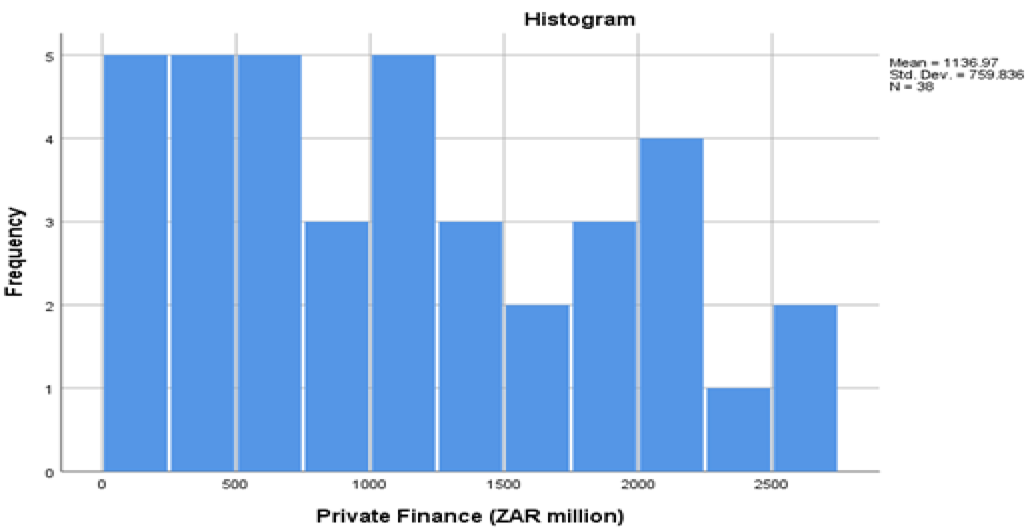
	Variance	.148	
	Std. Deviation	.38424	
	Minimum	7.23	
	Maximum	8.93	
	Range	1.70	
	Interquartile Range	.39	
	Skewness	.314	.383
	Kurtosis	1.563	.750

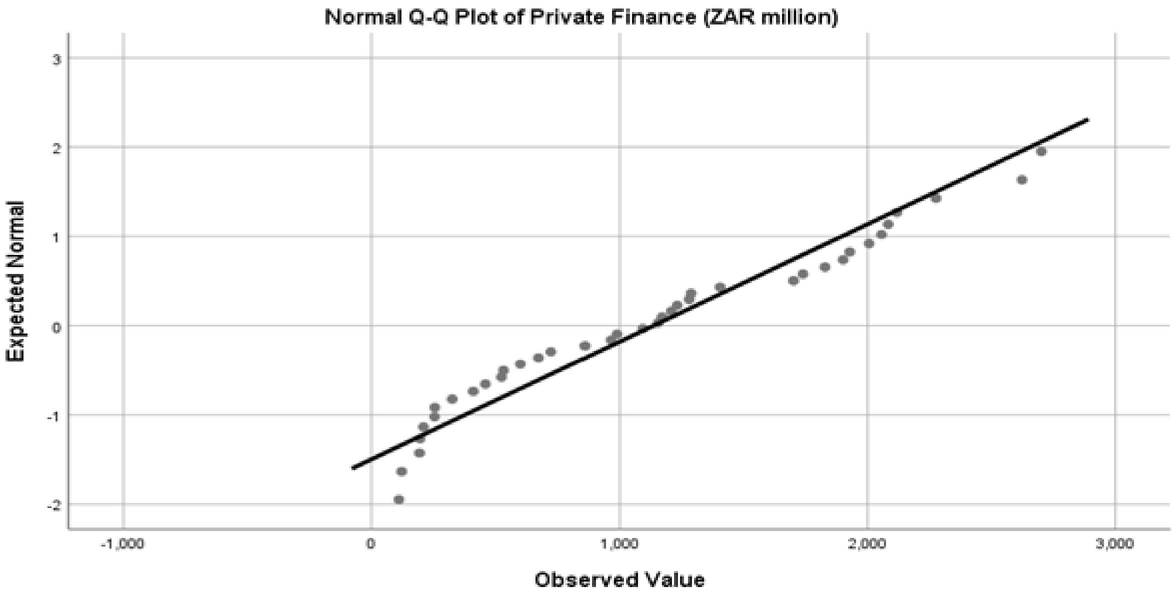
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Private Finance (ZAR million)	.102	38	.200*	.939	38	.038
Public Finance (ZAR million)	.195	38	.001	.802	38	.000
Project Capacity (MW)	.135	38	.077	.927	38	.016
Average Tariff (ZAR)	.217	38	.000	.819	38	.000
Long-Term Interest Rates (%)	.258	38	.000	.846	38	.000

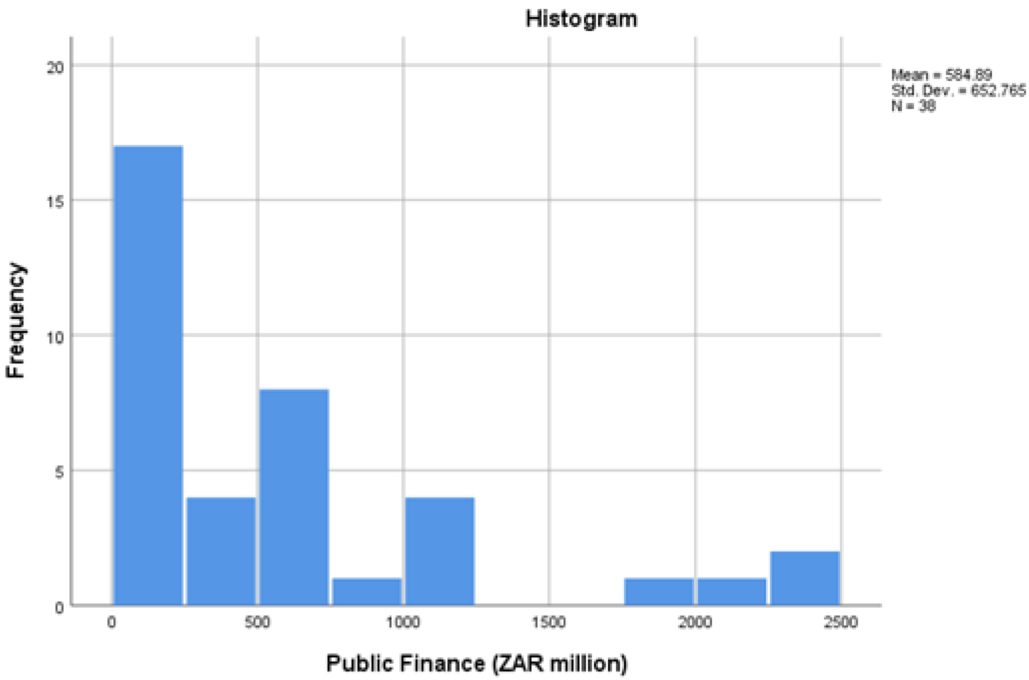
*. This is a lower bound of the true significance.

