Gordon Institute of Business Science
University of Pretoria

Project finance in Sub-Saharan African power plants: prevalence and influence of drivers

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A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements of the degree of Master of Business Administration

07 November 2018

Abstract

Electricity supply in Sub-Saharan Africa is inadequate, unreliable and costly. With cheap energy resources such as sun light, wind, hydropower, and natural gas widely available in the region, the problem is infrastructure to harness them. Given the high cost of infrastructure and other pressing social needs placing demands on government budgets, the support of private sector is needed in the provision of the infrastructure.

Project finance (PF) may be instrumental to firms in raising funds for infrastructure projects given the region's economic and political uncertainties. The risk mitigation properties and non-recourse nature of PF affords project sponsors the means to implement lucrative, high risk projects without risking the core firm. It also enables firms take up larger projects than their corporate balance sheets can support. Corporate finance, which depends on the inherent value of the firm, limits its scope of projects. PF could be a potent answer to the infrastructure challenge in Sub-Saharan Africa.

The research aimed to understand the prevalence of PF as well as the extent of influence of its drivers in power plant projects in Sub-Saharan Africa. Analysing 156 projects from 22 countries, with financial close between 200 and 2016, PF was found to be highly prevalent in the sector. Its use increased with increase in investment size but decreased with increase in country political risk. PF was found to be an effective investment mechanism, but high country political risk is a hinderance to its use. Reduction in political risk in the region will enhance PF and infrastructure investments.

Keywords: project finance, Sub-Saharan Africa, power plants, investment size, country risk

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements of the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination at any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

James Anafi

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07 November 2018

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Glossary

GW	-	gigawatts
ICRG	-	International Country Risk Guide
IPP	-	Independent Power Project
MW	-	megawatts
PPA	-	Power purchase agreement
PPI	-	Private participation in infrastructure
TWh	-	terawatt hours
SOE	-	State owned enterprise
SPV	-	Special purpose vehicle
USD	-	United States Dollar

1 Introduction to research problem

1.1 Research title

Project finance in Sub-Saharan African power plants: prevalence and influence of drivers

1.2 Description of the problem

1.2.1 Poor state of electricity provision in Sub-Saharan Africa

Populations in a number of African countries experience extremely low access to modern energy services. Irregular electricity supply is a phenomenon experienced by many countries on the continent. The problem is particularly severe in Sub-Saharan Africa (Eberhard, Gratwick, Morella, & Antmann, 2017).

There is a wide variation in national electrification rates (percentage of national population with access to electricity) in Sub-Saharan Africa. South Africa has a relatively high rate of 85%, but the figure goes as low as four percent for Chad and three percent for the Central African Republic (International Energy Agency, 2014b). Clearly some countries in the region are getting it right while others are failing dismally.

As pointed out by Eberhard and Shkaratan (2012), Sub-Saharan Africa is underpowered and experiencing a crisis of electricity supply. The region has the lowest household power grid connections, and electricity supply is inadequate, unreliable, and costly. To put the situation into context, as of 2014 the combined generating capacity of all the 49 Sub-Saharan African countries was 92 gigawatts (GW). This was less than the generating capacity of a single country, Spain, that stood at 106 GW (Eberhard et al., 2017; EIA, 2014; Findt, Scott, & Lindfeld, 2014). Generating capacity of the region has not grown much over the last thirty years. Only 1.84 GW of additional capacity was added in the 1990s. There was an improvement in the situation after 2000 with 13.8 GW being added between 2000 and 2013 apart from South Africa. This increase in capacity was poorly distributed with 94% of it going to just 15 countries and some countries actually losing capacity due to civil war and poor maintenance (Eberhard et al., 2017; EIA, 2014). This has resulted in an increasing difference between countries of the Sub-Saharan Africa region and their peer developing countries in other parts of the world (Eberhard & Shkaratan, 2012; Pierce, Yepes, & Foster, 2008). The dire situation was confirmed by Banerjee et al. (2008) who found that Sub-Sahara Africa lags behind other regions with more than three out of every ten inhabitants of Sub-Saharan Africa lacking electricity,

which compares unfavourably with 50% and 90% in South Asia and East Asia respectively.

Electricity demand in Sub-Saharan Africa is projected to increase from its 2012 level of 385 terawatt hours (TWh) to an approximate level of 1250 TWh by 2030. 2040 is expected to see a demand level of 1870 TWh. These projections are linked to a Sub-Saharan Africa yearly growth rate of 4.6% (International Energy Agency, 2014b). Supply of electricity in Sub-Saharan Africa is unreliable owing to ageing plant and poor maintenance. This has resulted in 15% of existing capacity not being operational (Eberhard, Rosnes, Shkaratan, & Vennemo, 2011; Eberhard & Shkaratan, 2012). Due to the very low supply reliability, own generation forms a significant part of the region's installed capacity. Backup power generators make up half of the capacity of Mauritania, Democratic Republic of Congo and Equatorial Guinea. For West Africa, the combined figure is 17% (Eberhard & Shkaratan, 2012).

The weak state of permanent power infrastructure in Sub-Saharan Africa has resulted in an over reliance on cost-inefficient temporary emergency power generators, which are connected to the grid to meet pressing power shortfalls. A sizable 750 MW of the region's electricity generating capacity is attributable to this expensive mode. The region's power tariffs are on average double compared to those of other developing parts of the world. The use of expensive generation modes such as emergency power generation and own generation is responsible for the high cost. Other factors include low economies of scale resulting from limited size of national systems, 33 of the 49 countries have national installed capacity smaller than 500 MW. The situation is made worse by inefficient public utilities, and poor regional corporation and integration which has led to sub-optimal selection of system design options (Eberhard & Shkaratan, 2012).

Supplying adequate electricity to Sub-Saharan Africa appears a daunting task for the region. This is clearly not due to a lack of energy resources, the region is rich in resources such as hydropower, natural gas, coal, and sun light. The inadequate power is rather due to the poor use and utilisation of the available resources (Rosnes & Vennemo, 2012).

1.2.2 Power infrastructure investment challenge

The two main challenges confronting the provision of electricity in Sub-Saharan Africa are improvement of rates of access and expansion of infrastructure to meet demand (Taliotis et al., 2016). To address these challenges, extensive investments in infrastructure are required. These have to target power generation, efficient transmission, and reliable distribution (Rosnes & Vennemo, 2012; Taliotis et al., 2016).

Having the energy resource is one thing, developing and utilising it can be quite an undertaking. The cost of developing a large hydropower plant can be overpowering for a poor Sub-Saharan African country. The hydropower resources are usually located in remote areas, which adds more cost to transmission of power to population centres. Cost is a major constraint to solving the power problems of Sub-Saharan Africa (Eberhard & Shkaratan, 2012; Rosnes & Vennemo, 2012). A major step in solving the problem is the determination, to an appropriate level of confidence, of the required investment to provide the needed electricity. This surprisingly had not been done until (Rosnes & Vennemo, 2012). Rosnes and Vennemo (2012) have estimated the cost of supplying adequate electric power to Sub-Saharan Africa by taking account of each country's demand for electricity, generation potential, and electricity trading opportunities with neighbours. These were optimally modelled to obtain the cost of providing the required electricity. The exercise estimated a required investment of USD 160 billion to USD 215 billion over an investment period of 10 years. The amount can provide 100 – 120 GW from both revamping the existing and new provision of power infrastructure including required transmission and distribution networks. Converting the above cost to an annual amount, USD 28 – 37 billion will be needed per year to meet the cost of providing the additional capacity requirements of Sub-Saharan Africa (Rosnes & Vennemo, 2012). An estimated 50% of the cost will target development of new generating capacity, 13% for the overhauling of existing infrastructure for generation and transmission and the remaining for the development of new networks for transmission and distribution (Eberhard & Shkaratan, 2012).

According to Eberhard and Shkaratan (2012), 80% of the existing USD 11.6 billion spent on power infrastructure needs is sourced domestically. This includes taxes and user charges. A significant proportion, 75%, of the domestic spending is used for funding operations and maintenance of infrastructure. Fifty percent of capital expenditure comes from domestic public sector, while the remainder comes from donor countries and the private sector (Eberhard & Shkaratan, 2012).

Comparing the current spend of USD 11.6 billion and the required USD 28 – 37 billion, illustrates the significant funding gap which leads Eberhard and Shkaratan (2012) to advocate that "the ideological debate of public versus private be set aside and all mechanisms and resources to reduce the gap be mobilized" (Eberhard & Shkaratan, 2012, p. 13).

Irrespective of the source of funding, private or public sponsorship, the initial decision that needs to be made by the sponsoring firm is to choose between the two major project

funding options. Absorb the project onto the sponsor's balance sheet, which will mean using corporate finance or isolate the project from the core firm, which will mean starting a new balance sheet for the project using project finance (PF). Using corporate finance, will entail securing any credit given by lenders for the project with the core sponsoring firm's assets and cash flows (for public entities, the cash flows include future tax revenue). This is the traditional way that both private and public enterprises finance investments (Esty, 2004). In contrast, with PF, a new entity, a special purpose vehicle (SPV), is formed by the sponsors to incorporate the project. Lenders will rely only on cash flows emanating from the new project, there is no or limited recourse to the project sponsor's other assets (Steffen, 2018).

1.3 Purpose of the research

1.3.1 Research problem

The makeup of project sponsors seeking capital currently to put up power plants is well documented (Steffen, 2018). Globally, in 2015, state-owned enterprises commissioned 61% of all new conventional power plants, with private companies accounting for 35%, and households/ communities took up the remaining 4% (International Energy Agency, 2016b). Not much is known, however, about the structuring used to fund the power plants (Steffen, 2018).

PF has traditionally been utilised for high-risk sizeable projects to help sponsors shield their core firms from the ramifications of a possible project failure (contamination risk). Power plant projects, particularly large complex ones, have been perfect cases for PF. PF is typically used to fund capital intensive projects by both private and public sector sponsors (Gatti, 2013; Pinto, 2017). As further indicated by Pinto (2017), although PF is growing as a segment of financial markets and is economically significant, it remains largely understudied.

Studies of PF in the Sub-Saharan African power plant sector, to the knowledge of the author, have not been done and this research seeks to fill that gap. PF may be very useful to the sector as it tries to meet the high projected demand for electricity in an environment of economic and political uncertainties. These uncertainties limit the capability of sponsoring firms to raise funding. Given the high demand and supply gap of electricity in Sub-Saharan Africa, power plant projects themselves could be leveraged to raise the required funds through PF deals.

1.3.2 Scope of the research

The research studied investments in power plant infrastructure projects in Sub-Saharan Africa. The focus was on power plant projects with capacities of at least 5 MW that reached financial close between 2000 and 2016 (Eberhard et al., 2017). The research sought to do the following:

- gauge the prevalence of PF in power plant infrastructure investments in Sub-Saharan Africa; and
- assess the extent of influence of the drivers of PF on the use of PF in power plant infrastructure investments in Sub-Saharan Africa.

1.3.3 Academic rational for the research

The research allowed the empirical testing of theory relating to PF as a means of risk mitigation in the funding of large power plant projects in Sub-Saharan Africa. This is important research as power plant projects in the region are exposed to varying degrees and combinations of risks and opportunities.

Previous academic studies on the role of PF in infrastructure finance like Ben Ammar and Eling (2015); Bonetti, Caselli, and Gatti (2010); Brealey, Cooper, and Habib (1996) have not considered the particular case of power plant infrastructure in the unique combination of risk and opportunity presented by the Sub-Saharan Africa context. The general characteristics of PF have been assumed to apply to power plant infrastructure projects without any particular variation. However, as was found by Steffen (2018), PF in power plant projects in a low-risk investment location did not follow the classical behaviour. The typical contamination risk rational did not hold. PF was found not to be used for big and risky projects as expected from classical PF theory, but for low-risk smaller power projects in that context.

Following Steffen (2018)'s findings in a low-risk investment location (Germany), it is of academic interest to find what the situation is in the higher risk investment environment of Sub-Saharan Africa. The findings of this research coupled with Steffen (2018) could signal the need for an adjustment of theory on PF to take cognisance of the actual behaviour of power plant projects on either ends of the risk spectrum.

1.3.4 Business rational for the research

The insights that will be provided by the research will throw more light on the importance and motivations for PF in power plant infrastructure projects in Sub-Saharan Africa. It will show which countries have succeeded in attracting investments and which have not. It will help policy makers in the region design regulations and policies that will attract private investment into the sector. Project sponsors and financial intermediaries looking to invest in the sector will also gain from the insights that will be provided by the research regarding how current investors are approaching the sector. Existing and potential business players alike will benefit from the research regarding how the most successful players are dealing with the challenges posed by the sector.

The findings from the research will be useful to private sector businesses contemplating or currently investing in power plants, public sector utility companies planning expansion projects, and donors considering supporting these initiatives. Providing adequate electrical power to Sub-Saharan Africa is vital to rousing the giant region from its decade's long slumber to achieve her huge potential. The solution to Sub-Saharan Africa's power problems lies in the provision of funding, the natural resources to generate the power are in abundance on the continent. By adopting the right financing structure, the available funding resources will be better utilised, and more funding will be attracted to the sector.

Poor electricity supply in the region affects businesses negatively directly. Formal businesses lose on average 6% of turnover due to frequent power outages, this results from foregone sales and damage to equipment. Informal businesses lose even more, about 16% on average, as they usually also lack backup generators (Eberhard et al., 2011). At the macroeconomic level, the unreliable electricity supply impacts substantially on the economies of Sub-Saharan African countries. An analysis of load-shedding data indicates that power outages cost them 2.1% of their GDP on average. Individual citizens also benefit from good power infrastructure through improved health care and nutrition as vaccines, and food can be correctly stored. Literacy and school completion rates also improve with improved electricity as students are able to study beyond day light hours (Eberhard & Shkaratan, 2012). This could result in an improvement in the supply of high-quality labour to organisations in the region.

1.4 Overview of the report

The remaining sections of the report are structured as follows:

- Chapter 2 provides a literature review on the subject matter of the research;
- Chapter 3 covers the research questions and hypotheses;
- Chapter 4 discusses the methodology used for the research;
- Chapter 5 presents results of the research process as outlined in Chapter 4;
- Chapter 6 contains a discussion of the results provided in Chapter 5; and
- Chapter 7 concludes the research by highlighting its findings, implications and recommendations for future research.

2 Literature review and theory base

2.1 Introduction

Research addressing PF has focused on general economic and financial theory. Sawant (2010) for instance, sought to explain the motivations for the use of PF by multinational enterprises in infrastructure investments. After testing data from 128 countries, he found that PF helps to manage the risk of hold-up by major suppliers and buyers, but mitigated country risk to a lesser extent. Studies looking specifically at the use of PF in the energy sector are rare (Steffen, 2018). Pollio (1998) looked at the inclination towards PF found in the world energy sector. Through review of literature and discussing the motivations of project sponsors, such as commercial banks and host governments, he reached a conclusion that the feature of PF that helps manage risk (protection of the core firm from lenders if a project should fail) is the overriding reason driving the use of PF. He emphasized that capital restrictions did not drive PF.

More recent papers have focused on the prevalence of PF in renewable energy. Specific funding structures and country contexts have dominated focus rather than the preference of PF over corporate finance. Kann (2009) examined the case of Australia and concluded that PF is the main funding structure for wind projects located onshore. This made it possible for large projects to be undertaken by small developers. This contradicts the opinion held be Pollio (1998) that capital restrictions was not an issue. In the same vain, Steffen (2018) also assessed the importance of PF in renewable energy projects in the context of low risk, investment-grade countries. He used Germany as a case study. A data set of investments in new power plant projects in Germany from 2010-2015 was used to empirically evaluate reasons for using PF by power plant project developers. Steffen (2018) found that in the context of low investment risks, PF is more important for renewable energy plants than for plants utilising fossil fuels. In that instance, PF is not used to mitigate contamination risk, but the motivation for it is to help non-utility sponsor's (such as independent project developers) deal with overhang of debt.

2.2 Project finance

Various definitions have been advanced for PF. Nevitt and Fabozzi (2001) describe PF as a mechanism through which a specific economic unit was financed. Lenders consider cash flows from the unit to be the avenue for loan repayment. Assets of the economic unit serve as security for the borrowing. Sponsor's creditworthiness does not determine the funding. The same reasoning is adopted by Gatti (2013) in referring to PF as the use

of share capital to structure financing of an economic unit. The financiers relying on cash flows for the repayment of loans. Assets of the project are considered collateral.

Stressing the non-recourse nature of debt and the fact that loan reimbursement only comes from the project itself in PF, Esty (2004) defines PF as a transaction that creates a legally distinct entity, a project company. It is funded by non-recourse debt and equity from sponsor firms. The objective is to invest in a long-term asset. In this definition, PF is differentiated from securitization, leveraged acquisitions, and structured leasing, which are other forms of structured financing.

Yescombe (2013) brings up the need to deal with risk evaluation and allocation in PF. He defines PF as a long-term debt raising technique for financing large projects that utilises financial engineering. The debt is raised against cash flows that will be produced through the operations of the project. Critically, he points out PF's dependence on the meticulous assessment of project implementation, operation and income risks and their distribution among lenders, investors and other players through contracts. To this point, Gatti (2018) adds that the approval of PF loans is not contingent on the value of collateral that sponsors are prepared to put up, but on the project's ability to make debt repayments and reward the capital investment at a rate commensurate with the level of risk inherent in the project.

Yescombe (2013) also identifies the authoritative definition of PF as that given by the Basel Committee on Banking Supervision within the Basel II rules. Their definition, apart from capturing the essence of the other definitions discussed above, also highlights the point that the borrower in a PF transaction is usually an SPV (special purpose vehicle) that is restricted from involving itself in any other business apart from developing, owning, and running the project installation.

2.2.1 Prevalence of PF

The importance of PF as a source of funding relevant to both public and private sector projects globally has been demonstrated over the last 35 years (Pinto, 2017). Its most common application is found in capital-intensive projects including power plants, industrial plants, and refineries. It is also widely used for telecommunications facilities and transportation projects such as toll roads, and pipelines. These types of projects are well suited for PF as they have relatively transparent cash flows and require long-term financing. PF especially aids the execution of these types of projects in risker than average countries (Pinto, 2017). Some Sub-Saharan African countries fall in this category.

Pinto (2017) argues that PF remains a promising area of worldwide lending activity post the financial crisis. Although the size of the market for PF was smaller compared to asset securitization and corporate bond segments in 2014, investment attracted by PF was higher than that attracted by IPOs and venture capital funds. This signals that the 2008 financial crisis only had a minor effect on the funding of large infrastructure through PF (Pinto, 2017). la Cour and Müller (2014) and Steffen (2018) disagree with Pinto (2017)'s characterisation of the level of impact of the crisis on PF, they consider the impact to be considerable. However, Pinto (2017) has the upper hand in the debate as his conclusion is based on quantification and analysis of global PF deals from 2000 to 2014 which showed that after a peak in 2008, there was only a slight drop in 2009 which was quickly recovered in 2010. Five key sectors namely, utilities, manufacturing, transportation, construction, and mining dominate PF, accounting for 77.3% of all PF lending (Pinto, 2017).