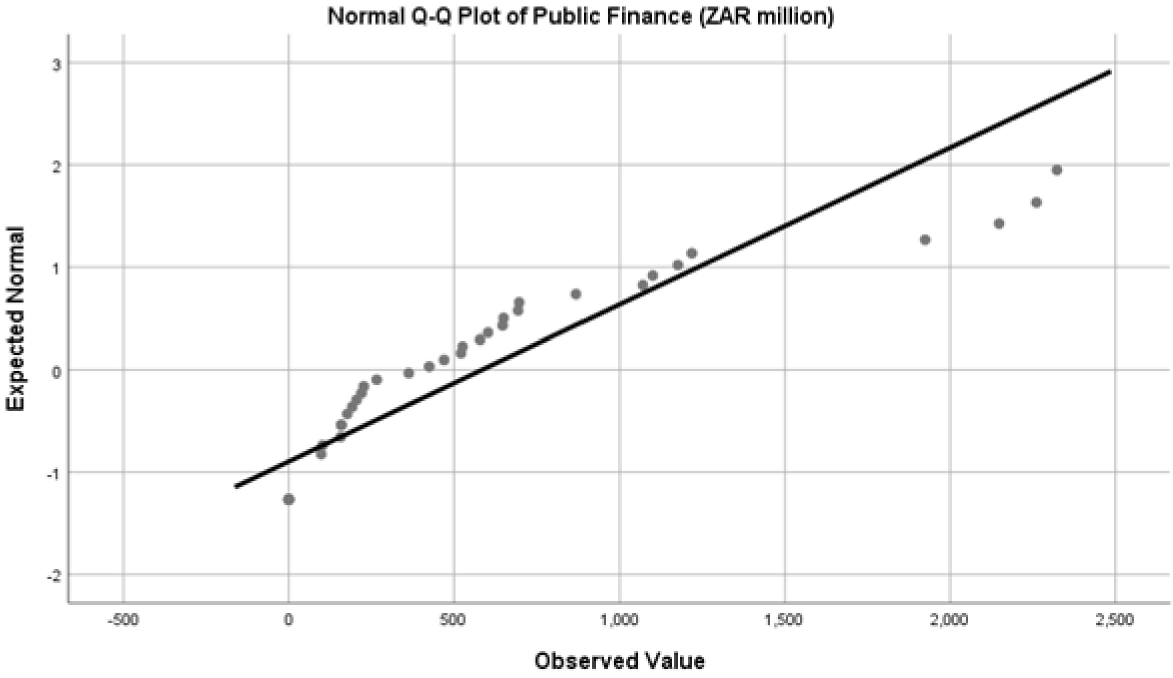
Private Finance



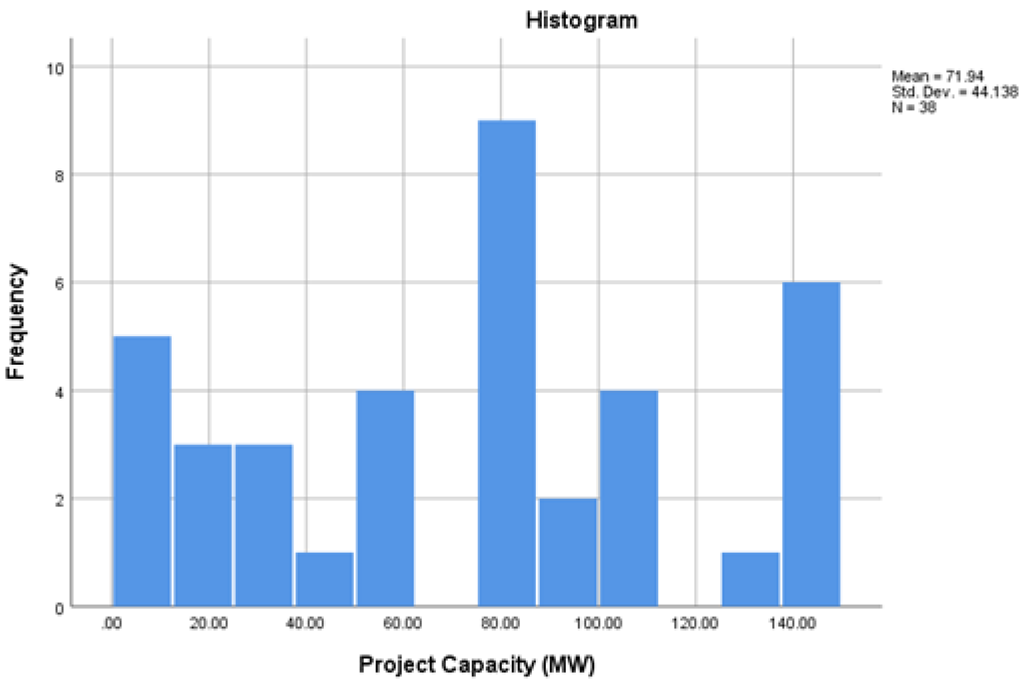


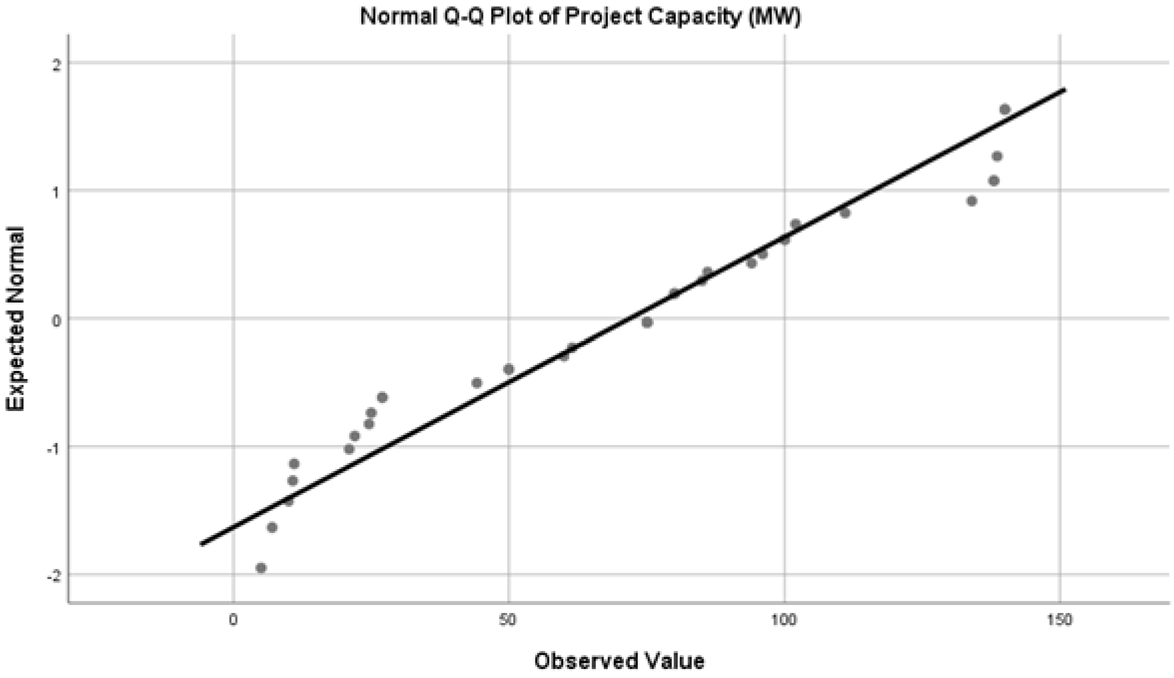
Public Finance



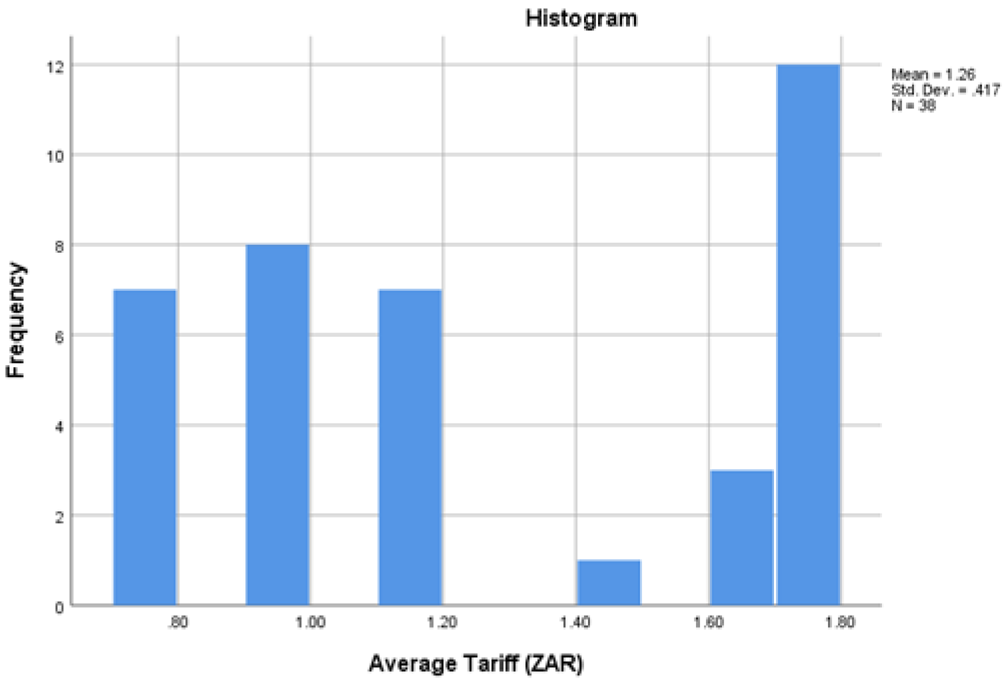


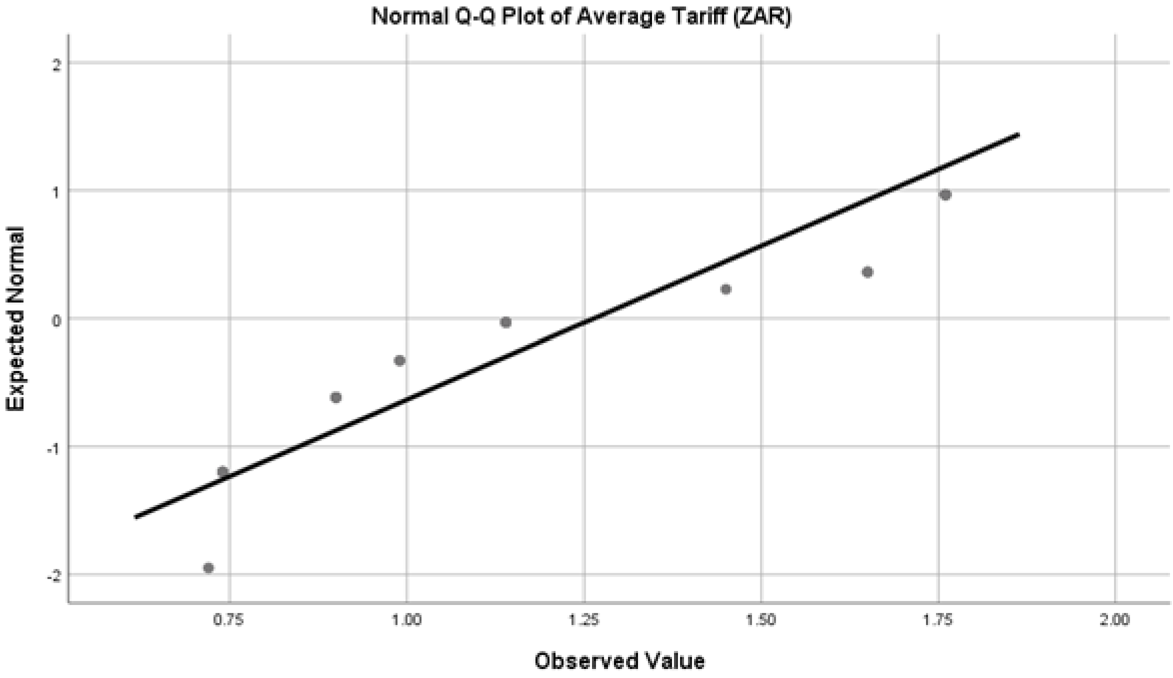
Project Capacity



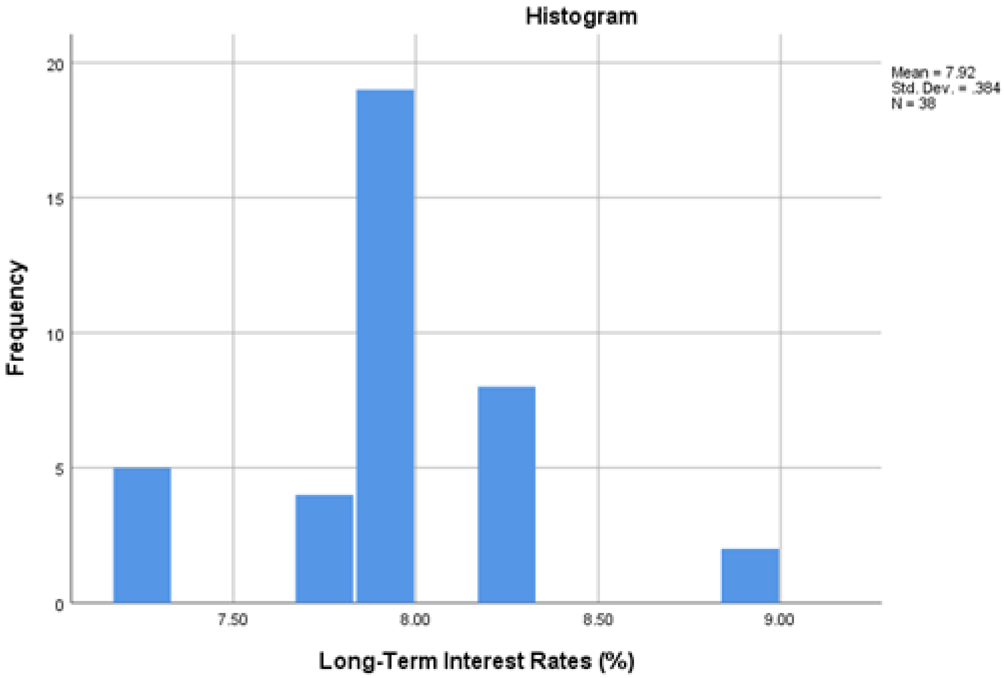


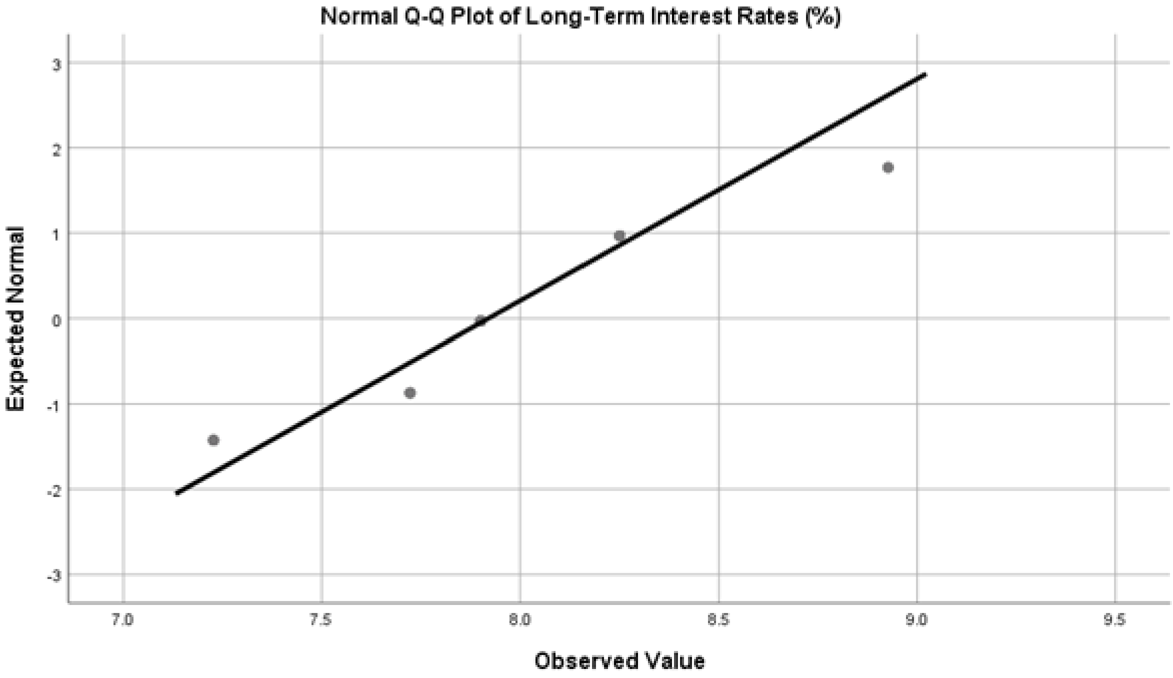
Average tariff





Long-term Interest Rates





3. After transformation

Descriptive Statistics

			Statistic	Std. Error
Private Finance (ZAR million)	Mean		1136.97	123.262
	95% Confidence Interval for Mean	Lower Bound	887.22	
		Upper Bound	1386.73	
	5% Trimmed Mean		1108.85	
	Median		1124.00	
	Variance		577350.134	
	Std. Deviation		759.836	
	Minimum		111	
	Maximum		2701	
	Range		2590	
	Interquartile Range		1399	
	Skewness		.358	.383
	Kurtosis		-.990	.750
SqrtPubFinancep	Mean		19.8774	2.26478
	95% Confidence Interval for Mean	Lower Bound	15.2886	
		Upper Bound	24.4663	
	5% Trimmed Mean		19.4255	

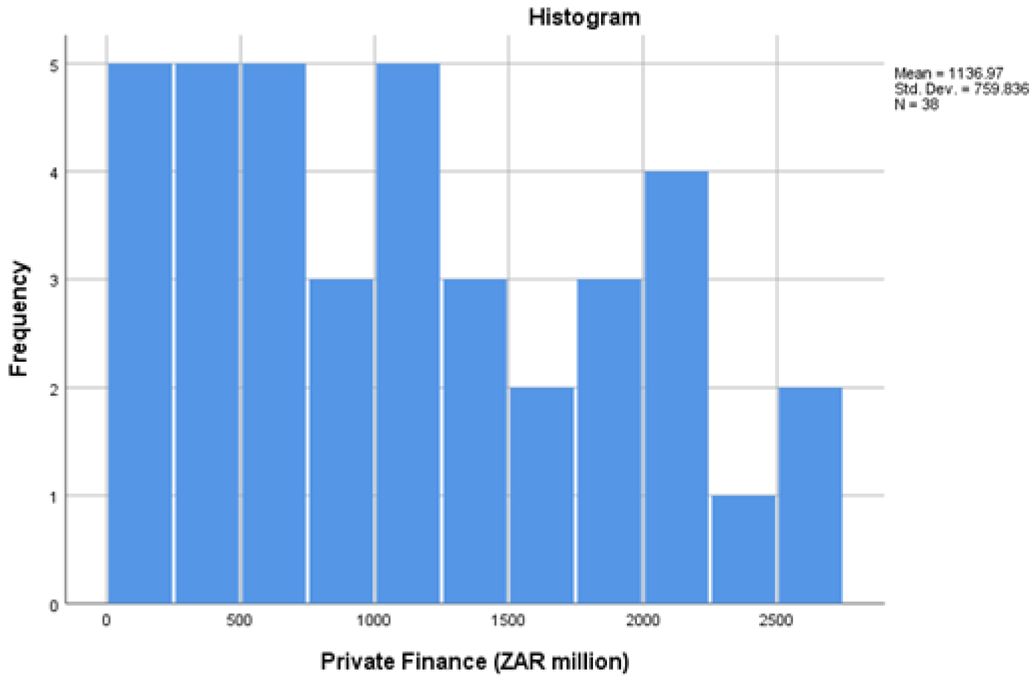
	Median		19.8340	
	Variance		194.911	
	Std. Deviation		13.96106	
	Minimum		.00	
	Maximum		48.20	
	Range		48.20	
	Interquartile Range		15.25	
	Skewness		.315	.383
	Kurtosis		-.461	.750
Project Capacity (MW)	Mean		71.9379	7.16020
	95% Confidence Interval for Mean	Lower Bound	57.4300	
		Upper Bound	86.4458	
	5% Trimmed Mean		71.8228	
	Median		75.0000	
	Variance		1948.200	
	Std. Deviation		44.13841	
	Minimum		5.00	
	Maximum		140.00	
	Range		135.00	
	Interquartile Range		74.00	
	Skewness		.086	.383
	Kurtosis		-1.128	.750
LnTariffp	Mean		.3207	.08513
	95% Confidence Interval for Mean	Lower Bound	.1482	
		Upper Bound	.4932	
	5% Trimmed Mean		.3175	
	Median		.1310	
	Variance		.275	
	Std. Deviation		.52478	
	Minimum		-.33	
	Maximum		1.02	
	Range		1.34	
	Interquartile Range		1.12	
	Skewness		.343	.383
	Kurtosis		-1.541	.750
Long-Term Interest Rates (%)	Mean		7.9205	.06233
	95% Confidence Interval for Mean	Lower Bound	7.7942	
		Upper Bound	8.0468	
	5% Trimmed Mean		7.9031	
	Median		7.9000	