2.2.2 Characteristics of PF

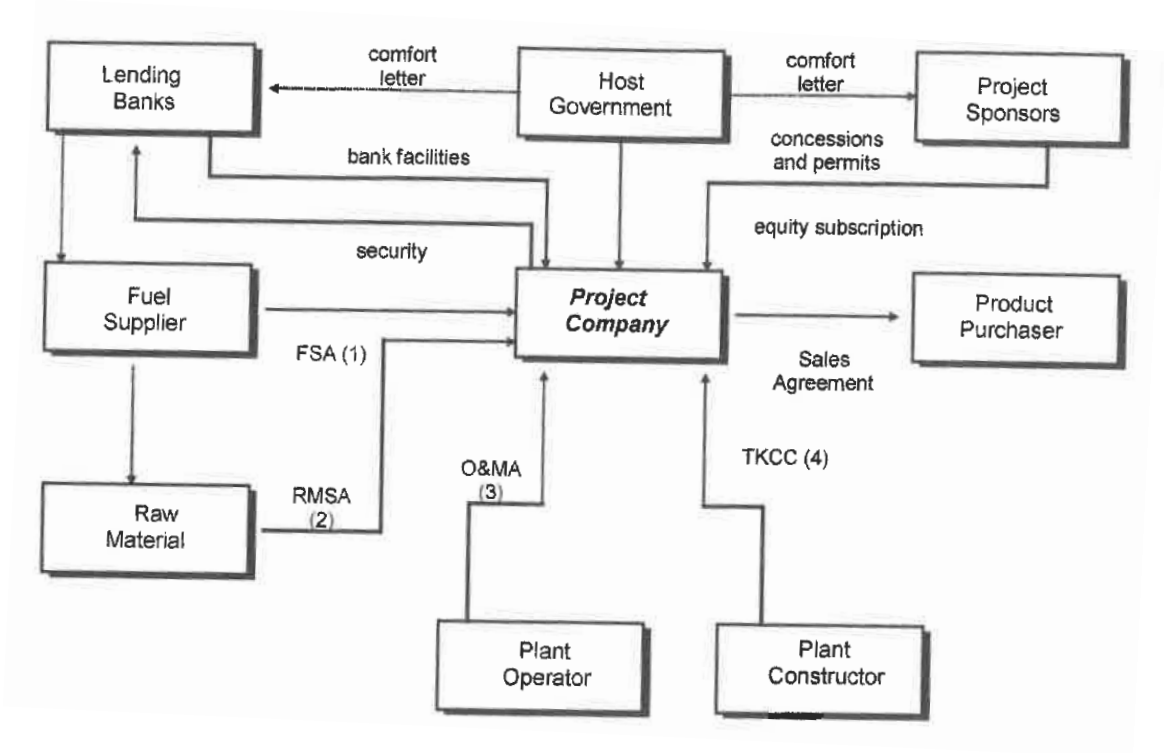

Figure 2-1: Typical structure of a PF deal

Source: (Gatti, 2018)

A typical structure of a PF deal is shown in Figure 2-1 above. PF requires the incorporation of a project company, a special purpose vehicle (SPV). The SPV is distinct from the sponsors of the project legally and financially and its life is limited to that of the

project. The sponsors of the project have very limited or no liability to the funders of the project. The major players in PF transactions are:

- project sponsors (they hold a majority share in the SPV, they could be public or private sector entities who see the project as complimentary to their core business or just as a means of generating income), and
- the host government and state-owned enterprises (SOEs) (often government entities will provide a concession to the SPV).

Other important players include professionals such as engineers, contractors, lawyers and accountants. A player may play a dual role, for example a sponsor could also be a contractor, or a bank could play the roles of sponsor and lender (Pinto, 2017).

An important feature of PF is the mode of risk allocation. Players that are best placed to handle a particular risk get allocated that risk. Given the method of loan repayment, the revenue from the project has to be adequate to take care of operations as well as servicing of debt. Projects are appraised on their own merits, sponsors have no influence on project appraisal. Funders' loans to the SPV are secured by the project assets (Pinto, 2017). This description of PF is supported by Byoun, Kim, and Yoo (2013) who also emphasize that project companies are more levered and their level of leverage depends on the level of project risk.

As stated by Corielli, Gatti, and Steffanoni (2010), fundamental to a PF transaction is a collection of contracts with third parties. These include:

- construction contracts,
- guaranteed raw materials purchasing agreements (guaranteeing the supply of inputs to the SPV of specified quantities and costs),
- selling agreements that guarantee the buying of the SPV's outputs, and
- operations and maintenance contracts for the SPV.

These contracts are presented to funders and form the basis of negotiations for the amount and cost of external funding made available to the SPV. This is supported by Finnerty (2013) who notes that on average SPVs have 70% leverage and more than 40 contracts which share their cash flows. The network of contracts, shown in Figure 2-1 above that the project company sets up with the different parties, determine the success of the PF deal (Gatti, 2018).

Vaaler, James, and Aguilera (2008) found PF debt intensities to be 75% on average. According to Sawant (2010), PF exhibits levels of debt much greater than seen in corporate finance, and PF debts are provided by groups of lenders. Finnerty (2013) concurs, noting that the loan syndicates are made up of commercial banks, pension funds, insurance companies, equipment vendors, export credit agencies and multilateral development institutions. These institutions provide 90% of PF debt while capital market bonds provide the remaining 10%.

2.2.3 Risk management in PF

Analysis of risks inherent in the project is fundamental to PF (Pinto, 2017). (Gatti, 2013) supports this view and categorises the risks as follows:

- pre-completion phase risks (these include construction risk),
- completion risks (these include supply and demand risks), and
- risks associated with both phases (these include country risk).

The process of risk management is critical to PF. The process usually incorporates the identification of risks, followed by their analysis, transfer, allocation, and the management of residual risks. This process is central to PF because it allows the identification of project risks and their proper allocation to the various project players. The allocation of risks in PF incentivises the participants in the venture (Pinto, 2017). This mechanism allows the players to utilise their comparative advantage to generate revenue.

2.2.4 Advantage and disadvantages of PF

A major strength of PF is the use of non-recourse debt that is contracted based on the merits of the project itself. Brealey et al. (1996) argue that PF is able to resolve agency issues well and better manage risk. This is supported by Sawant (2010) who extends the argument to include the point that PF also mitigates underinvestment costs as the separation of firm assets from the project allows earnings generated by the project to accrue to the providers of the project's capital and not be accessed by debt providers of the sponsoring firm.

In general, the literature identifies the following categories of advantages offered by PF (Brealey et al., 1996; Byoun et al., 2013; Esty, 2004; Gatti, 2013; Nevitt & Fabozzi, 2001; Sawant, 2010, 2012; Steffen, 2018):

- Its high leverage structure disciplines project players to prudently use free cash flow which is required to pay off debt, in this way costly agency conflicts are mitigated.
- The high leverage also generates economic benefit through increase in interest tax shields.
- PF also allows firms with low debt capacity to pursue positive NPV projects through PF thereby avoiding a debt overhang and the opportunity cost of underinvestment.
- Firms through PF are able to carry out risky but lucrative projects without fear of contaminating the core firm if the project went bad.

Gatti, Kleimeier, Megginson, and Steffanoni (2013) add another dimension by empirically showing that PF reduces loan spreads thereby creating value for firms.

The major drawback of PF is the higher cost of structuring compared to corporate finance deals. This disadvantage is due to the higher complexity and lengthy negotiations required to pull off PF deals. However, both Esty (2004) and Bonetti et al. (2010) both indicate that the extra structuring cost of PF is more than made up for by the advantages derived from PF deals in terms of net financing cost reduction, financing off balance sheet, and risk mitigation and appropriate allocation.

PF also suffers from more rigidity in its governance compared to corporate finance. Typically, most aspects of a PF project's operations and management are governed by rigid interlocking contracts. These restrict management autonomy especially in terms of capital structure and use of cash (Sawant, 2010). Also, as was shown by Gatti (2018), a project could benefit from the effects of coinsurance and commingling of cash flows from different projects carried out by a single company. This allows struggling projects to be supported by proceeds from other projects. This advantage is enjoyed by corporate financed projects but not PF ones. The absence of coinsurance and commingling of cash flows could result in the failure of an otherwise good project because of temporary cash flow problems.

2.3 Power plant infrastructure projects in Sub-Saharan Africa

2.3.1 Demand and supply

The 49 countries of the Sub-Saharan Africa region have a severe power shortage. As of 2014 their combined population of 800 million people had access to only 92 GW of electricity generation capacity. This is less than Spain's 106 GW capacity serving her 45

million people. The fact that South Africa alone retains half of Sub-Saharan Africa's power capacity puts the dire situation of the remaining 48 countries in proper perspective (Eberhard et al., 2017; EIA, 2014; Findt et al., 2014).

Electricity demand in Sub-Saharan Africa is expected to double by 2030, and triple by 2040. Recent estimates put the amount of investment required for additional generation capacity to meet 2040 projected demand at USD 490 billion. The region (including South Africa) only invested USD 45.6 billion in electricity generation capacity from 1990 to 2013 (Eberhard et al., 2017). The levels of investment are clearly nowhere near what is needed and private sector participation is required (Eberhard & Shkaratan, 2012). The main source of private sector participation in the region's power industry is Independent Power Projects (IPPs) (Eberhard et al., 2017).

2.3.2 Investment trends

Investments in Sub-Saharan Africa's electricity sector have been far below requirements. A 1.84 GW addition of capacity was made in the 1990s. The picture improved somewhat from 2000 with 13.8 GW being added between 2000 and 2013 (excluding South Africa). This investment was still quite restricted with 94% going to just 15 out of the 48 countries. Some countries actually lost generating capacity due to wars and poor infrastructure maintenance (Eberhard et al., 2017; EIA, 2014).

The power investment landscape in Sub-Saharan Africa is changing. Historically, power investments have only come from government sources through public utilities. However, now most of the governments cannot fully fund the needed investments and the public utilities lack investment grade rating so can also not raise enough debt at affordable rates. Western donor support represents only a small portion of investments and is stagnated. The sources with the quickest growth are private investments in power projects and Chinese funding. This notwithstanding, the government sources still constitute about 50% of investments in the sector. This source is stagnant and so the private sector and Chinese funding are set to dominate the sector in future (Eberhard et al., 2017; International Energy Agency, 2016a).

2.3.3 Private involvement

The first independent power project (IPP) in Sub-Saharan Africa was in Cote d'Ivoire in 1994, the second was in Kenya in 1996. Since then there has been about 151 IPPs in the region worth over USD 30 billion in investments. These have only served to compliment public utilities and represent a small portion of the region's generating

capacity. Most of the IPPs are less than 100 MW in capacity, but the biggest is about 600 MW in size. While there has been a recent increase in renewables (wind and solar) the overwhelming majority (about 82%) of the IPPs is thermal (Eberhard, Gratwick, Morella, & Antmann, 2016; Eberhard et al., 2017; Eberhard & Gratwick, 2011).

Sponsors and debt providers of the IPPs in Sub-Saharan Africa are varied. The majority are European with a few from North America, Asia and also Africa including SOEs (Eberhard et al., 2017). Considering the fact that out of the 49 countries in the region, only Mauritius, South Africa and Botswana are rated as investment grade, the growth in IPPs in the region has been impressive. The investment grading is bound to have an impact on PF options available to the IPPs in the region (Mecagni et al., 2014).

Other issues that have been recognised in the literature as contributing to the success and attraction of IPPs in the region are: independent regulation, power planning, procurement and contracting, and risk mitigation (Eberhard & Gratwick, 2011; Eberhard et al., 2011; Eberhard & Shkaratan, 2012; Findt et al., 2014; Kapika & Eberhard, 2013). At the heart of all these issues is the appropriate handling of risk in these projects. Risk should be eliminated or avoided when the level of risk is deemed unacceptable, in which case investment could be delayed. Risk can also be reduced through strategies such as financial hedging and fixing of prices and quantities. It can also be made manageable through collaborations between firms, and with long-term contracts that result in the spread of risk (Kardes, Ozturk, Cavusgil, & Cavusgil, 2013).

A major risk for IPPs is security of revenue because of the poor financial health of most public utilities who are their off-takers. The credit ratings of most of the utilities are poor and they are also very inefficient. Considering inefficiency in terms of a combination of losses in their distribution systems and revenue that is not collected as a proportion of turnover, African utilities have inefficiency equivalent to on average half of their turnover (Eberhard et al., 2017).

2.4 Theory of PF in infrastructure projects

Infrastructure assets require large capital and high sunk costs. These costs are only recoverable by the investor over long periods of time (Sawant, 2010). Investments in these assets, which are usually financed through debt, can only be recouped through the productive operation of the assets over a lengthy period (Sawant, 2010). As the size of infrastructure investments increase so do the risks of contamination of the sponsoring firm in case of project failure. Failure of a large infrastructure project with large sunk costs could seriously jeopardise the financial stability of the sponsor if it is liable for debt

repayment. As PF incorporates non-recourse debt, firms would tend to use PF more with increase in project investment size (Sawant, 2010; Steffen, 2018).

The opposite of contamination risk, securitisation, is also a good reason for the use of PF in infrastructure projects. As was shown by Leland (2007), firms with risky core businesses can securitise low risk assets into a separate entity using PF, allowing them to finance the new entity at a lower cost. Leverage is another reason that could make PF attractive to firms. Since PF projects are self-contained and do not depend on the sponsor's capital structure, sponsors can choose higher debt ratios for PF projects than they can for corporate finance projects. This allows firms to benefit from the value created by increased tax shielding (John & John, 1991).

Infrastructure assets such as power plants are susceptible to creeping expropriation (nationalisation) from governments of the countries where they are located. These assets are tangible, highly locality specific and cannot be easily relocated for other uses. They tend to provide vital economic and social needs which make them attractive to governments for nationalisation. Corporate finance-based investments are not efficient in mitigating these risks. These risks are very pertinent to power plants especially in some Sub-Saharan African countries with unstable economic and political environments.

PF on the other hand can make use of its high leverage and syndicated capital structure to strengthen the negotiating position of firms to allow mitigation of these risks. Its non-recourse debt and high leverage also precommits cash flows to debt servicing. This induces the lenders to back firms in negotiations with host governments to protect the firm's ability to repay the loans. The lenders are usually syndicates of big, important international financial players sometimes including multilateral organisations such as the World Bank's International Finance Corporation (IFC). The involvement of lenders in negotiations on the behalf of PF firms, significantly improves the chances of the firms compared with the firms taking on the host governments on their own (Sawant, 2010). As was shown by Woodhouse (2005), when multilateral institutions get involved in renegotiations, they significantly influence the results in favour of investors. This is supported by Hainz and Kleimeier (2012) who found that the tendency to use PF increases with political risk. Development banks take part in the syndicates that fund these projects and they use their influence on host governments to ensure good outcomes for the projects.

Cash flows being precommited to debt servicing also reduces the project firm's reported net profits. This reduces the firm's attractiveness to nationalisation or windfall taxing.

High profits accruing to a firm providing an essential national service can make the firm seem exploitative and unreasonable, and thus justify nationalisation (Sawant, 2010). As PF deters creeping expropriation, the propensity towards PF is expected to increase with a rise in the risk of expropriation. This risk can come from varied sources including political instability, and poor legal climate (Sawant, 2010).

According to Sawant (2010), transactions that require specialised investments, which have little or no worth to alternate users give rise to asset specificity. Both Esty (2003) and Habib and Johnsen (1999) agree that a motivation for firms to use PF when investing in specific assets, is PF's ability to mitigate the transaction costs associated with the specificity of the asset. Power plants, like some other infrastructure assets, cannot easily be redeployed to other uses as they are connected to and supply power to a specific grid. This puts them at risk of hold-up resulting from opportunistic behaviour from their suppliers/ buyers.

State owned enterprises (SOEs) in some countries are granted monopoly rights, which can allow them to exhibit opportunistic behaviour when they are primary buyers/ sellers to firms. This goes against the interest of the firms and puts their investments at risk (Sawant, 2010). Many power plant project firms have to deal with SOE monopolies like Eskom as primary buyers/ sellers. These SOEs can dictate the terms of transactions due to their strong positions. This can squeeze the margins of the firms. A way that PF can mitigate this SOE hold-up risk is through vertical integration. The separate incorporation of SPVs in PF allows suppliers and buyers to participate in the SPV as equity-holders by bearing some of the upfront sunk cost in exchange for equity in the project firm. Being equity holders in the project, any behaviour on the part of the SOE that threatens SPV revenue is likely to affect the SOE's own interest as well. This could result in their investment in the SPV registering losses since cash flow first has to satisfy debt holders before equity holders. By this vertical integration mechanism, PF mitigates opportunistic behaviour of SOEs (Sawant, 2010).

Another way that PF firms can mitigate hold-up risk is through long-term contracts with buyers/ suppliers (Edlin & Reichelstein, 1996; Hermalin & Katz, 1993). However, this method depends on courts granting legal remedies for breach of contract. In situations where specific performance is not granted by courts as contract breach remedy, vertical integration is a more efficient mechanism (Edlin & Reichelstein, 1996).

2.4.1 Theoretical framework

Sawant (2010) developed a framework to theoretically explain the reasons why multinational firms, when investing in infrastructure choose to use PF and not corporate finance. The framework considered firms' aim of mitigating the risks associated with both creeping expropriation and transaction costs arising from the specificity of their project assets. It hypothesizes that given the susceptibility of infrastructure assets to creeping expropriation, and PF's ability to deter this, the propensity to PF is expected to rise with a rise in the risk of expropriation (Sawant, 2010). The framework uses the country risk rating compiled in the International Country Risk Guide (ICRG) as proxy for the risk of creeping expropriation from the project host country. The country risk rating ranges from 0 for the riskiest country to 100 for the safest country. The riskier the country, the higher the propensity for PF is expected to be.

In terms of transaction cost economics, the framework recognises the high transaction costs of infrastructure assets associated with the following:

1. The presence of strong SOEs as primary suppliers/ buyers that can hold up an asset.
2. Infrastructure sunk costs that cannot be recovered through alternate deployment due to the specificity of their use.

The larger the investment, the higher the associated transaction costs. It acknowledges the need for an efficient mechanism to protect firms from the risk of SOE hold-up. PF's relationship-based mechanism offers such protection, which will be efficacious even where laws are weak. Based on PF's ability to mitigate transaction cost risks, the framework further hypothesizes the following:

1. PF will increase with the presence of SOEs as primary suppliers/ buyers.
2. The use of PF will also increase with the size of infrastructure investments.

The framework also recognises that there are other factors that will lead firms to adopt PF apart from the location and project specific factors captured by the above hypotheses of the framework. The other factors are controlled for through the use of control variables in the framework. They encompass reasons for firms to choose PF over corporate finance because of attributes of the firm and not the project or its location. The control variables applicable to the current research are:

a. firm size, and

b. leverage.

The size of the firm may lead it to select PF as a mode of investment in projects. The amount a firm can invest in a project depends on the size of the firm (Sawant, 2010). A small firm tackling a big project may not have a big enough balance sheet to support the debt required for the investment. This would lead the firm to opt for PF where the debt will be supported by revenue from the project. A firm's book value was used to represent its size in the framework. Sawant (2010) found that the use of either firm book value or market value did not alter the results of analysis using the framework. However, the use of book value allowed unlisted firms to be included in the analysis, book value was used instead of market value.

Leverage, the level of debt in a firm, when high may leave the firm no option but to opt for PF for projects. This will allow the firm to raise capital at a reasonable cost for the project. Using corporate finance to raise capital based on its own balance sheet would be more expensive given the high level of debt. An example is seen with Calpine Corporation which had high leverage (95% debt to capital ratio). It made use of PF to raise investment funding for new power plant projects (Esty & Kane, 2001). Leverage as a control variable in the framework is determined as the ratio of long-term debt to total capital (Sawant, 2010; Welch, 2007).

2.5 Conclusion of literature review

As a backdrop to the research, the chapter begun with a review of PF. This started with a look at the various definitions of PF in literature. The authoritative definition from the Basel Committee on Banking Supervision was identified. The prevalence of PF was then considered highlighting its frequent use in capital intensive projects globally and the impact the 2008 global financial crisis had on it. The review on PF was concluded with a deeper look at it in terms of its characteristics, risk management features, advantages, and disadvantage.

Next a review was done on power plant infrastructure projects in Sub-Saharan Africa. The level of demand and supply of power plant infrastructure was reviewed along with current investment trends in the sector. The big gap between demand and supply with demand completely outstripping supply was noted from various peer reviewed papers. Private involvement in power plant projects in Sub-Saharan Africa was identified as the leading area of growth in the sector in the face of stagnation of public sector investment in the area.

To bring the aspects of PF and infrastructure investment together in the context of the research topic, theory of PF in infrastructure projects was reviewed. The alignment of PF and infrastructure projects due to the capital intensiveness and requirement of large sunk costs in infrastructure projects was brought to the fore. The use of PF to mitigate core company contamination risk and utilise securitisation of low risk projects to allow firm's with risky core businesses to fund projects cheaper came out strongly in the literature. The use of PF to mitigate high transaction costs associated with investments with high asset specificity was also emphasized.

The literature review was concluded with a review of Sawant (2010)'s theoretical framework which formed the theory base of the study. The framework identified drivers of project finance which were tested in the context of the study.

3 Research hypothesis

The Sawant (2010) theoretical framework discussed in Section 2.4.1 above, formed the theory base for the research. The research tested the framework with data on power plant projects in Sub-Saharan Africa. The framework has remained relevant and been relied on by recent articles on infrastructure investments such as (Ben Ammar & Eling, 2015), (Garcia-Bernabeu, Vitoria, & Verdú, 2015), and (Steffen, 2018).

From the literature review in Chapter 2, transaction cost economics theory offers a set of motivations for PF in infrastructure projects as set out in the Sawant (2010) theoretical framework. The relevance of different funding models for power plants in Sub-Saharan Africa is an empirical question. To gain insight into this, the research conducted an assessment of the influence that different project characteristics have on the propensity for firms to use PF in power plant investments in Sub-Saharan Africa. Similar to Sawant (2010) and Steffen (2018), a theoretical advantage was gained by restricting the cases studied to investments in a specific sector and context. This allowed the observation and analysis of capital-intensive and tangible transactions that are homogeneous, have similar asset characteristics and have defined suppliers/ buyers. Applying the theoretical framework to the research problem, the assessment conducted in the research was based on the following stylised model (Sawant, 2010):

Equation 3-1: Research's stylised model

$$pfproject = f(investsize, ctryrisk)$$

$Where$:

$pfproject$: $project\ investment\ structure\ (PF\ or\ not)$,

$investsize$: $size\ of\ project\ investment, and$

$ctryrisk$: $measure\ of\ country\ risk\ of\ project\ location.$

The research addressed the following questions:

1. What is the prevalence of PF in power plant investments in Sub-Saharan Africa?
2. What is the extent of influence of the drivers of PF in power plant projects in Sub-Saharan Africa?

To help in answering Research Question 2, the following testable hypotheses, which are linked to the Sawant (2010) theoretical framework were proposed:

H1: The use of PF increases as the size of project investments increase.

H2: The use of PF increases as country risk increases.

The above hypotheses were tested in the context of power plant projects in Sub-Saharan Africa. Since the study was considering the propensity for PF to be used for power plant investments based on project and project location (country) characteristics, there was the need to control for other factors that might also influence the selection of PF. The control variables identified in the theoretical framework, firm size and leverage, were also used in this study for that purpose.

H1 and H2 span potential reasons in the context of the research problem for PF from the theory explained above. If the theory can explain the use of PF in power plant investments in Sub-Saharan Africa, then H1 and H2 should hold. The table below summarise the variables and how they link to the hypotheses.

Table 3-1: Description of variables

Variable	Independent variable	Hypothesis to be tested	Predicted sign of variable	Description of variable
Dependent variable: *pfproject* Investment structure (PF or not)				Binary variable
Investment size	***investsize***	H1	Positive	USD millions
Country risk	***ctryrisk***	H2	Negative	ICRG country risk index
Control variables				
Book value of firm	***bookvalue***		Control for size of firm	USD millions
Total debt to total capital of sponsor	***leverage***		Control for under-investment	Ratio

Adapted from Sawant (2010)

4 Research methodology

This chapter provides details of the research methodology used. The basis of the methodology is also elaborated. The chapter is structured as follows:

1. Section 4.1 Research methodology and design;
2. Section 4.2 Analysis techniques;
3. Section 4.3 The research process;
4. Section 4.7 Part 1: Data gathering and preparation;
5. Section 4.5 Part 2: Data validity and reliability confirmation;
6. Section 4.6 Part 3: Determination of study variables;
7. Section 4.7 Part 4: Empirical analyses; and
8. Section 4.8 Methodology limitations.

4.1 Research methodology and design

Pragmatism is the philosophy that was adopted for the study. The research was guided by what is possible and driven by the research questions and objectives (Saunders & Lewis, 2012). The aim of providing useful insight into the prevalence and drivers of PF in power plant infrastructure investments in Sub-Saharan Africa to help solve her infrastructure challenge was the driving force throughout the study.

In line with Eberhard et al. (2016); Pinto (2017); Sawant (2010); Steffen (2018) who studied similar concepts and research questions, a deductive approach was adopted in the research. This involved the testing of theoretical hypotheses utilising a strategy for the research that was specifically designed for it (Saunders & Lewis, 2012). The approach sought to explain the relationships between PF and its identified theoretical drivers based on economic, financial and management theories. Research questions have been defined base on the application of the theoretical framework developed by Sawant (2010) to PF in power plant infrastructure investments in Sub-Saharan Africa. Ways to answer these questions were devised and incorporate statistical tests. Descriptive statistics were done to describe the basic features of the data. Appropriate statistical tests were done to show relationships, trends and correlations. These helped in providing answers to the research questions. The results of the tests were analysed to determine if the theories exposed in the literature are supported by the data.

The research tested the Sawant (2010) theoretical framework specifically for power plant infrastructure investments in Sub-Saharan Africa. Just like Pinto (2017); Sawant (2010); and Steffen (2018) who carried out similar studies, a mono quantitative method was used

to analyse the investment data. This provided insights as to whether practices concur with theory or some adjustment of theory is required to better describe what is seen in practice.

The research was both descriptive and explanatory. Answers to Research Question 1 provided a description of the prevalence of PF in power plant investments in Sub-Saharan Africa. Descriptive statistics of the data was used to provide the answers. The explanatory angle was provided by answers to Research Question 2, which were obtained by the testing of hypotheses (using statistical analyses) to determine the extent of influence of the drivers of PF.

As is prevalent in this type of research and area of study, a case study strategy was used. Each identified infrastructure project was considered a case from which insights were extracted. The same strategy was adopted by Pinto (2017); Sawant (2010); and Steffen (2018). The approach aided detailed appreciation of the broader context of the research as well as the specific circumstances of each individual project studied (Saunders & Lewis, 2012). Data from different sources were utilised to provide the different layers of information on the cases that were studied. The layers included among others:

- project name,
- country of project location,
- risks associated with the country,
- date of financial close of the project,
- size of investment,
- funding approach (debt to equity ratio),
- ownership structure (project sponsors),
- financial details of project sponsors (book value, leverage), and
- financing structure (corporate finance or project finance).

The various required layers were not contained in a single database, databases with different foci were interrogated for required data.

4.1.1 Time horizon

The research considered power plant projects with financial close spanning 2000 - 2016 and was longitudinal in time horizon. This provided insights regarding the effect on PF of changes in the energy infrastructure sector, and the economic and political climates of Sub-Saharan African countries over the period. The time horizon was chosen to coincide

with the period after year 2000, which has seen accelerated growth in energy demand in the region. Energy demand in the region went up by 50% between 2000 and 2014 (International Energy Agency, 2014a; Ouedraogo, 2017). Eberhard et al. (2017) also confirm that investments in the power sector of the region increased from 2000. The year 2000 lower bound date was also used in (Eberhard et al., 2017). The upper bound year of 2016 allows a reasonable time period for the details of the projects to be captured and made available in the various databases used. Some debate has been seen in the literature concerning the effect of the 2007 – 2008 global financial crisis on PF volumes. la Cour and Müller (2014) and Steffen (2018) indicate a negative impact, but Pinto (2017) showed that PF did not witness a significant reduction due to the financial crisis. Pinto (2017) looked at 5,935 global PF deals closed between 2000 and 2014 and found a marginal drop in 2009 after a peak in 2008. Activity growth bounced back in 2010 reaching record levels in 2014. The data for the research sheds some light on the extent of the drop that was experienced in PF in power plants in Sub-Saharan Africa.

4.1.2 Population

The population comprises all the cases from which a sample can be selected (Saunders, Lewis, & Thornhill, 2016). The population for the study comprises all power plant projects in Sub-Saharan Africa with private sector participation, with financial close occurring from 2000 – 2016, structured as either corporate finance or PF investments (Sawant, 2010) with capacity of at least 5 MW (Eberhard et al., 2017). The 5 MW cut-off size was also used by (Eberhard et al., 2017) to ensure only sizeable projects are considered. This is in line with a recommendation in (Esty, 2004) to focus on large projects exclusively to derive maximum academic, pedagogical and managerial benefits. Steffen (2018) used a cut-off of 10 MW for his study. However, his study was done in Germany which has a higher preponderance of bigger power plants compared to Sub-Saharan Africa. The Eberhard et al. (2017) cut-off of 5 MW is followed as their study was done in Sub-Saharan Africa and so is more context relevant to the current research. Inclusion of corporate financed investments in the population allowed the relative prevalence of PF to be ascertained out of the entire universe of power plant investments.

4.1.3 Sampling method and size

The aim of data collection for the study was to capture as much of the entire population, as defined above, as possible. The research questions and objectives require that as much of the population as possible be included in the analysis. Just like in Steffen (2018), the starting point of data collection was a comprehensive listing of power plants, meeting the population criteria, captured on an online database. A similar approach was also

successfully used by Sawant (2010). Starting with a comprehensive infrastructure asset list where almost every member of the population is captured rather than a data set based on financial deals means the data set will be less affected by selection biases (Steffen, 2018). The data set used was focused on listing the assets for the assets' sake, not in listing assets for their financial data. Financial data focused databases might prioritise financially prominent projects and neglect some less prominent projects that still fall within the study population.

The financial data for the sponsors of the projects were obtained from financial data focused databases once the projects had been identified and selected. The data collection process is explained in Section 4.4 below.

4.1.4 Unit of analysis for the study

Unit of analysis for a study is the object that will be the source of data for the study (Zikmund, Babin, Carr, & Griffin, 2013). The study's units of analysis were investments in power plant infrastructure projects in Sub-Saharan Africa. They included both corporate finance structured investments and PF structured ones. A similar approach was utilised by both Sawant (2010) and Steffen (2018). This approach finds support in the argument by Teece (1986) that the transaction be the unit of analysis as opposed to the firm undertaking the transaction. This allows a closer examination of the nature of the transaction that is being studied.

4.1.5 Measurement instruments

Secondary data was collected and utilised for the study as was done by Pinto (2017); Sawant (2010); Eberhard et al. (2017) and Steffen (2018) in their similar studies of PF in infrastructure projects. The data was captured in spreadsheet and statistical analysis software MS Excel and IBM SPSS respectively. A structured technique was used for data collection with the same type of details collected for each case. Cases (power plant investment projects in Sub-Saharan Africa between 2000 and 2016) were first identified, then available databases and press sources were researched to provide the required data details for each case. Each case was given a unique identifying code to aid data entry, analysis and reporting.

Based on methods used in (Sawant, 2010) and (Steffen, 2018); the main measurement instruments were online databases of power plants, company and investment data, and country risk measures. These were complemented, confirmed and triangulated with data from trade journals that follow the infrastructure finance industry, press sources and

documents of national energy authorities of the various countries that are published on the internet. The instruments are described below:

4.1.5.1 World Bank's PPI database.

The primary online infrastructure database used was the World Bank's ***Private Participation in Infrastructure (PPI) Database***. It focuses on infrastructure projects and contains 6,400 of them in 139 middle- and low-income countries starting from 1984 to present. (IJGlobal, 2018). According to PPP Knowledge Lab (2018) the database is the leader in terms of sources of PPI data focused on the developing world. It contains a comprehensive list of Sub-Saharan African power plant projects that have private sector involvement. World Bank (2017a) indicates that the database takes its information from sources that are publicly available, which allows them to make the results also publicly available, however, there is the chance of inaccuracy based on original source reliability. This fact was taken cognisance of in using the database for the research. It was used as a starting point for identifying projects, but all the relevant project details were separately verified form additional sources before being incorporated in the research.

In the database each project is listed separately with the following relevant attributes among others:

- Country of location,
- Financial closure year;
- Project name;
- Type of project (greenfield, brownfield, divestiture);
- Subtype of project (build, operate and transfer; rental; etc.);
- Project status (active, cancelled, etc);
- Date of status update;
- Segment (electricity generation, electricity distribution);
- Location (town or city);
- Contract period;
- Investment year;
- Percentage private participation;
- Total investment;
- Capacity of plant;
- Technology (hydro, diesel, solar, wind, etc);
- Sponsors;

- Revenue source;
- Total debt funding;
- Debt to Equity Ratio; and
- Project banks.

The PPI database focuses on middle and low-income countries, which incorporate all Sub-Saharan African countries. It registers contracts for public infrastructure projects in these countries that have reached financial closure and have private sector taking up operating risks. The projects captured in the database are not just those that are wholly privately owned, sponsored or operated, they include projects with public participation also. Project investments recorded in the database include both private and public shares. The database focuses on infrastructure sectors with high capital costs that have traditionally been provided by the public sector and serve the public. The sectors included in the database are transport, water, information and communication technology, and energy. Only the energy portion was utilised for this research as it focuses on power plant projects.

4.1.5.2 Eikon (Thomson Reuters)

Eikon (Thomson Reuters) was the financial database that provided financial information on the project sponsors. It contains global economic, and company financial information. The database is maintained by Thomson Reuters, is updated every day and its data dates from the 1960s to present with an international coverage. University of Leicester (2018) points out that it is a well-rated database extensively used in academia and industry. It is also supported by the GIBS Research Information Centre and was accessed through its web link. The information obtained from this database included the book value and level of leverage of the sponsors at the time of project closure.

4.1.5.3 ICRG country risk rating

The ICRG country risk rating provided country composite risk measures that were used for the study. The ICRG risk rating has been published on a monthly basis since 1980. It furnishes ratings regarding financial, economic and political risk for developing and developed countries (PRS Group, 2018c). ICRG database was access through the publicly available World Bank website via *https://info.worldbank.org/governance/wgi/pdf/prs.xlsx*.

4.1.5.4 Additional sources of data

Other sources of data utilised included:

- Sponsor company's annual reports and financials.
- Press sources including ESI Africa (an online power journal of Africa that provides news updates on power projects in Africa), and Hydro World (an online news source for hydropower projects).
- Websites and official publications of energy regulators of the various countries in which the projects are located such as the National Energy Regulator of South Africa (NERSA).

4.1.6 Research ethics

The research made use of secondary quantitative data from publicly available sources. The data used consisted of power plant investment information, sponsor company financial information and country risk ratings that are publicly available. Ethical concerns regarding human data collection did not arise in the study. The main sources of the data used were The World Bank and Eikon (Thomson Reuters). These were complemented by company and industry data published on the internet.

Ethical clearance for the research was received on 19 July 2018. See Appendix 1 for a copy of ethics approval letter.

4.2 Analysis techniques

This section introduces analysis techniques that were used for the study. The purpose of the section is to discuss these techniques in the context of the study, indicate how they were applied, justify their use and serve as a reference for subsequent sections of the report.

4.2.1.1 Descriptive statistics

A description of the basic features of the study data utilising measures and summaries of the sample data.

4.2.1.2 Bivariate correlation

Correlation entails the modelling of relationships between variables. Bivariate correlation involves fitting a model to data. Both Sawant (2010) and Steffen (2018) used Bivariate Correlation in their analyses of the relationships between study variables. Similarly, bivariate correlation was used in this study to assess the strength of relationship between pairs of study variables. Since it aims to model a relationship between variables in order to predict an outcome variable based on an independent variable, bivariate correlation uses the following general equation:

Equation 4-1: Bivariate correlation

$$outcome_i = (bX_i) + error_i$$

Where the *outcome* is predicted by the independent variable, *X*, plus an *error* factor. *b* is a parameter that describes the relationship between the outcome and X. b is estimated from sample data (Field, 2013).

Bivariate correlation assumes that the data is normally distributed. However, normality is only of concern if confidence intervals and significance tests are required and the sample size is small (Field, 2013). Given the reasonably large size of the study data (above 100 cases), normality was assumed (Field, 2013), and just like Sawant (2010) and Steffen (2018) the bivariate correlation was done with the sample data without transformation. Bivariate correlation also assumes linearity. This condition is met as the independent variables are measured at the interval level and the dependent variable is categorical with only two categories (Field, 2013).

The correlations were done between the independent variables with each other and each independent variable with the dependent variable, financial structure. The correlations with the dependent variable were point-biserial correlations as the dependent variable is discrete dichotomous. It is categorical with two categories either PF (coded 1) or not (coded 0). The independent variables are all interval in nature.

The Pearson's correlation coefficient, r, was used:

Equation 4-2: Pearson's correlation coefficient

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{(N-1)s_x s_y}$$

$Where\ x\ and\ y\ are\ the\ two\ variables, \bar{x}\ and\ \bar{y}\ are\ thier\ respective\ means, s_x\ and\ s_y$ $their\ respective\ standard\ deviations\ and\ N\ the\ number\ of\ observations$ (Field, 2013).

4.2.1.3 Multiple linear regression

Multiple linear regression entails fitting of a linear model to a data set in order to predict values of a dependent variable from the values of multiple independent variables as a group. This yields a useful tool as it allows inferences beyond the particular data set (Field, 2013). Like Sawant (2010) and Steffen (2018), multiple linear regression was used in this study to assess the explanatory power of the different independent variables studied as a group. The independent variables were selected based on theoretical rationale provided by Sawant (2010)

The multiple linear regression model takes the form:

Equation 4-3: Multiple linear regression

$$Y_i = (b_0 + b_1X_{1i} + b_2X_{2i} + \cdots + b_nX_{ni}) + \varepsilon_i$$

Where Y is the dependent variable, b_1 is the coefficient of the first independent variable (X_1), b_2 is the coefficient of the second independent variable (X_2), b_n is the coefficient of the nth independent variable (X_n), and ε_i is the error for the ith case. The parameters (bs) are estimated using the least squares method (Field, 2013).

The assumptions of the multiple linear regression include:

- Linearity and Additivity: the dependent variable should have a linear relationship with the independent variables. This condition is met as the independent variables are measured at the interval level and the dependent variable is categorical with only two categories (Field, 2013).
- Independent errors: this requires that the residual terms of any two cases have to be independent. This assumption was tested with the Durbin-Watson test and fulfilled.
- Homoscedasticity: the variance of the residual terms of the independent variables should be constant.
- Normally distributed errors: the difference between the model and observed data are random, normally distributed and have a mean of 0. This assumption is relevant only with regards to significance tests and confidence intervals in small samples and not with the estimating of model parameters. With the reasonably large sample size of the study (more than 100 cases) this assumption was not relevant in the study (Field, 2013).
- Independent variables have to be quantitative or categorical with two categories. This condition is met by the study variables.
- No perfect multicollinearity: the independent variables should not be highly correlated. This condition is met as the bivariate correlation of the variables does not show any high correlations among the variables. The correlations are less than 0.8 (Field, 2013).
- Non-zero variance: the independent variables should have some variance in their values. The variables in the study all have variance in their values.