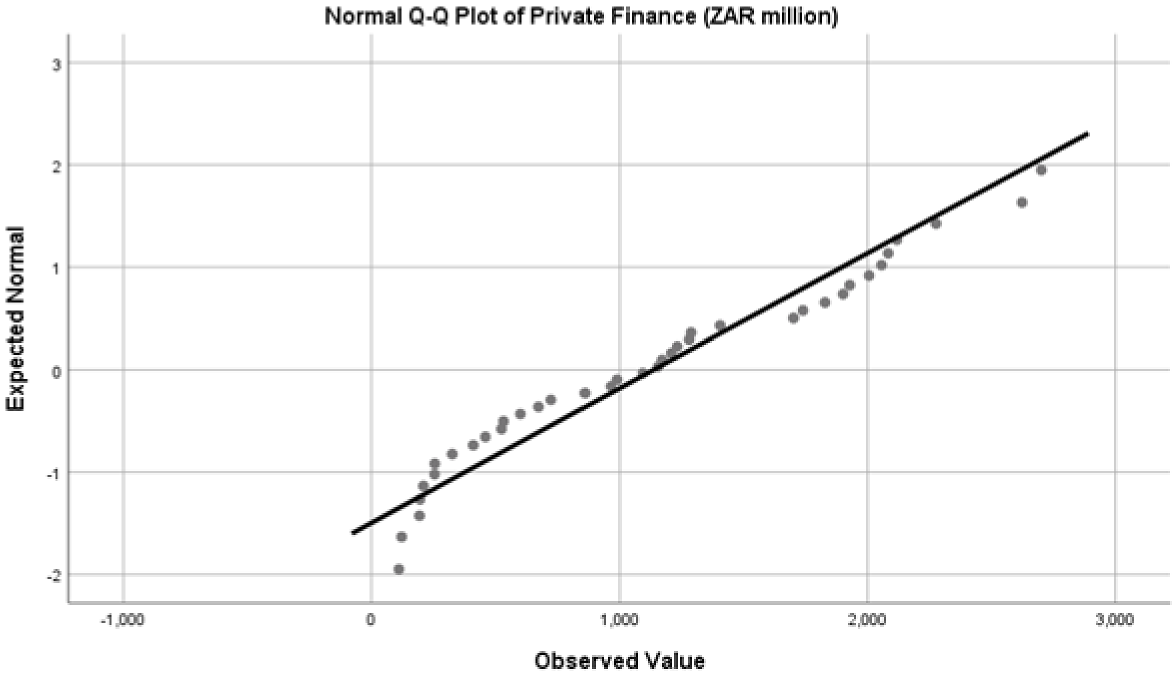
	Variance	.148	
	Std. Deviation	.38424	
	Minimum	7.23	
	Maximum	8.93	
	Range	1.70	
	Interquartile Range	.39	
	Skewness	.314	.383
	Kurtosis	1.563	.750

Tests of Normality

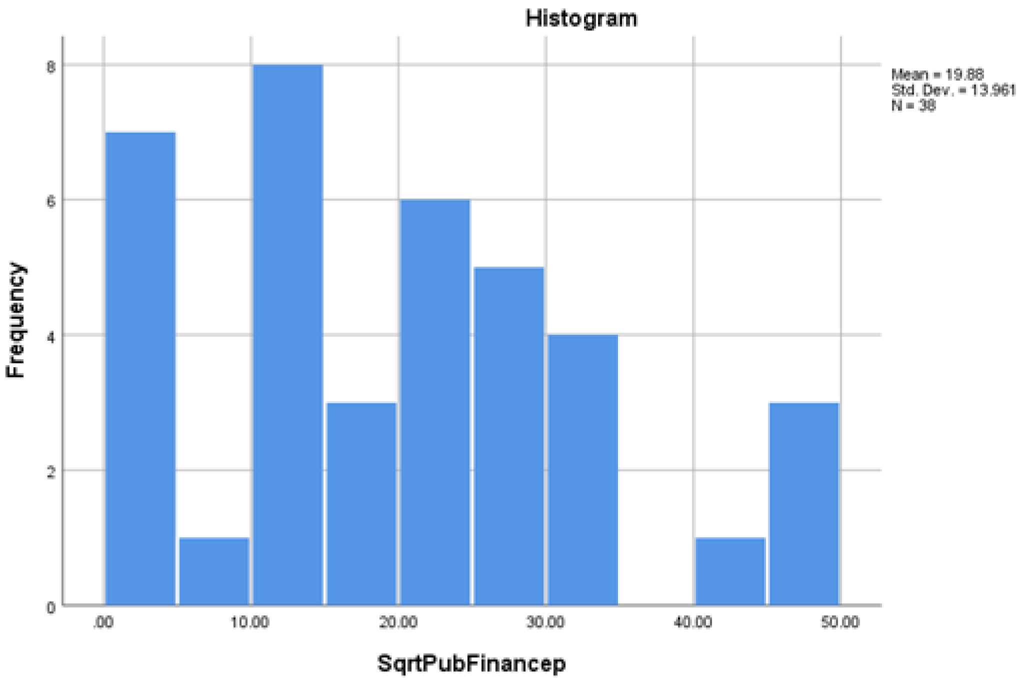
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Private Finance (ZAR million)	.102	38	.200*	.939	38	.038
SqrtPubFinancep	.107	38	.200*	.943	38	.052
Project Capacity (MW)	.135	38	.077	.927	38	.016
LnTariffp	.223	38	.000	.825	38	.000
Long-Term Interest Rates (%)	.258	38	.000	.846	38	.000