The level of fit of the regression model obtained was assessed with the coefficient of determination (R^2). R^2 gave the proportion of the variation in the dependent variable that could be explained by the regression model (Field, 2013). The *adjusted R^2* was used to

assess the variation in the dependent variable that would be explained if the model were applied to the population of the sample of the study. The significance of the unique contribution of each independent variable to predicting the outcome was also evaluated based on their individual *p-values* (Field, 2013).

According to Field (2013) the sample size for regression depends on the size of the effect being measured and the statistical power at which it will be measured. Given the aim of the study and the number of independent, a sample size in excess of 85 is adequate (Field, 2013). The study sample exceeds this number.

4.3 The research process

Section 4.2 above contains techniques that were used throughout the research process and will be referred to in the rest of this chapter. The remainder of the chapter details the research process that was conducted in the following 4 parts:

1. Data gathering and preparation.
2. Data validity and reliability confirmation.
3. Determination of study variables.
4. Empirical Analyses.

A study database encompassing all evidence gathered during the research process was maintained electronically. A summary of the evidence is contained in Appendix A to the report.

4.4 Part 1: Data gathering and preparation

Based on approaches used by both Sawant (2010), and Steffen (2018) the following data gathering process was followed.

4.4.1 Compilation of a comprehensive list of projects

A search was conducted for a comprehensive, up to date online database of power plant projects in the Sub-Saharan Africa region, covering the date range of interest to the study. Four privately and publicly available databases were identified. Their locations and availability details are provided in the table below.

Database	Website	Availability
The World Bank's Private Participation in Infrastructure (PPI) Database	https://ppi.worldbank.org/data	Public (free access)
Open Data Soft's World Power Plants Database	https://data.opendatasoft.com/explore/dataset/world-power-plants-list%40kapsarc/?disjunctive.power_plant_type&disjunctive.country&disjunctive.state&sort=design_capacity_mwe.	Public (free access)
Africa Energy's Power Plants Database	https://www.africa-energy.com/database	Private (paid access)
Enterdata's Power Plant Tracker Database	https://www.enerdata.net/research/power-plant-database.html	Private (paid access)

Two of the identified sources were publicly available with access free of charge while the other two were private, requiring payment for access. The cost of access for the private databases were beyond the budget of the study and thus could not be used. The publicly available *World Bank's Private Participation in Infrastructure (PPI) Database* was selected as the preferred source as it is more comprehensive, up to date and contained more attributes relevant to the study. It contains almost the entire universe of power plant projects with significant private participation. Further, the World Bank database has been recognised by the *PPP Knowledge Lab* as the preeminent source of private participation in infrastructure (PPI) trends in the developing world (PPP Knowledge Lab, 2018). *PPP Knowledge Lab* is an authoritative online resource for public-private partnerships (PPPs) created by multilateral development agencies. Data from the other publicly available source (Open Data Soft's World Power Plants Database) was used to cross check the data from the preferred so source to aid data reliability and validity checking.

A comprehensive list of energy infrastructure projects in the Sub-Saharan Africa region was extracted from The World Bank's Private Participation in Infrastructure (PPI) Database on 20 July 2018. The data consisted of 285 project entries with financial closure dates ranging from 1990 to 2017. The projects were located in 36 out of the 49 countries in the Sub-Saharan African region (Eberhard et al., 2017). Some countries in the region did not have PPI power plant projects. The date range of the data extended beyond both the lower and upper bound dates of the study, this gave confidence that all

the data within the required date range had been included in the extraction and data had not been truncated. The "raw" downloaded data, however, had the following anomalies with respect to the study requirements:

- Some of the listed projects fell outside the required financial closure period of 2000 – 2016.
- Some of the projects were not power plants, but other forms of energy projects such as power transmission lines.
- Some projects had capacities below the minimum threshold of 5MW.
- Some projects were listed multiple times.
- Some of the project entries did not include some vital data attributes such as the size of investment.
- Some cancelled projects were still included in the data set.

The data was cleaned to remove the listed anomalies. This reduced the number of projects to 157 from 22 countries. The resulting data was categorised into countries of project location and arranged in alphabetical order vertically. Within each country category, the projects were arranged vertically in chorological order of financial closure date. This aided project identification, project coding, and further data handling.

4.4.2 Data coding

To aid data handling and analysis, the projects in the study data set were coded. Coding was done by assigning each project a two-part code:

a country code based on the United Nations' Trade Statistics country codes found at https://unstats.un.org/unsd/tradekb/Knowledgebase/50347/Country-Code corresponding to the country where the project is located and

a sequential number based on the chronological order of the project's financial closure within its country category.

To illustrate with two examples, the first project in Angola will have a code of AGO-1 and the fifth project in Ghana will be GHA-5.

4.4.3 Data cleaning

The data cleaning process entailed the removal of the following:

- projects with financial close outside study time horizon,
- non-qualifying projects (projects that are not power plants (eg. The West African Gas Pipe Line),
- power plant projects with capacities less than 5MW, and

- duplicated project entries.

The cleaning reduced the number of projects from 285 to 157.

4.5 Part 2: Data validity and reliability confirmation

Following an approach utilised by Sawant (2010), the compiled power plant projects data set's validity and reliability were confirmed by exhaustively researching the projects through publications independent from the original data source (The World Bank).

Starting with the name and location of each power plant in the data set, a publications research was conducted to confirm the following:

- The existence of the project,
- Plant capacity,
- Project financial close year,
- Investment estimate at financial close, and
- Identity of project sponsors at financial close.

These details have a bearing on the determination of the variables for the study. For a detail to be accepted it must be corroborated by at least two different sources.

Each of the 157 projects in the study's data set was individually confirmed in this way. If the existence of a project in the data set could not be confirmed from an independent source it was not included in the study. Only one project in the data set was removed due to lack of independent confirmation. The remaining 156 projects were utilised for the study. This final data set incorporated a total investment size of USD 29,759 million and 16,910MW of power plant capacity from 22 countries in the region.

The details contained in the data set were confirmed from independent sources. The publication sources used were accessed through the internet and included the following:

- Industry journal sources including:
  - ESI Africa (https://www.esi-africa.com/, Africa's Power Journal,), established in 1996 as a trusted knowledge source of insights in electricity generation, transmission and distribution across the African continent (ESI Africa, 2018). According to Spintellignet (a specialist in providing industry publications for markets in Sub-Saharan Africa) ESI Africa is the choice journal for the power utilities market in Africa (Spintelligent, 2018).
  - Hydro World (https://www.hydroworld.com/, an online news source for hydropower projects). Renewable Energy World, a network for renewable energy news and information, cites Hydro World as providing practical, and useful information to hydro professionals.

- Websites and official publications of energy regulators of the various countries in which the projects are located such as the National Energy Regulator of South Africa (NERSA).
- Sponsor company's annual reports and financials.
- Sponsor company's websites.
- Funding agencies such as the African Development Bank, Standard Bank, etc. publications and websites.
- Peer reviewed journal articles on energy projects in Africa such as (Eberhard & Gratwick, 2011).

In extracting data from these sources, cognisance was taken of the fact that they are secondary sources and were prepared for audiences and purposes other than the study. The particular purpose and context of any publication was taken into account in utilising its contents. The contents were critically considered and if necessary additional verification and confirmation sought. For instance, details contained in project proposals issued by firms and countries were treated only as hints requiring confirmation of actual implementation. For such details to be included in the study they had to independent corroborating evidence of actual implementation of the proposal from another source.

4.6 Part 3: Determination of study variables

In order to carry out analyses required to answer the research questions, additional data not found in the data set so far assembled were required. The additional data pertained to the variables described in Table 3-1 above and discussed in Chapter 3. The aim of this part of the research process was to complete the data set compilation to allow data analyses to answer both research questions. Descriptive statistics of the variables was used in answering question 1 (to gauge the prevalence of PF in power plant investments in Sub-Saharan Africa). Correlation and multiple regression analyses of the variables were utilised in answering question 2 (to establish the drivers of PF in power plant projects in Sub-Saharan Africa). Details of the process followed are discussed below.

4.6.1 Project funding structure (PF or not)

The funding structure used by each project was determined by scrutinising identified relevant publications and documents with information on each project to establish their funding structure. For a project to be classified as PF specific evidence of at least one of the following characteristics of PF should be sighted by the investigator in the documentation researched:

- Existence of a SPV with the sole purpose of owning and operating the project.

- The sponsor(s) of the project at financial close structure the funding of the project to include limited or non-recourse debt to a project company. The repayment of the debt is to be done from the revenue of the project.

In the absence of the above project funding features or the presence of evidence of project funding structured as corporate finance (funding through sponsor's balance sheet), the project was judged to be corporate financed.

The determination of PF or not was looked at purely from the perspective of the power plant. In instances where a project company was set up to own and operate a broader project say a sugar mill that owned an attached power plant, the power plant was counted as corporate finance. This is because the SPV was not setup for the sole purpose of owning the power plant and the power plant was essentially funded by the balance sheet of the Sugar mill company not limited or non-recourse loans.

4.6.2 Project investment size

The project investment size variable constituted the value of the total initial capital investment in the project estimated at financial close. This was obtained from the World Bank PPI database and confirmed from publications on the individual projects researched.

4.6.3 Country risk rating

The PRS Group is the world leader in political risk research and rating of nations. They are the only firm in the sector deemed authorities in the field by judicial bodies. Their output has been utilised in the settlement of commercial cases. Their results have been back-tested for relevance and accuracy by prominent organisations like the National Bureau of Economic Research and the Fuqua School of Business (PRS Group, 2018a). Their international ratings data have been used for academic research such as (Sawant, 2010).

PRS Group's International Country Risk Guide includes a Political Risk Index that has been identified by the World Bank as gauging the various facets of political and business environment encounter by companies operating in a country (World Bank, 2018). The political risk rating is made up of the following variables (PRS Group, 2018b):

- Government Stability,
- Socioeconomic Conditions,
- Investment Profile,
- Internal Conflict,

- External Conflict,
- Corruption,
- Military in Politics,
- Religious Tensions,
- Law and Order,
- Ethnic Tensions,
- Democratic Accountability, and
- Bureaucracy Quality.

The World Bank makes averages of the sub-indicators publicly available via its website: https://info.worldbank.org/governance/wgi/pdf/prs.xlsx. The data ranges from 1996 to present. Averages of the relevant years and countries for each of the projects studied were utilised in the study for the country risk variable.

In the context of the study's time horizon of 2000 to 2016, data for 2001 was missing from the World Bank data set. This had an impact on only five out of the 156 projects in the study sample. Since data was available for the preceding and succeeding years of 2000 and 2002 respectively, it was deemed reasonable to remedy the situation by interpolating between 2000 and 2002 values to obtain a reasonable estimate for 2001.

A further issue with the use of the data set was that three of the countries in our study area namely Cape Verde, Mauritius and Rwanda were not covered at all by the PRS data. This could not be reasonably remedied. The total of seven projects from these three countries were excluded from the stage of the analysis that required the country risk variable.

4.6.4 Sponsor book value

Book values of main project sponsors at project financial close were gleaned from financial statements. The statements used were those of lead sponsors for projects with multiple sponsors and the year of project financial close. This was to capture the size of the firm that made the project funding choice (PF or corporate finance) at the time the decision was made. Care was taken to ensure the lead sponsors at financial close was used as some projects changed sponsors after financial close as the original sponsors sold their interest to other firms. These new sponsors will not have a bearing on the funding structure of the project as that decision would already have been made at project close before their involvement in the project.

The book values were obtained from the company financial database maintained by Eikon (Thomson Reuters). This was augmented by data from company financial

statements for the firms that did not have their financials included on the database. These firm financials were typically obtained from company websites. Some the private sponsor firms did not have their financial statements publicly available, so their information could not be captured.

4.6.5 Sponsor leverage

The process described above for obtaining project sponsors' financial information for determining their book values was used to for obtaining information for sponsors' leverage. Sponsor leverage is defined as the ratio of sponsor long-term debt to total capital (Sawant, 2010). This information was available from the Eikon (Thomson Reuters) database as key ration for companies included in the database. The ration was worked out for sponsors not captured in the Eikon data from their company annual reports where available. However, 49 of the sponsor firms that were not covered by the Eikon database also did not have their company financials publicly available, so they could not be included in the analysis stage that required company financials.

4.6.6 SOE as a primary supplier/ buyer

Sawant (2010) regarded the presence of a SOE as a primary supplier or buy as a variable in his study. However, this was eliminated as a variable in this study because each of the power projects in the study sample has a SOE as a primary buyer of their electricity output.

4.7 Part 4: Empirical analyses

To answer the research questions, empirical analyses of the compiled data was required. These were done using IBM SPSS analysis software.

To conduct the necessary analyses, the study data set that had been compiled in MS Excel was imported into IBM SPSS version 25. It was ensured that the appropriate variables with suitable measurement scales were created for the data in SPSS before the data was transferred from Excel to SPSS. To ensure that no data was lost or misplaced in the transfer, each data point was checked using the four-eye-principle. All missing data values (e.g. unavailable sponsor financial information) were identified and assigned a "missing value identifier". This ensured that the software correctly interpreted the data.

As was done by Steffen (2018), descriptive analyses were conducted on the study data set to assess the prevalence of PF to answer research question 1. These analyses also

provided some preliminary insights into the drivers of PF (relevant to research question 2). Question 2 was subsequently more rigorously analysed through regression analyses.

A noteworthy observation during the descriptive analyses was the dominance of South Africa in terms of number of projects in the data set as well as their spread in the study time horizon. More than 36% of the projects in the data set were located in South Africa and were concentrated in the period between 2012 and 2015. This has potential to distort some of the empirical results of the study if not taken into account. The decision was taken to follow Eberhard et al. (2017) who studied Independent Power Projects in the region to report findings and insights with and without South Africa to provide a proper contextual basis. While South Africa may be considered a significant outlier in terms of its dominance in the number of projects compared to other countries in the region, the focus of the study is the entire Sub-Saharan Africa region and not specific countries. South Africa's projects thus form part of the projects in the region and should be counted as such. South Africa's dominant position will come into focus when it comes to considerations of national policy implications.

4.7.1 Descriptive analyses

Descriptive analyses were done by exploring the data set in graphical form. The results of this exercise are presented in Section 5.4.1 below. The graphs generated provided answers to Research Question 1 (the prevalence of PF in power plant investments in Sub-Saharan Africa) and some preliminary insights for Research Question 2 (the extent of influence of the drivers of PF in power plant project in Sub-Saharan Africa).

4.7.1.1 Research Question 1

Table 4-1 below presents the various graphs generated for research question 1 and the derived insights.

Table 4-1: Research Question 1 descriptive graphs

S/N	Graph	Insight Provided
1	Financial structure share of project	Overall share of corporate finance and project finance projects in study data set.
2	Number of projects per country	Overview of the spread of projects among the countries in the study region
3	Funding structure of projects per country	Share of corporate finance and project finance in the various countries with projects

S/N	Graph	Insight Provided
4	Projects per country income group	Share of projects per country income grouping
5	Funding structure per country income grouping	Split of corporate finance and project finance per country income grouping
6	Projects per financial year close	Spread of projects according to financial year close
7	Project funding structure per financial year close	Split of corporate finance and project finance per financial year close
8	Projects per PPI type	Overview of spread of projects per PPI type
9	Funding structure per PPI type	Split of corporate finance and project finance per PPI type
10	Projects per plant type (rental or permanent)	Overview of spread of projects per plant type
11	Funding structure of projects per plant type	Split of corporate finance and project finance funding of projects per plant type
12	Projects per technology type	Overview of spread of projects per technology type
13	Funding structure of projects per technology type	Split of corporate finance and project finance funding of projects per technology type.

4.7.1.2 Research Question 2

Table 4-2 below presents the various graphs generated for research question 2 and the derived insights.

Table 4-2: Research Question 2 descriptive graphs

S/N	Graph	Insight Provided
Hypothesis 1		
1	Mean of Total Investments per financial structure	Mean of total investments of corporate finance and project finance projects in study data set.
2	Median of Total Investments per financial structure	Median of total investments of corporate finance and project finance projects in study data set.
3	Mode of Total Investments per financial structure	Mode of Total Investments of corporate finance and project finance projects in study data set.
4	Minimum of Total Investments per financial structure	Minimum of total investments of corporate finance and project finance projects in study data set.
5	Maximum of Total Investments per financial structure	Maximum of total investments of corporate finance and project finance projects in study data set.
6	Sum of Total Investments per financial structure	Sum of total investments of corporate finance and project finance projects in study data set.
Hypothesis 2		
7	Mean of Country political risk per financial structure	Mean of Country political risk of corporate finance and project finance projects in study data set.
8	Median of Country political risk per financial structure	Median of Country political risk of corporate finance and project finance projects in study data set.
9	Mode of Country political risk per financial structure	Mode of Country political risk of corporate finance and project finance projects in study data set.
10	Minimum of Country political risk per financial structure	Minimum of Country political risk of corporate finance and project finance projects in study data set.

S/N	Graph	Insight Provided
11	Maximum of Country political risk per financial structure	Maximum of Country political risk of corporate finance and project finance projects in study data set.
12	Sum of Country political risk per financial structure	Sum of Country political risk of corporate finance and project finance projects in study data set.
Control Variables		
Sponsor Book Value		
13	Mean of Sponsor book value per financial structure	Mean of Sponsor book value of corporate finance and project finance projects in study data set.
14	Median of Sponsor book value per financial structure	Median of Sponsor book value of corporate finance and project finance projects in study data set.
15	Mode of Sponsor book value per financial structure	Mode of Sponsor book value of corporate finance and project finance projects in study data set.
16	Minimum of Sponsor book value per financial structure	Minimum of Sponsor book value of corporate finance and project finance projects in study data set.
17	Maximum of Sponsor book value per financial structure	Maximum of Sponsor book value of corporate finance and project finance projects in study data set.
18	Sum of Sponsor book value per financial structure	Sum of Sponsor book value of corporate finance and project finance projects in study data set.
Sponsor Leverage		
19	Mean of Sponsor leverage per financial structure	Mean of Sponsor leverage of corporate finance and project finance projects in study data set.

S/N	Graph	Insight Provided
20	Median of Sponsor leverage per financial structure	Median of Sponsor leverage of corporate finance and project finance projects in study data set.
21	Mode of Sponsor leverage per financial structure	Mode of Sponsor leverage of corporate finance and project finance projects in study data set.
22	Minimum of Sponsor leverage per financial structure	Minimum of Sponsor leverage of corporate finance and project finance projects in study data set.
23	Maximum of Sponsor leverage per financial structure	Maximum of Sponsor leverage of corporate finance and project finance projects in study data set.

4.7.1.3 Additional insights

Table 4-3 below mentions various graphs generated from the study data to provide additional insights from the study data not specifically connected to either research question.

Table 4-3: Additional insights descriptive graphs

S/N	Graph	Insight Provided
1	Mean of Country political risk rating per country of project location	Average country political risk during year of project financial close for each of the countries in the study data.
2	Sum of Total investments and plant capacity per financing structure	The sum of Total investment provided by corporate finance and the sum of plant capacity it provided and that of project finance.
3	The mean of Total investments and plant capacity per financing structure	The mean of Total investment provided by corporate finance and the sum of plant capacity it provided and that of project finance.

S/N	Graph	Insight Provided
4	Sum of plant capacity and sum of total investment per country of project location	Sum of investments in power plants and the corresponding plant capacity provided per country. An indication of value for money.
5	Sum of plant capacity per financing structure per country	How much of total of a country's capacity is funded by corporate finance and how much by project finance
10	Projects per plant type (rental or permanent)	Overview of spread of projects per plant type
11	Funding structure of projects per plant type	Split of corporate finance and project finance funding of projects per plant type
12	Projects per technology type	Overview of spread of projects per technology type
13	Funding structure of projects per technology type	Split of corporate finance and project finance funding of projects per technology type.
14	Presence or not of SOEs as primary buyer/ seller	The number of power plants in the study sample with SOEs as primary buyers/ sellers.

4.7.2 Bivariate correlation

Bivariate correlations were computed between the study variables using IBM SPSS analysis software with reference to Section 4.2.1.2 above.

The correlations were done for the following study variables:

1. Financial structure (PF or corporate finance),
2. Total Investment Size,
3. Country Political Risk Rating,
4. Book value of sponsor,
5. Leverage of sponsor,
6. Capacity of plant,
7. Financial close year of project.

A matrix of the resulting correlations made up of correlations between the explanatory variables with each other and each explanatory variable with the dependent variable is provided in Section 5.4.2 below.

4.7.3 Multiple linear regression

To evaluate the explanatory power of the independent variables identified in Research Question 2, the variables have to be considered both one-by-one and together as a group (Steffen, 2018). Following a one-by-one (bivariate correlation), the variables were evaluated in a multiple linear regression analysis with reference to Section 4.2.1.3 above. The analysis was done using SPSS analysis software. The results of the analysis are captured in Section 5.4.3

4.8 Methodology limitations

Some limitations of the study methodology are discussed below:

1. The effect of country risk on PF from literature is mainly due to nationalisation, but the variable that was used for country risk does not directly measure nationalisation, but rather proxy for it though other factors. This could distort the findings of the study.
2. The study methodology does not consider the effects of the additional cost in time, money and effort in structuring PF deals compared with corporate finance ones. According to Sawant (2010), PF cost more due to due diligence costs, accounting and legal fees as well as time delays. Kleimeier and Megginson (2000) also established that PF loans were more expensive compared to other syndicated loan types. They found that PF loans showed 130 basis points spread above the London Interbank Offer Rate (LIBOR) while fixed-asset-based loans only showed 86 basis points spread. They also found that it took two to eight years for PF loans to be approved and funds allotted, which is generally longer than other loan types. This means the measured propensity towards PF will not account for firms that go for corporate finance not because the drivers for PF are not present in a project, but because they do not want to incur the additional cost of structuring a PF deal.
3. The country risk factor will also influence the cost of PF structuring. PF deals in a risky country would cost more to put together than in a less risky one. This aspect is also not addressed by the study as the cost of PF structuring is ignored in the study methodology. This will also impact the measured propensity to PF.

4. The methodology only utilised secondary data for the determination of study variables. This could impact accuracy of findings. Primary data collected specifically for the study addressing it specific requirements would have provided more certainty regarding the study variables.
5. The initial sample of projects compiled for the study had to be reduced somewhat due to unavailability of public domain data on some of the projects. Though the reduction was not substantial, this could have an effect on the study results.

4.9 Conclusion of methodology

This chapter has described the methodology specially designed for the research. It was setup to answer the research questions posed in Chapter 3 and obtain additional useful insight from the study data. The methodology was based on methods successfully used by (Sawant, 2010) and (Steffen, 2018) who studied similar subject matters.

The methodology employed prudent data gathering and cleaning methods. It ensured data validity and reliability to compile a new data set drawing from different databases. The data set was analysed using appropriate statistical methods to reach conclusions that aided in answering the research questions.

5 Results

This chapter presents the sample and results of the study. It follows the same structure as Section 4.3 above, presenting the results of each part of the research process followed. Part 1 to Part 3 of the research mainly entailed data collection and sample preparation and their outcomes are summarised below in Section 5.1 to Section 5.3. Part 4 involved more rigorous analytical work and its results are presented in a more detailed fashion below in Section 5.4.

5.1 Part 1: Data gathering and preparation

Following the process outlined in Section 4.3 above, secondary data was extracted and prepared for the specific use of the study. The process yielded a rich data set initially comprising 285 projects. After data cleaning to weed out projects that did not fall within the defined study population parameters, 157 projects remained. The projects contained in the data set each had attached information categorised into 45 separate attributes. An extract of the data set is contained in Appendix 2 of this report.

5.2 Part 2: Data validity and reliability confirmation

Following a thorough publications research process, outlined in Section 4.5 above, the validity and reliability of the study data set (the 157 projects) was established by the individual confirmation of the existence of each project and its relevant details. This resulted in the trimming of the data set to only contain projects that could be independently confirmed. The data set confirmed as valid and reliable contained 156 projects. Only one project could not be confirmed, resulting in a data confirmation rate of 99%. The confirmed data set incorporated projects with a total investment value of USD 29,759 million and 16,910 MW of power plant capacity located in 22 different countries in the study region.

5.3 Part 3: Determination of study variables

Values for both the dependent and independent variables (including control variables) for the analysis part of the study were obtained from publications and financial databases. These variables were used to enrich the original power plant projects data set with sponsor firm information for analyses. The process followed is detailed in Section 4.6 above and is the same process followed by Sawant (2010); Steffen (2018). Out of the 156 confirmed projects, a full set of variable data was obtained for 101 of them. Descriptive statistics analyses of the 156 projects provided answers for Research Question 1. Correlation and regression analyses of the 101 projects provided answers

to Research Question 2. A summary of the number of observations for the variables is presented in Table 5-1 below.

Table 5-1: Summary of Study Variables Availability

Variable	Independent variable	Number of observations	Missing observations
Dependent variable: *pfproject* Investment structure (PF or not)		156	0
Investment size	***investsize***	156	0
Country risk	***ctryrisk***	149	7
Control variables			
Book value of firm	***bookvalue***	107	49
Leverage of sponsor	***leverage***	107	49

Table 5-2 below presents the descriptive statistics of the study data set. It shows the number of valid observations for each variable as well as the number of cases with all values available, valid N (listwise).

Table 5-2: Descriptive Statistics of Study Variables

Descriptive Statistics

	N	Range	Mini	Max	Sum	Mean		Std. Deviation	Variance
	Stats	Stats	Stats	Stats	Stats	Stats	Std. Error	Stats	Stats
bookvalue	107	92550	-56.30	92494	$9.7x10^5$	9037	1783	18441	$3.4x10^8$
ctryrisk	149	36.33	30.24	66.57	7993	53.64	0.505	6.159	37.939
Financial close year	156	15	2001	2016	$3.1x10^5$	2011	0.305	3.805	14.475
pfproject	156	1	0	1	115	0.74	0.035	0.442	0.195
investsize	156	1999	1.18	2000	29759	191	20.75	259	67166
leverage	107	1.06	0.00	1.06	38.40	0.36	0.024	0.251	0.063
Capacity	156	1315	5.00	1320	16910	108.4	13.12	163.9	$2.7x10^4$
Type of plant	156	1	0	1	134	0.86	0.028	0.349	0.122
SOE	156	0	1	1	156	1.00	0.00	0.00	0.0
Valid N (listwise)	101								

5.4 Part 4: Empirical analyses

This section presents the empirical results that were obtained by the application of the study methods detailed in Section 4.7 above. The results are fully discussed and interpreted in Chapter 6 of the report.

The empirical analyses results entail results for the following:

- descriptive analyses (relevant to Research Question 1 and Research Question 2)
- bivariate correlation (relevant to Research Question 2), and
- regression analysis (relevant to Research Question 2).

5.4.1 Descriptive analyses

This section contains the results of the descriptive analyses done in the study. They entail graphical exploration of the study data to distil insights relevant to the research questions. The results are categorised according to the research question they are relevant to. The opportunity was taken to also extract additional insights beyond the specific research questions but relevant to the research subject matter from the unique data set assembled for the study. The results for the additional insights are also presented below in its own category.

5.4.1.1 Research Question 1

Research Question 1 requires the evaluation of the prevalence of PF in power plant projects in Sub-Saharan Africa. The graphs below help answer the question from several perspectives.

Figure 5-1 below shows the prevalence of corporate finance and PF in the study data set from the perspective of number of projects in the study region.

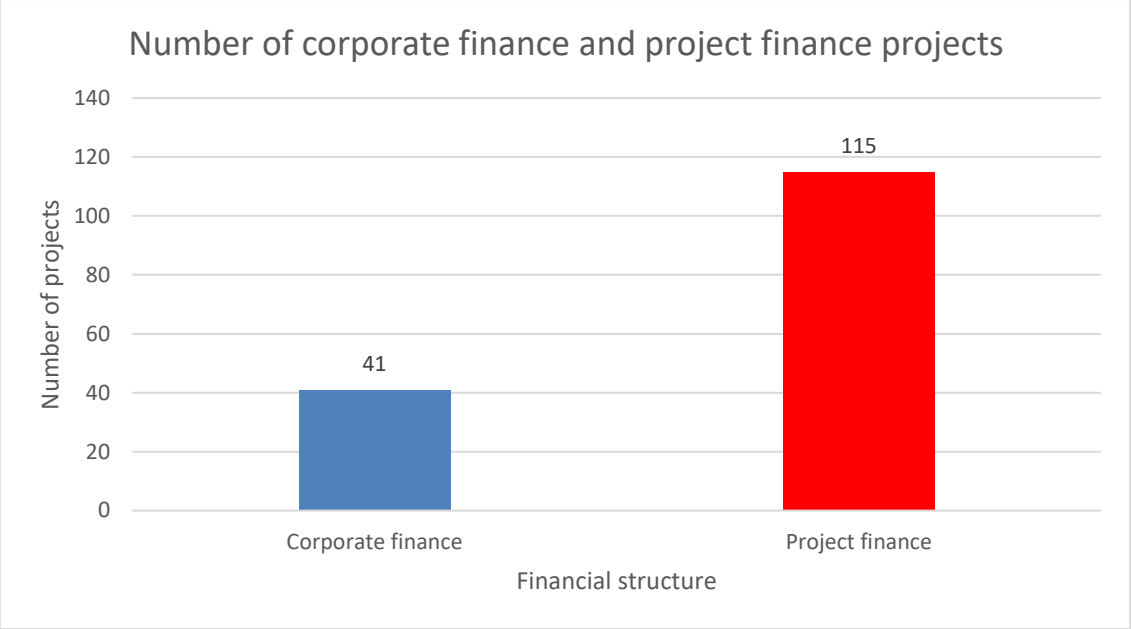

Figure 5-1: Number of corporate finance and PF projects

Figure 5-2 below shows the prevalence of corporate finance and PF in the study data set from the perspective of value (total investments) in projects in the study region.

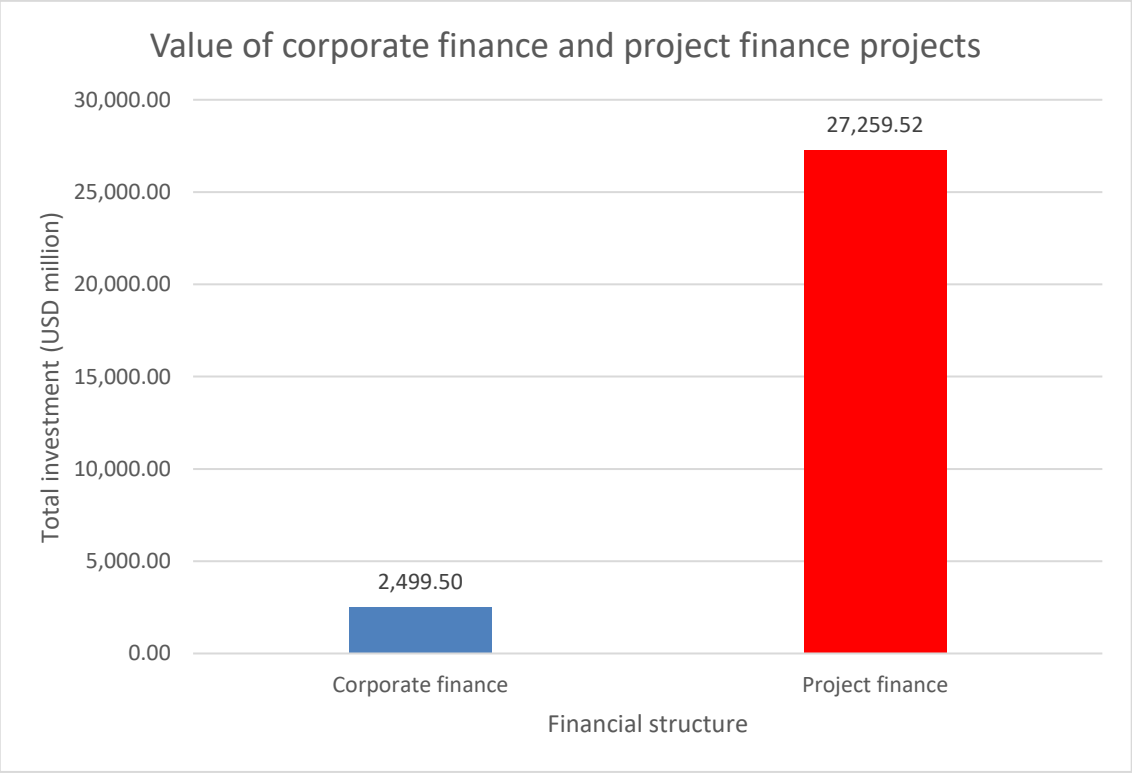

Figure 5-2: Total investments in corporate finance and PF projects

Figure 5-3 below shows the number of projects per country in the study data set.

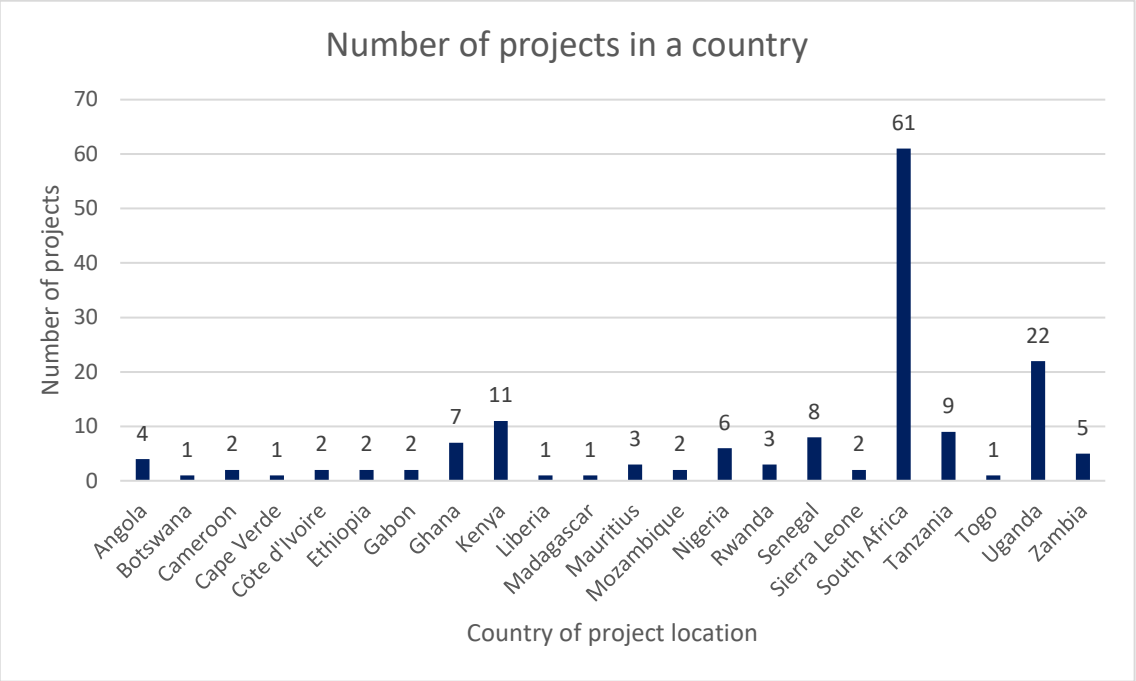

Figure 5-3: Number of projects per country

Figure 5-4 below shows the number of projects per country split into corporate finance and PF.

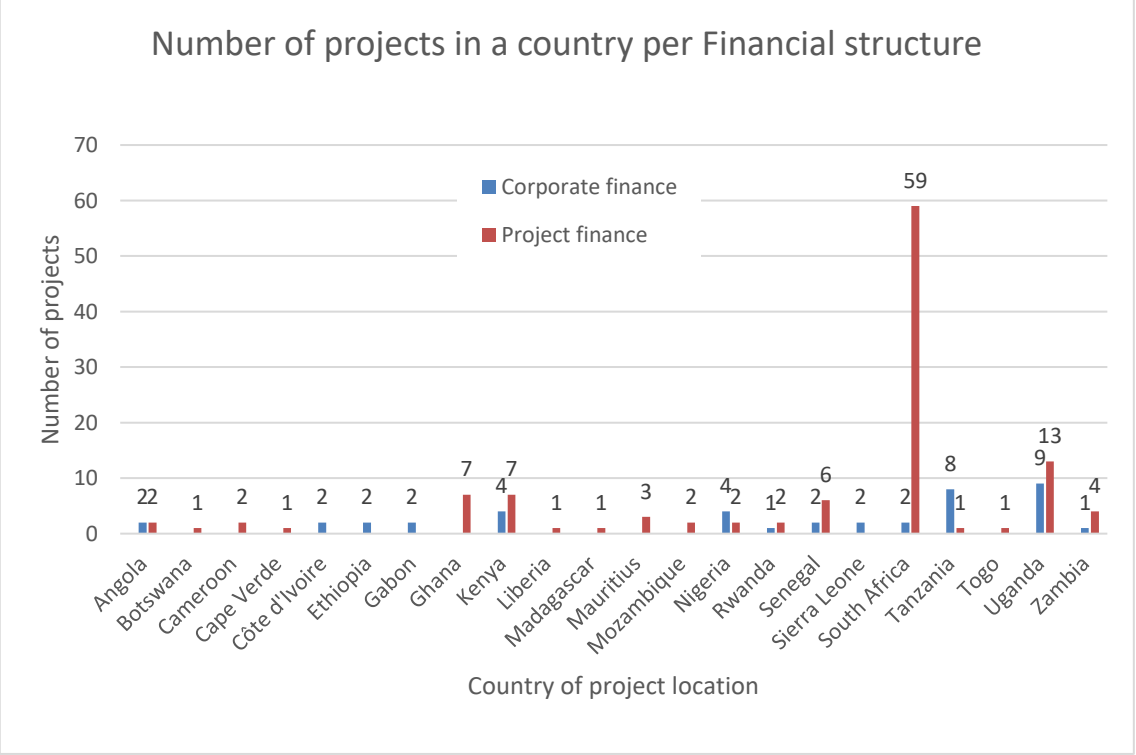

Figure 5-4: Split of number of corporate finance and PF projects per country

The World Bank classifies countries according to the income groups shown in Table 5-3 below.

Table 5-3: World Bank country income group thresholds

Threshold	GNI/Capita (current US$)
Low-income	< 1,005
Lower-middle income	1,006 - 3,955
Upper-middle income	3,956 - 12,235
High-income	> 12,235

Source: (World Bank, 2017b)

Figure 5-5 below shows the number of projects per country income groups in the study region.