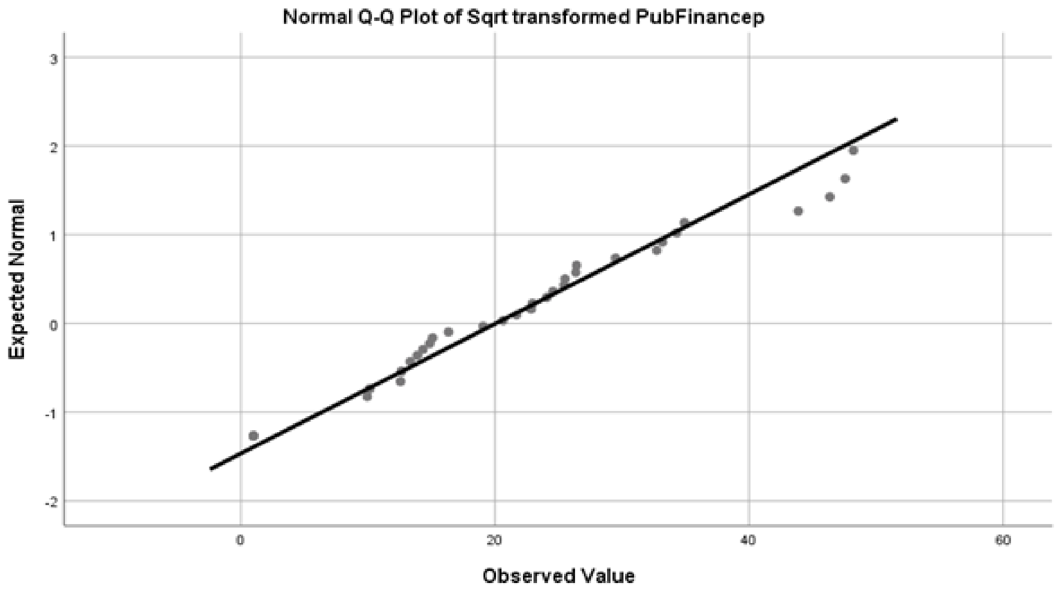
Private Finance



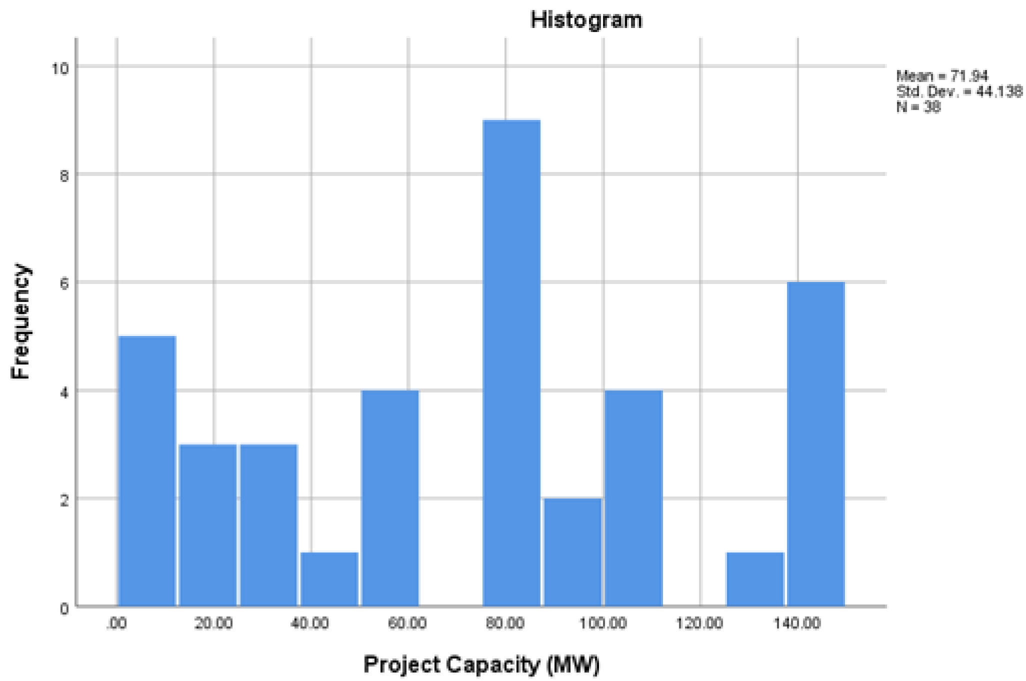


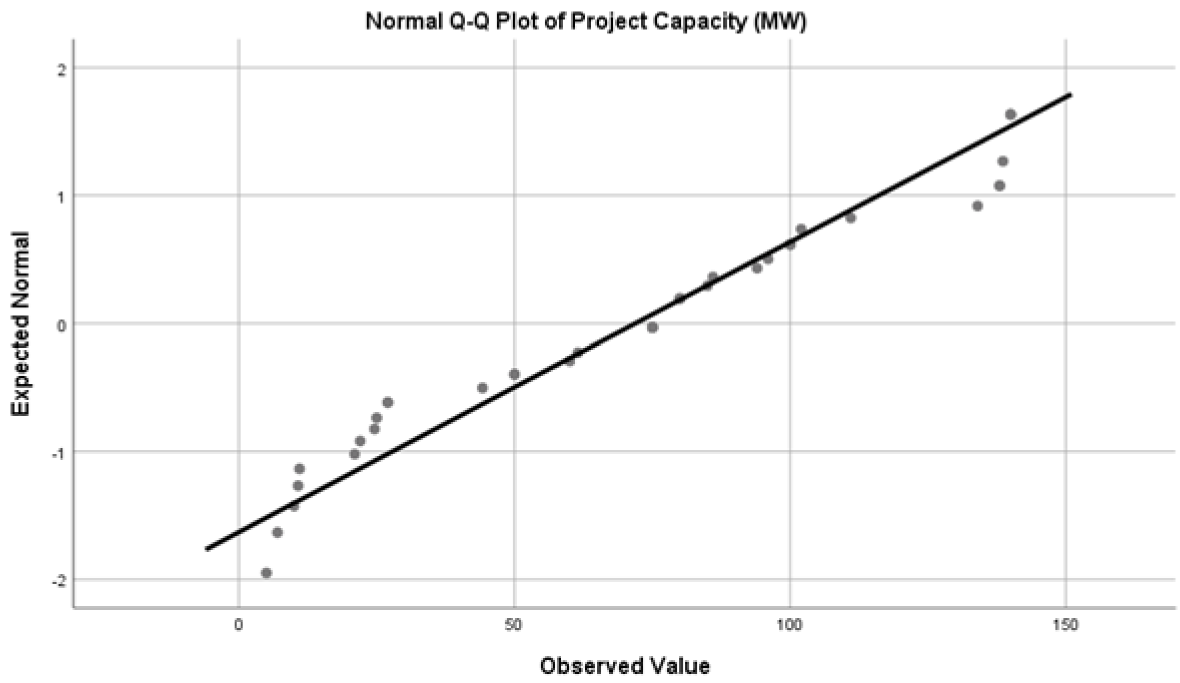
Public Finance



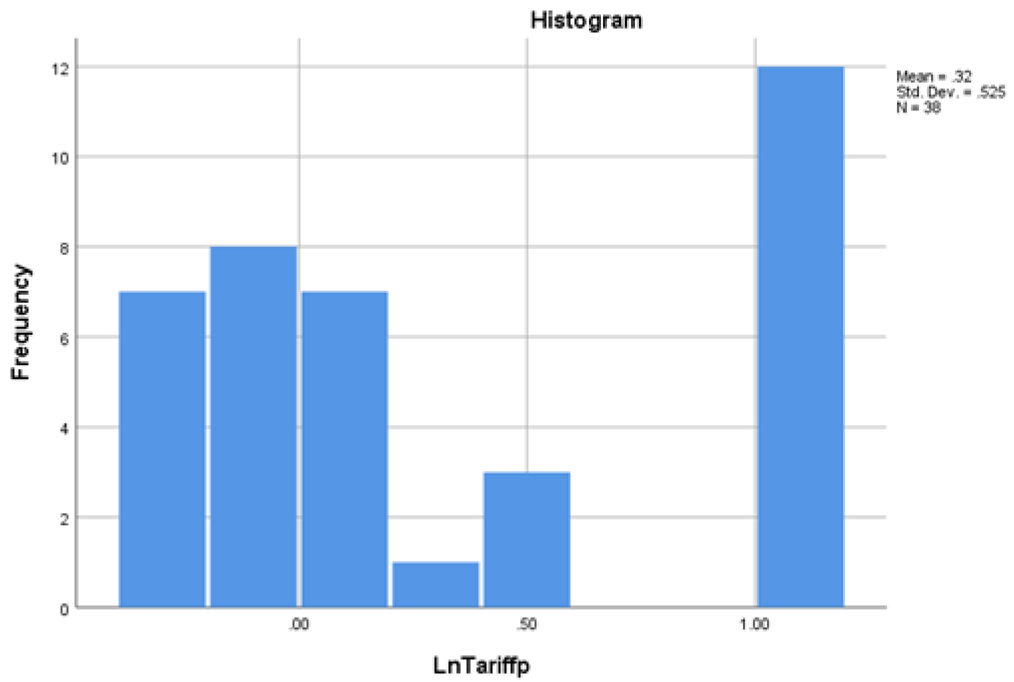


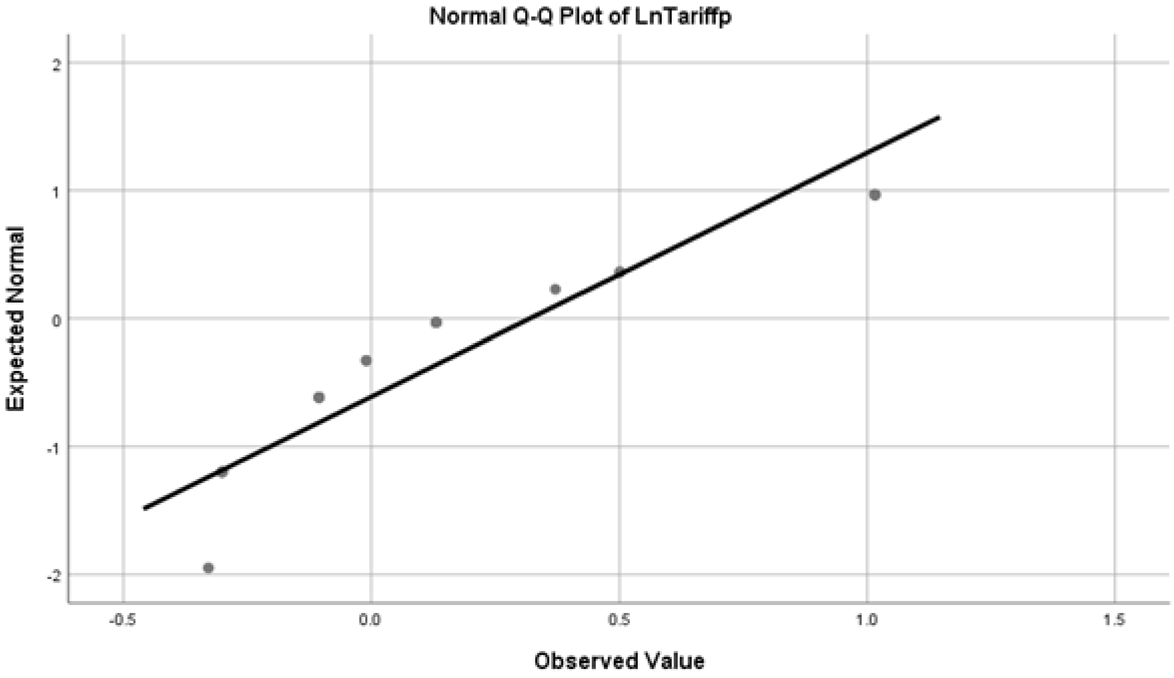
Project Capacity



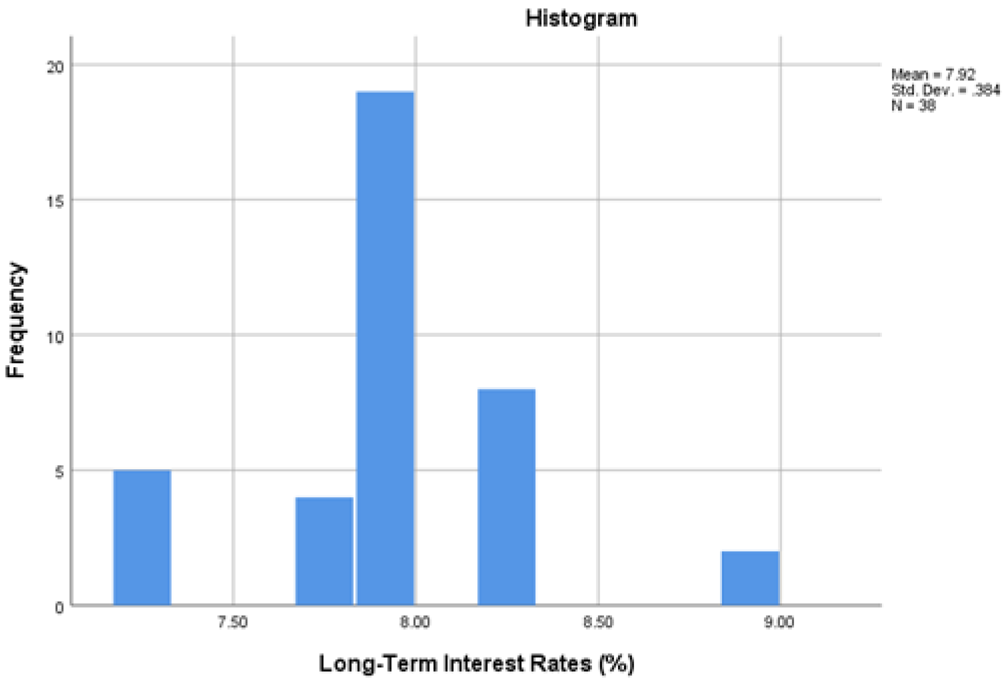


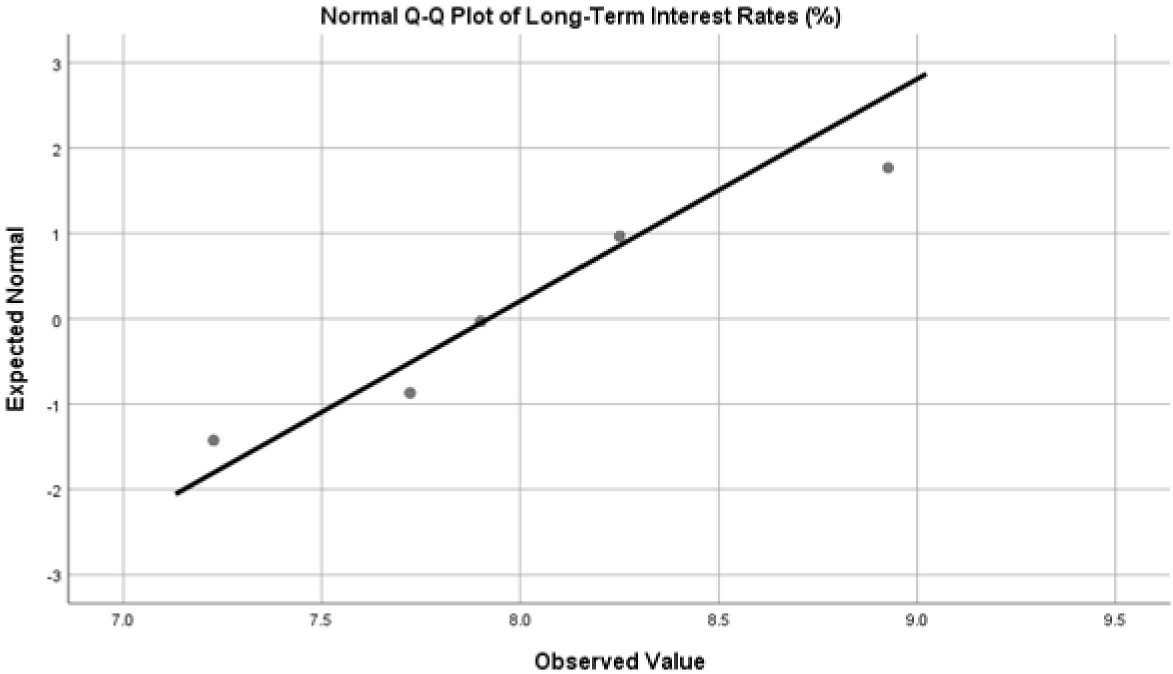
Average Tariff





Long-term Interest Rates




Normal Q-Q Plot of Long-Term Interest Rates (%)
Expected Normal
3
2
1
0
-1
-2
-3
7.0
7.5
8.0
8.5
9.0
9.5
Observed Value

Appendix C: Descriptive statistics for Green Growth Variables (2004 – 2015)

1. CO2 Intensity

	Germany	Brazil	Russia	India	China	South Africa
Mean	9.3313895	1.907051	10.5662225	1.244306283	5.387591833	7.814716917
Standard Deviation	0.345391336	0.24822323	0.32363235	0.234373303	1.026905893	0.225305596
Minimum	8.875973	1.661162	10.0662	0.9131226	3.594805	7.519586
Maximum	9.848785	2.325511	11.19891	1.578239	6.505528	8.396789
Count	12	12	12	12	12	12

2. CO2 Emissions

	Germany	Brazil	Russia	India	China	South Africa
Mean	758.775	374.625	1515.675	1531.525	7330.116667	402.5833333
Standard Deviation	29.29204437	61.41892106	44.82556342	360.0735155	1530.326205	21.81237486
Minimum	720.3	309.8	1440.4	1028.3	4723.6	372.3
Maximum	804.8	474.9	1604.4	2066	9040.7	434.6
Count	12	12	12	12	12	12

3. Energy Intensity

	Germany	Brazil	Russia	India	China	South Africa
Mean	3.964814083	1.309982	4.81126525	0.544535108	1.764523917	2.689080833
Standard Deviation	0.166741155	0.123061806	0.227551811	0.073272863	0.321611281	0.109208843
Minimum	3.751653	1.136968	4.494396	0.4410648	1.22878	2.568695
Maximum	4.247378	1.484616	5.159125	0.6501855	2.12827	2.92569
Count	12	12	12	12	12	12

4. Renewable Electricity

	Germany	Brazil	Russia	India	China	South Africa
Mean	17.91672617	83.284415	16.90145	16.39298333	18.4198925	0.899355258
Standard Deviation	6.570646753	5.592806349	1.08963733	1.008159015	2.782648437	0.509827164
Minimum	9.267474	73.08208	15.56373	14.4825	15.26335	0.4429942
Maximum	29.23177	88.99577	18.95624	17.86409	23.92682	2.255042
Count	12	12	12	12	12	12

5. Forests

	Germany	*Brazil*	*Russia*	*India*	*China*	*South Africa*