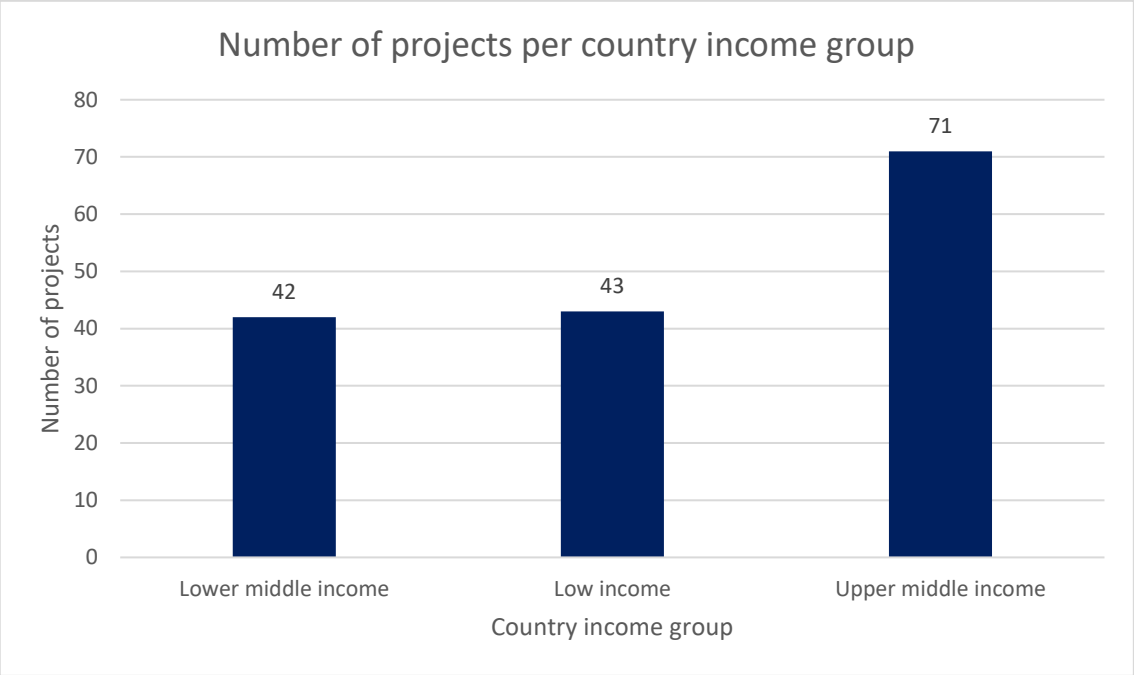

Figure 5-5: Number of projects per country income groups

Figure 5-6 below shows the number of projects per country income groups in the study region split into Corporate Finance and PF.

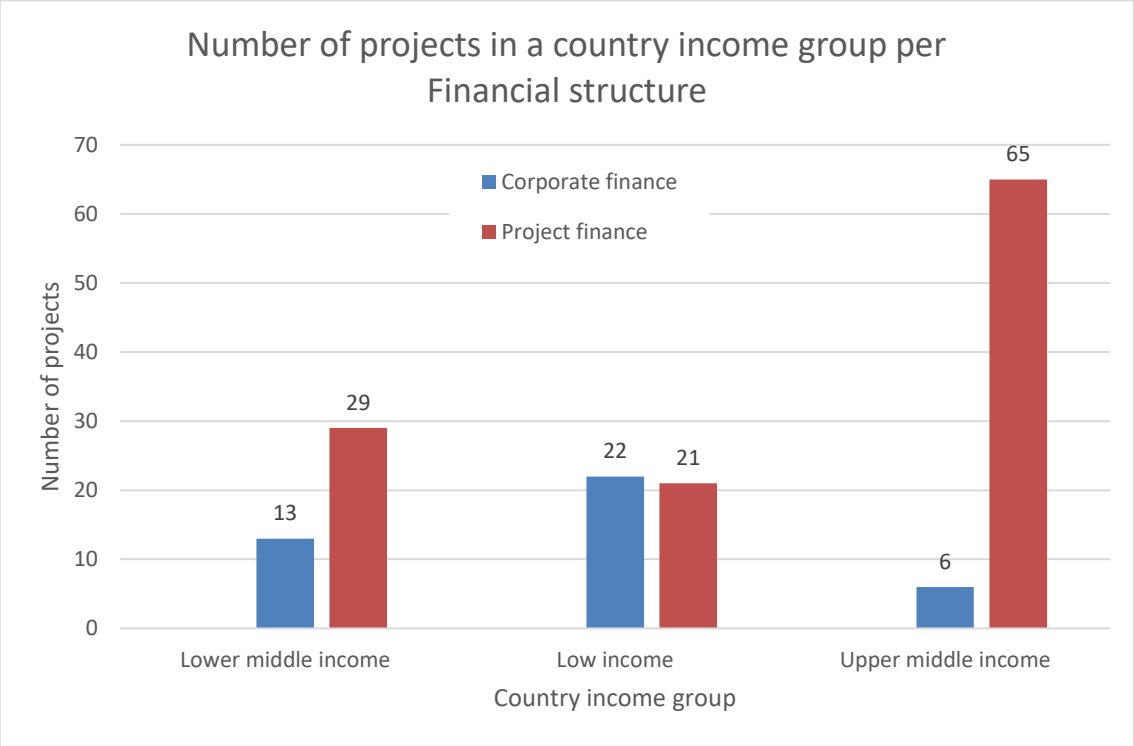

Figure 5-6: Number of projects per country income groups, per funding structure

Figure 5-7 below shows the trend and number of projects reaching financial close between 2000 and 2016.

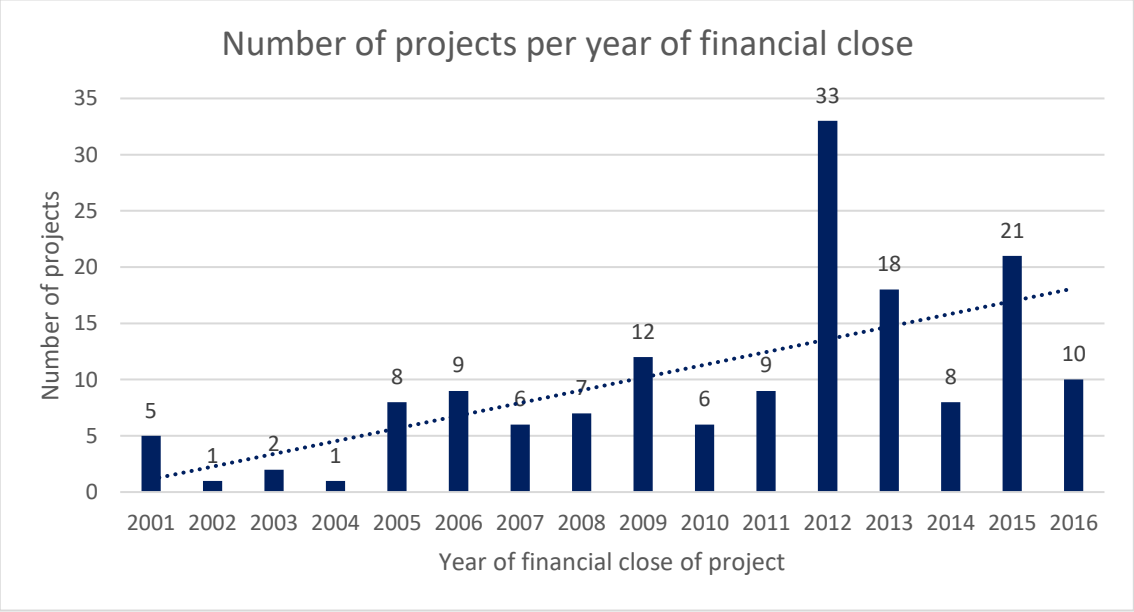

Figure 5-7: Trend and number of projects reaching financial close per year

Figure 5-8 below shows the trends and number of projects reaching financial close between 2000 and 2016 split by funding structure.

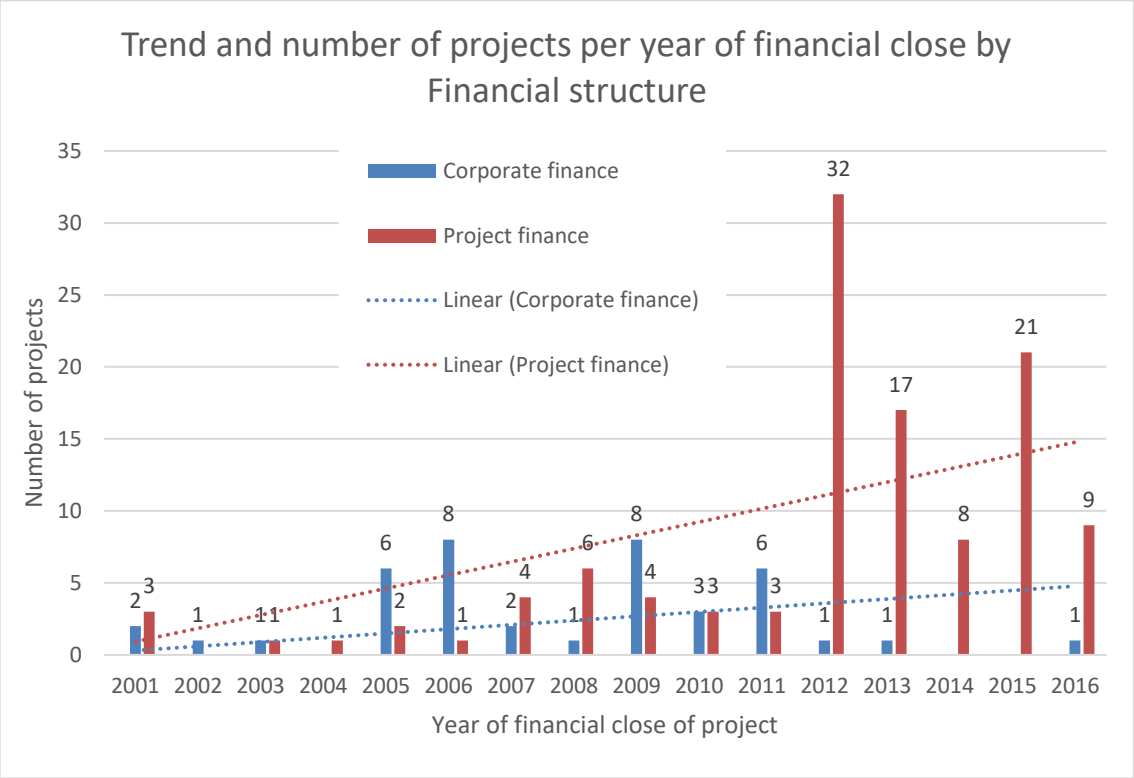

Figure 5-8: Trend and number of projects at financial close per funding structure

The power plant projects in the study data set can be divided into three types:

- Greenfield: a completely new facility.
- Brownfield: an existing facility that is redeveloped.
- Divestiture: a state-owned facility that is bought and taken over by a private firm.

Figure 5-9 below shows the number of projects per project type.

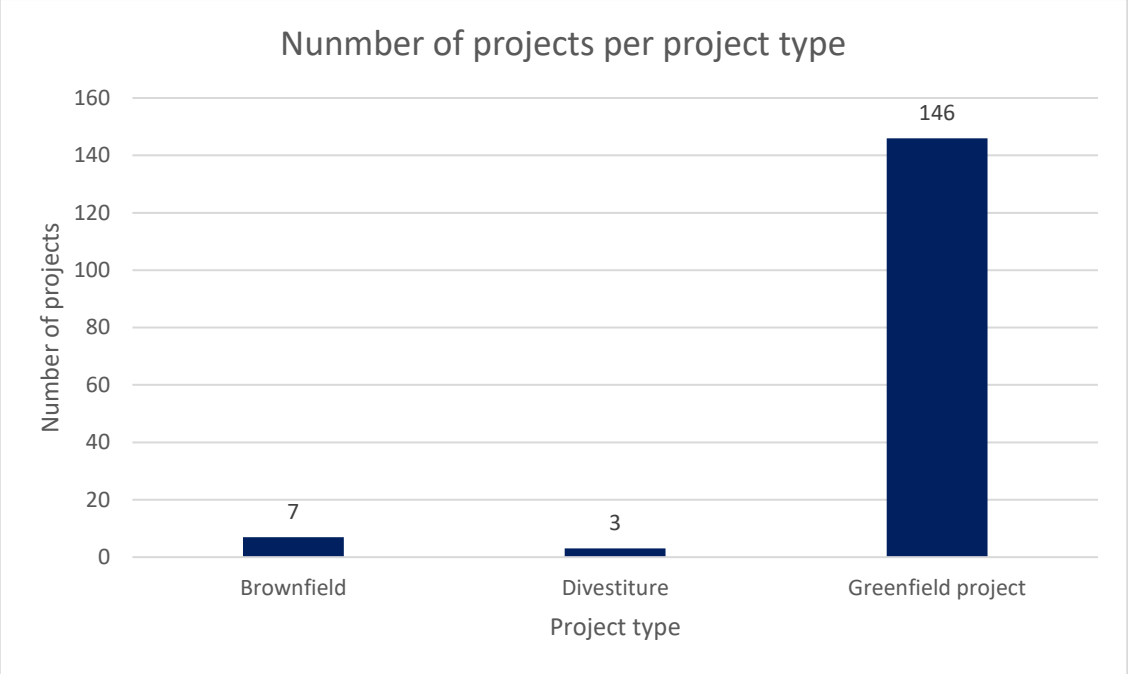

Figure 5-9: Number of projects per project type

Figure 5-10 below shows the number of projects per project type split by funding structure.

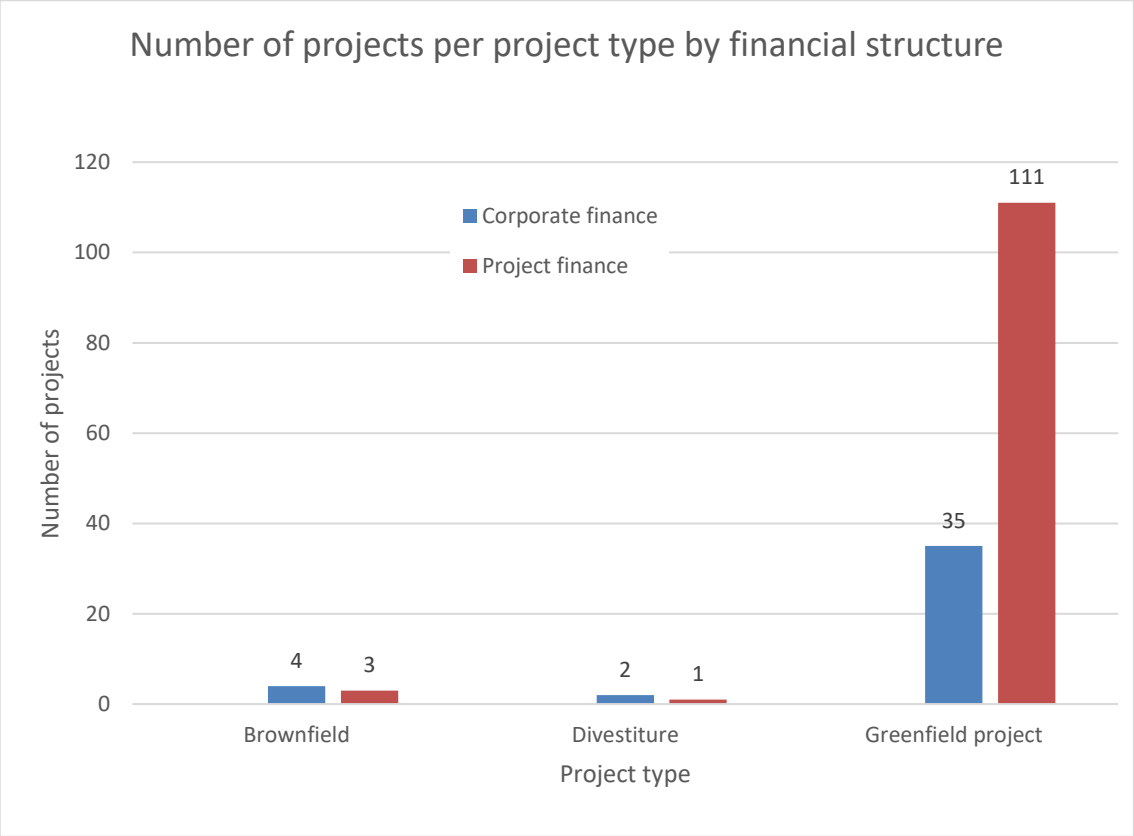

Figure 5-10: Number of projects per project type per funding structure

The power plants in the study are categorised into two types:

- *Rental plant* refers to mobile plants that are rented by government electricity utilities from private firms for periods ranging from 1-15 years.
- *Permanent plant* is a fixed facility that is permanently connected to a national electricity grid.

Figure 5-11 below shows the number of projects per plant type.

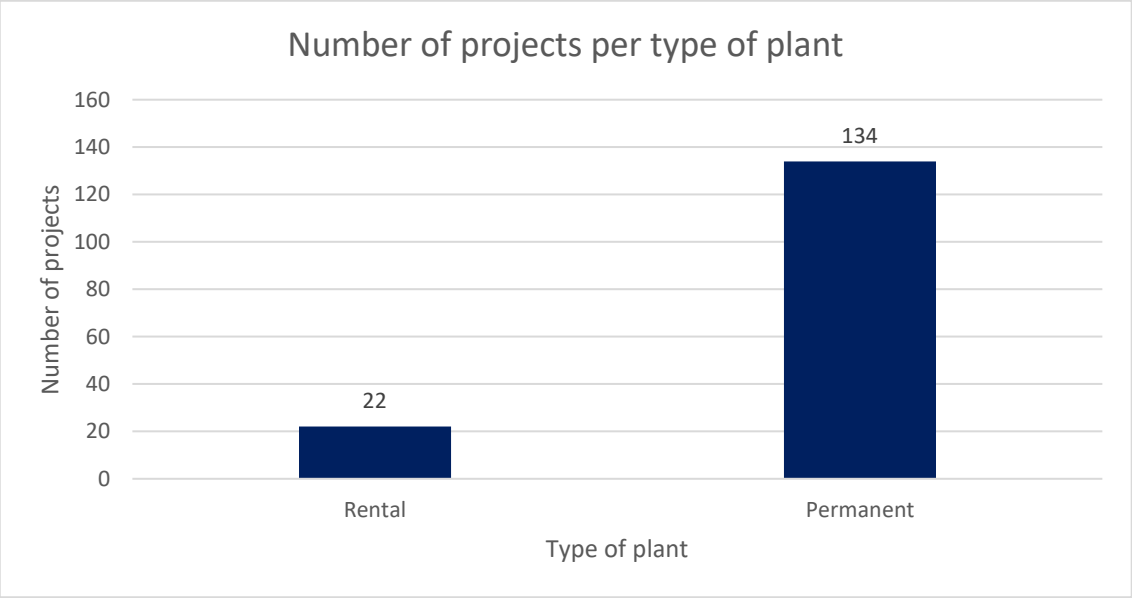

Figure 5-11: Number of projects per type of plant

Figure 5-12 below shows the number of projects per plant type split by funding structure.

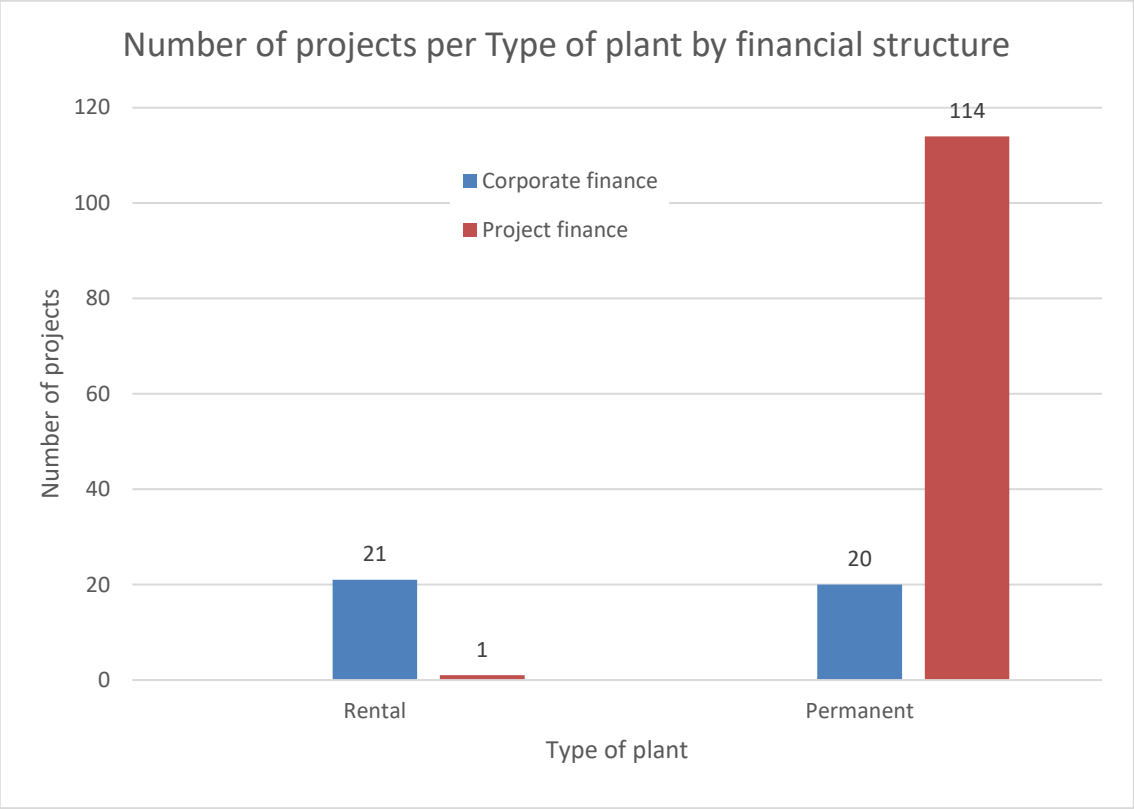

Figure 5-12: Number of projects per type of plant per funding structure

Figure 5-13 below shows the number of projects per technology type.

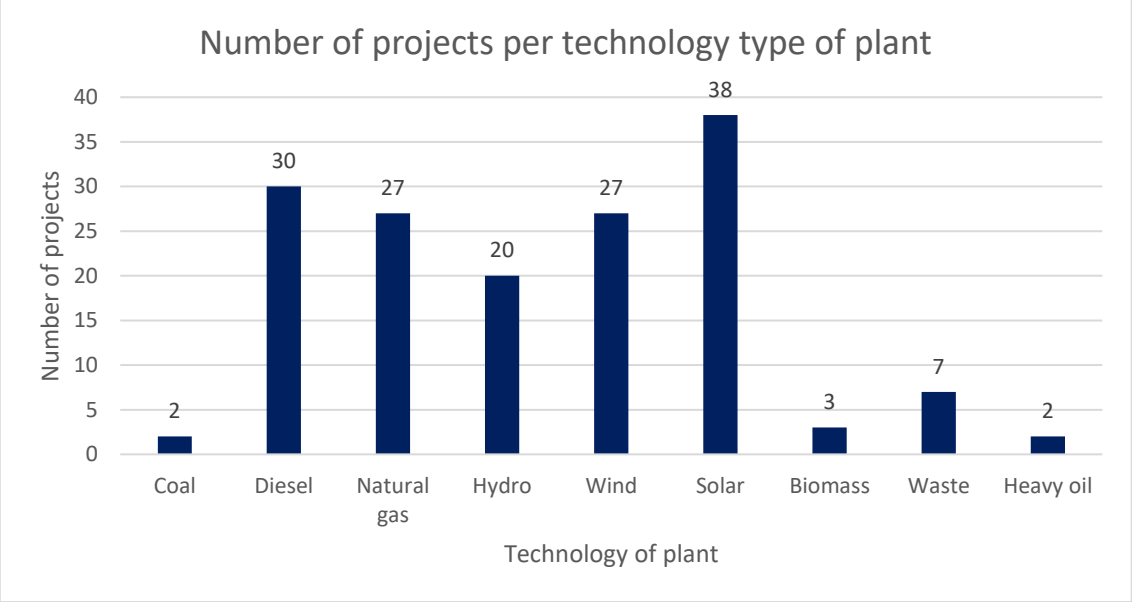

Figure 5-13: Number of projects per technology type

Figure 5-14 below shows the number of projects per technology type split by funding structure.

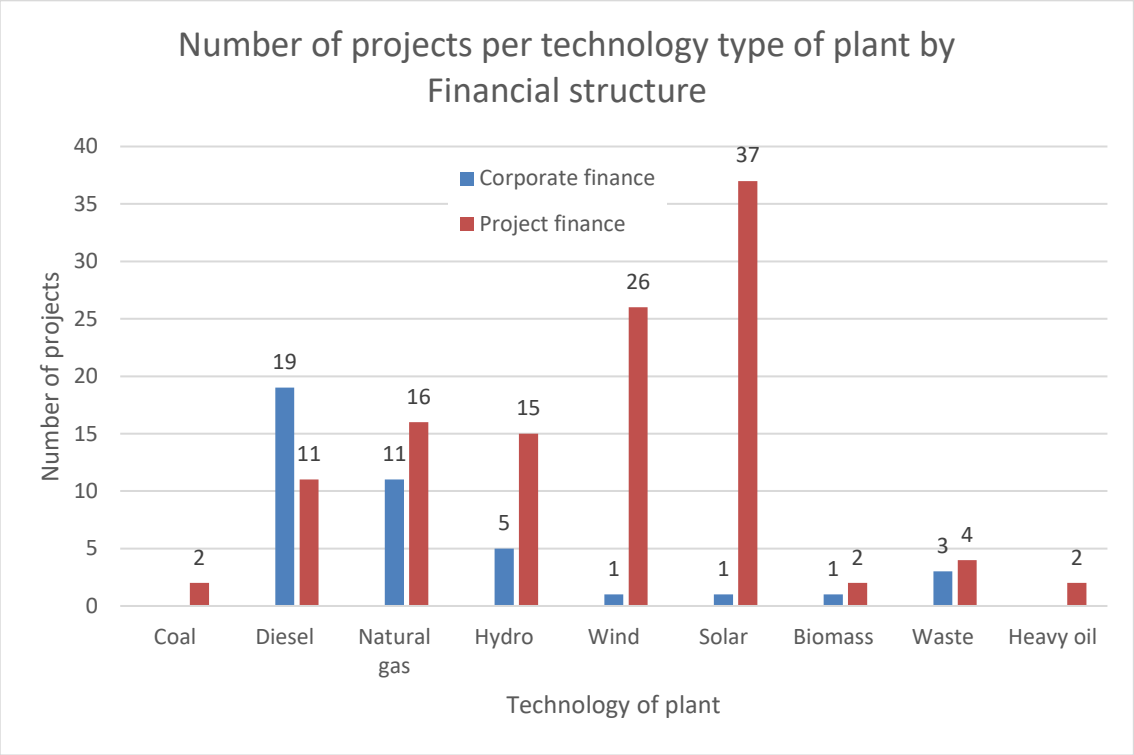

Figure 5-14: Number of projects per technology type per funding structure

The figures above provide insights from multiple perspectives regarding the prevalence of PF in power plant projects in Sub-Saharan Africa. This allowed the answering of Research Question 1 in a holistic way.

5.4.1.2 Research Question 2

The graphs relevant to Research Question 2 (extent of influence of the drivers of PF) are provided below. They have been split between the two hypotheses of the question.

Hypothesis 1

Hypothesis 1 concerns the influence of project investment size in driving PF. The graphs relevant to this topic are shown below.

Figure 5-15 below shows the distribution of total investments in projects by size.

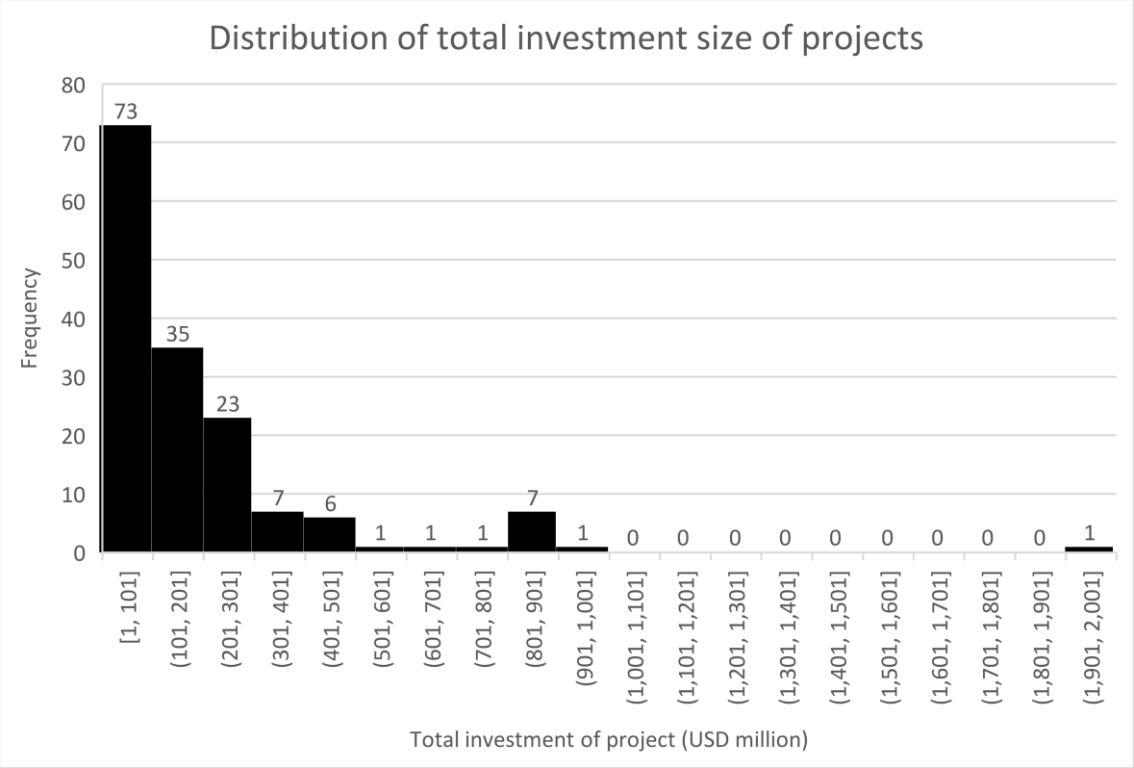

Figure 5-15: Distribution of total investments in projects by size

Figure 5-16 shows the average total project investments per funding structure.

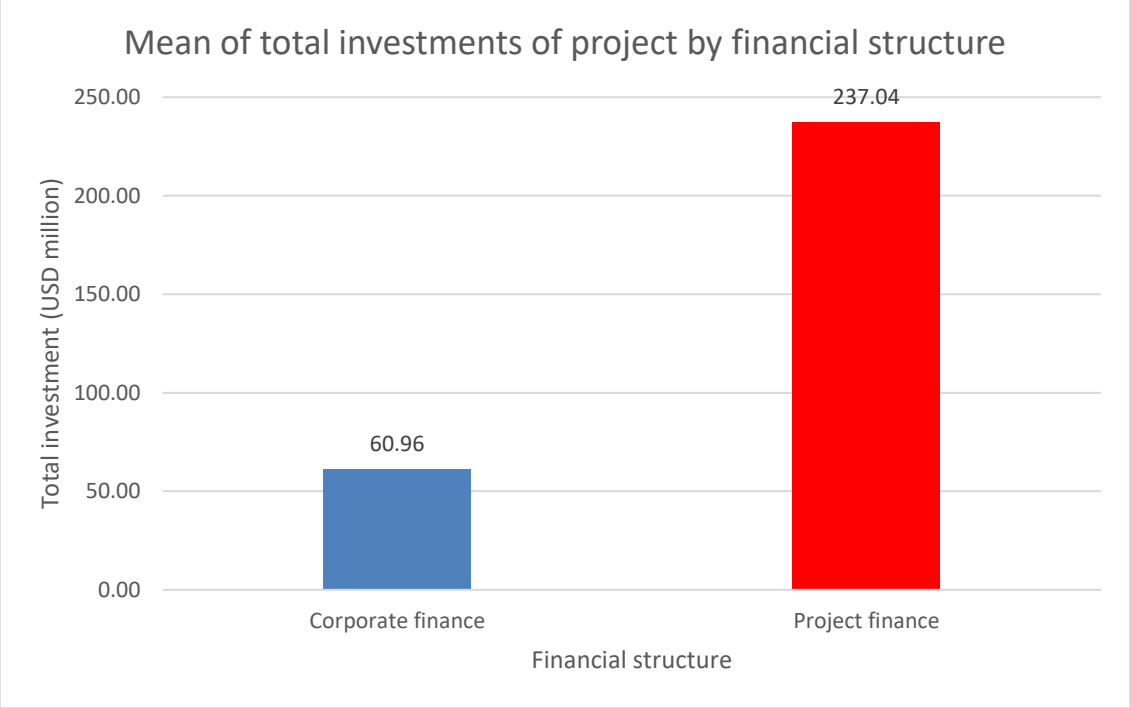

Figure 5-16: Mean of total investments per funding structure

Figure 5-17 shows the median total project investments per funding structure.

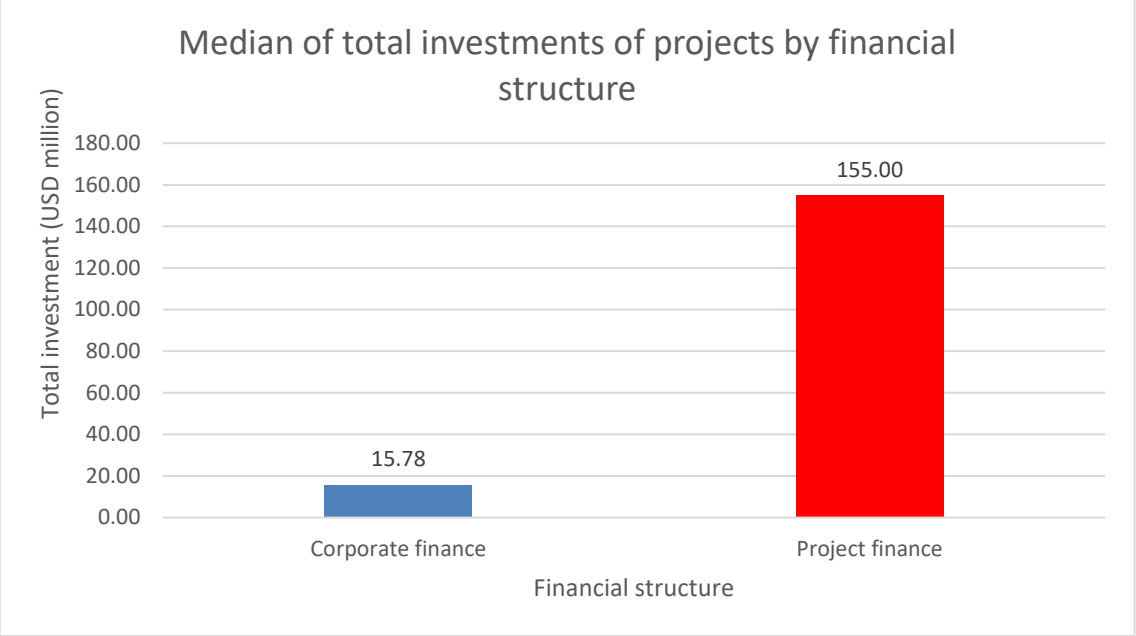

Figure 5-17: Median of total investments per funding structure

Figure 5-18 shows the modal total project investments per funding structure.

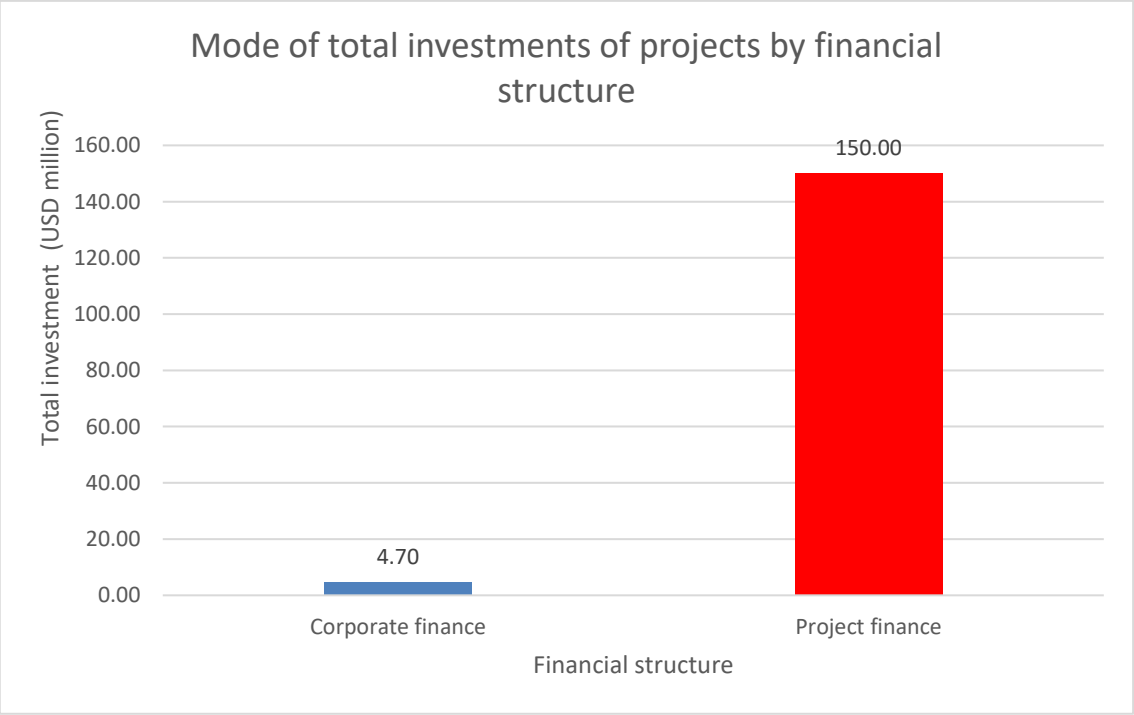

Figure 5-18: Mode of total investments per funding structure

Figure 5-19 shows the minimum total project investments per funding structure.