Mean	68.15802455	1.248601391	2.580056391	0.115383837	0.277003091	17.67536364
Standard Deviation	2.078836266	0.474485997	1.53179011	0.248999003	0.616294275	2.8072716
Minimum	65.01617	0.3169421	0.194585	0	0	11.63824
Maximum	72.90848	1.82432	4.759519	0.6421431	1.526352	23.28374
Count	11	11	11	11	11	11

6. PM2.5

	Germany	*Brazil*	*Russia*	*India*	*China*	*South Africa*
Mean	14.26470364	10.16984745	15.33281636	51.14934727	48.45520091	20.34873545
Standard Deviation	0.976797034	0.799935762	1.313330464	3.213080794	2.201212065	2.172269654
Minimum	13.25632	8.939332	13.74418	46.62827	44.19006	17.45024
Maximum	16.56283	11.26864	18.06864	57.3224	51.60458	26.09517
Count	11	11	11	11	11	11

7. Real GDP per capita

	Germany	*Brazil*	*Russia*	*India*	*China*	*South Africa*
Mean	39824.57917	13707.65583	21856.33583	4313.931083	8874.559083	11524.205
Standard Deviation	1956.210924	1170.357274	2271.906459	904.2893318	2682.892776	638.843069
Minimum	36660.26	11840.02	17294.86	2986.032	4991.347	10154.7
Maximum	42619.34	15111.16	24311.68	5791.651	13051.8	12139.09
Count	12	12	12	12	12	12