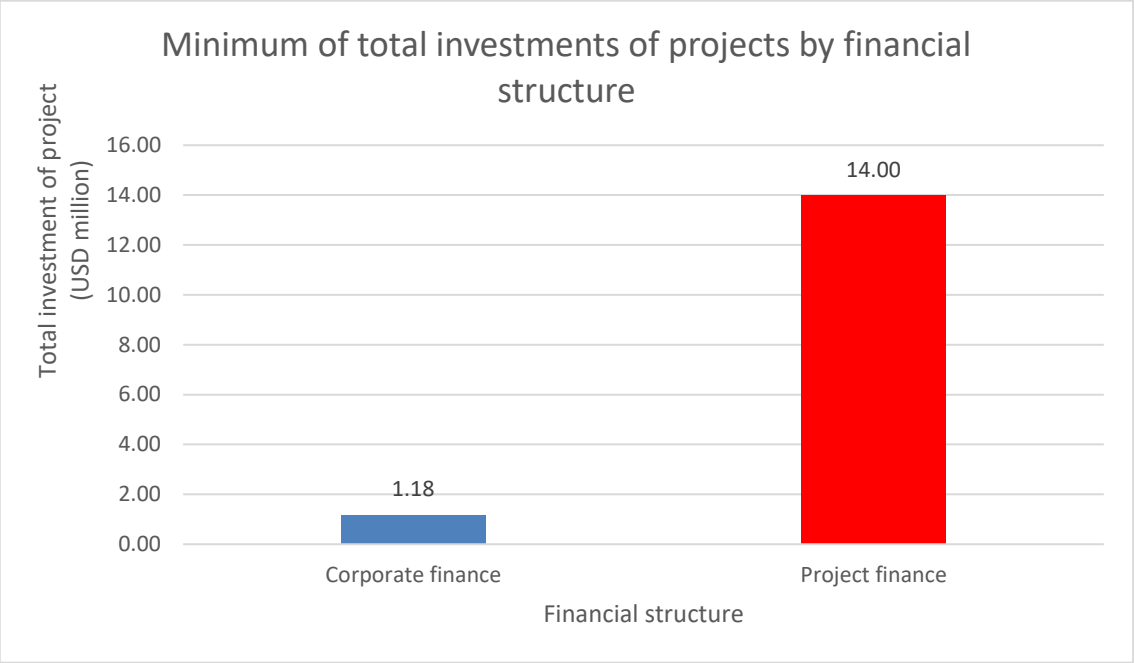

Figure 5-19: Minimum of total investments per funding structure

Figure 5-20 shows the maximum total project investments per funding structure.

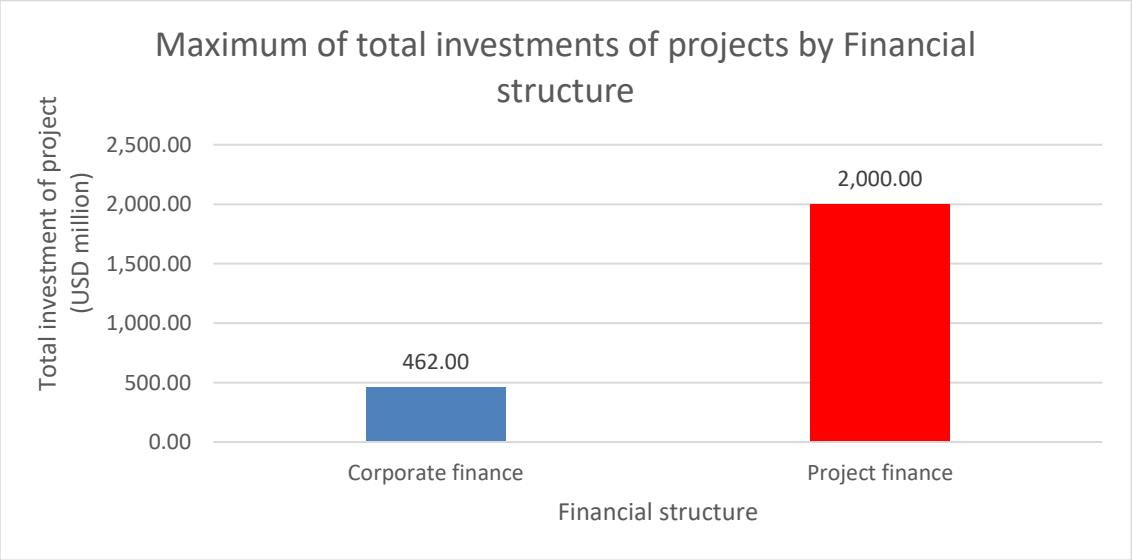

Figure 5-20: Maximum of total investments per funding structure

Hypothesis 2

Hypothesis 2 concerns the influence of country risk in driving PF. The graphs relevant to this topic are shown below.

Figure 5-21 shows means per country of the country political risk ratings for the years of project financial close.

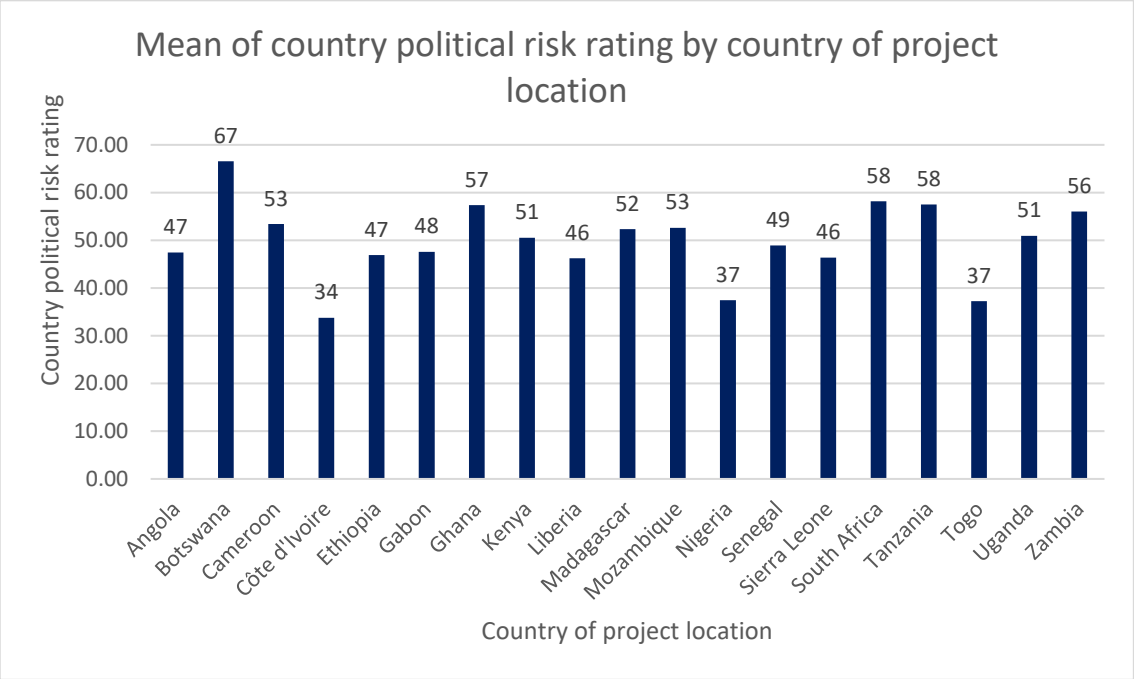

Figure 5-21: Means of the country political risk ratings per country

Figure 5-22 shows means per country of the country political risk ratings for the years of project financial close.

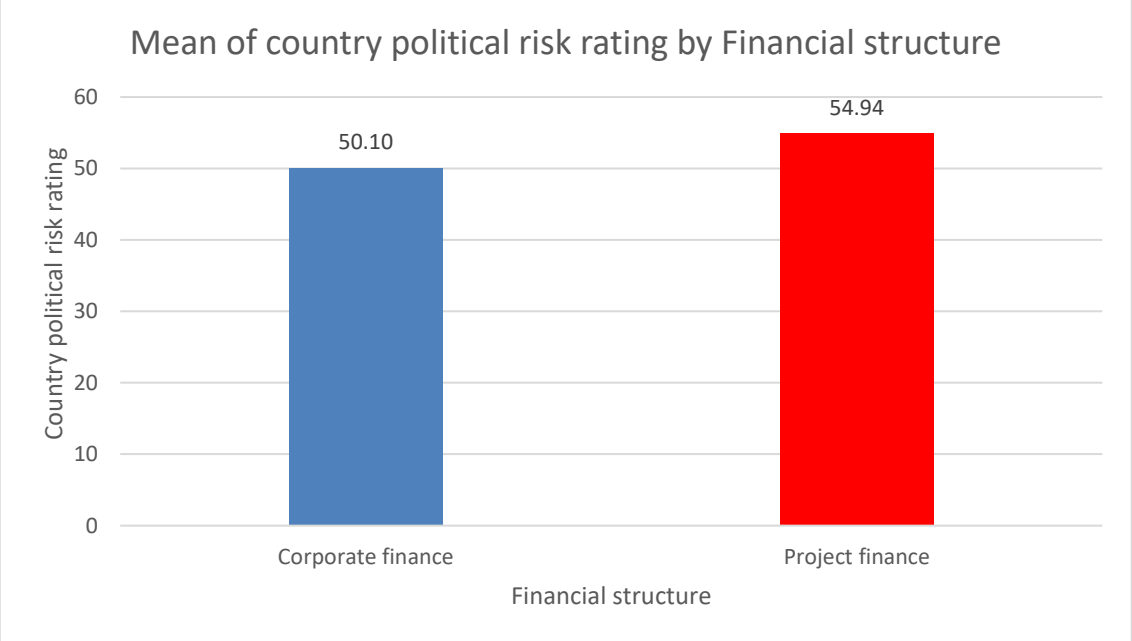

Figure 5-22: Means of country political risk ratings per funding structure

Figure 5-23 shows the medians of country political risk ratings for the projects per funding structure.

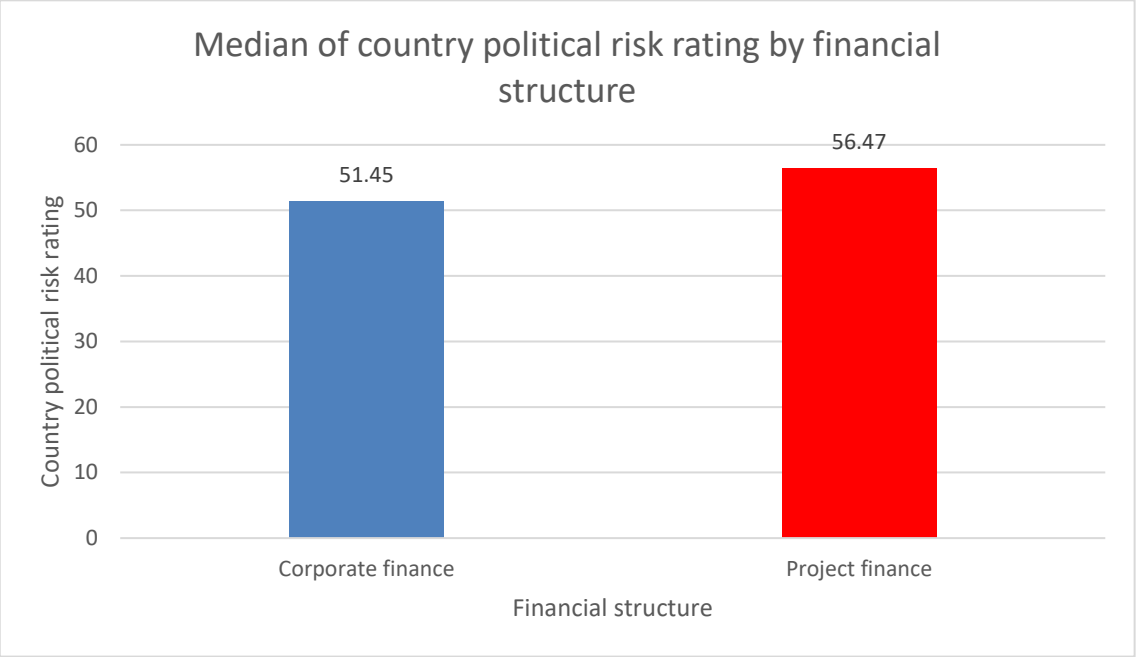

Figure 5-23: Medians of country political risk ratings per funding structure

Figure 5-24 shows the minimums of country political risk ratings for the projects per funding structure.

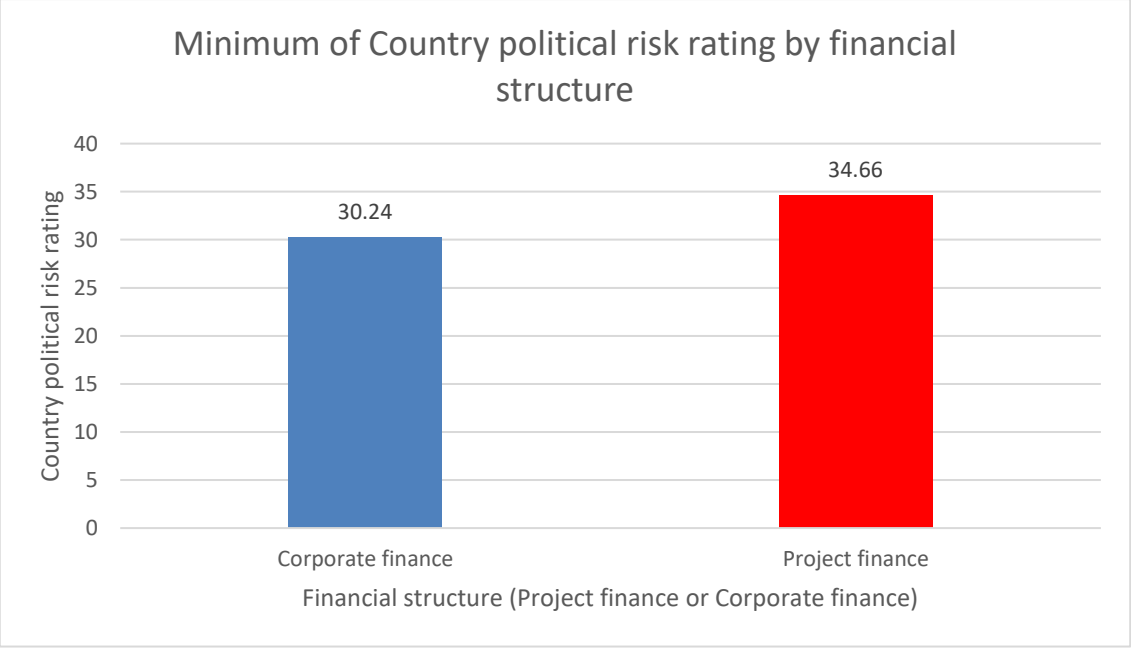

Figure 5-24: Minimum of country political risk ratings per funding structure

Figure 5-25 shows the maximums of country political risk ratings for the projects per funding structure.

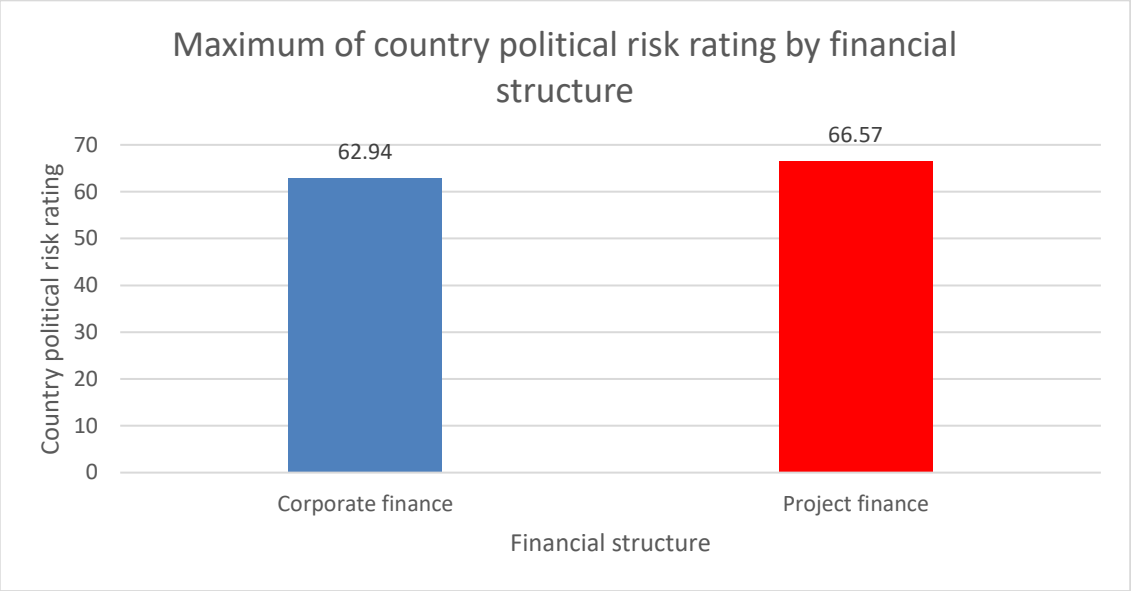

Figure 5-25: Maximum of country political risk ratings per funding structure

Figure 5-26 shows the sums of country political risk ratings for the projects per funding structure.

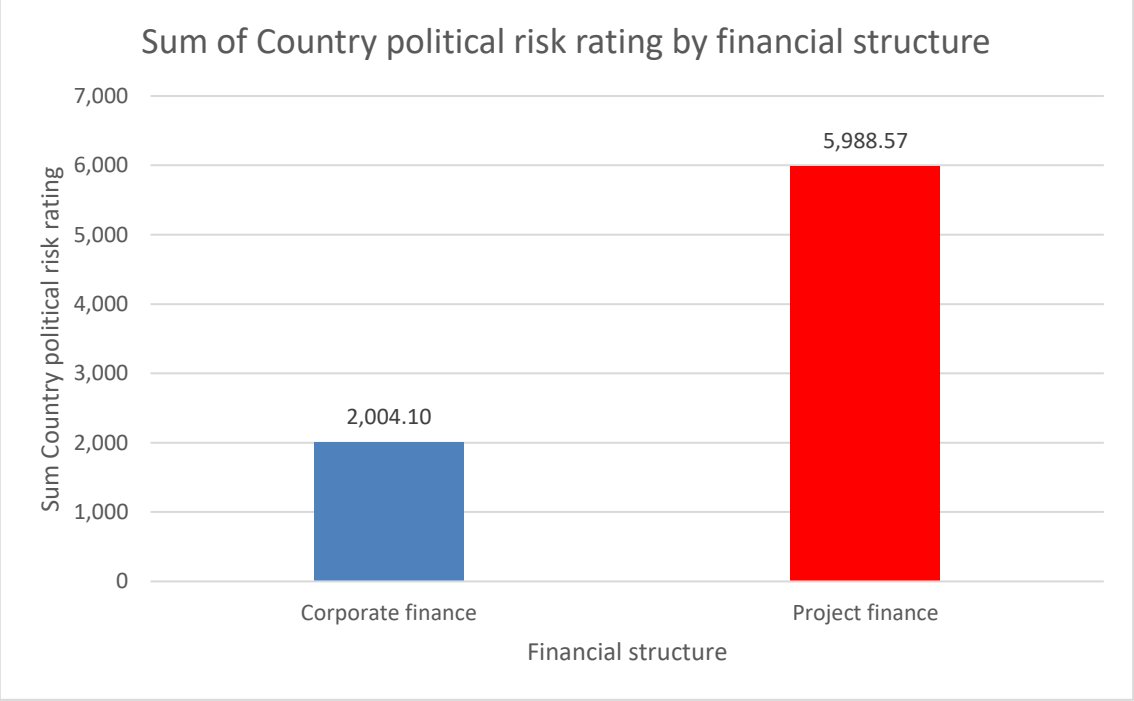

Figure 5-26 Sums of country political risk ratings per funding structure

5.4.1.3 Control variables

The graphs relevant to control variables used in the study are provided below. They have been split between the two variables Sponsor Book Value and Sponsor Leverage.

Sponsor book value

Sponsor Book Value relates to the value of the main sponsor firms according to their balance sheets.

Figure 5-27 below shows the mean of book values of main sponsors of projects per funding structure.

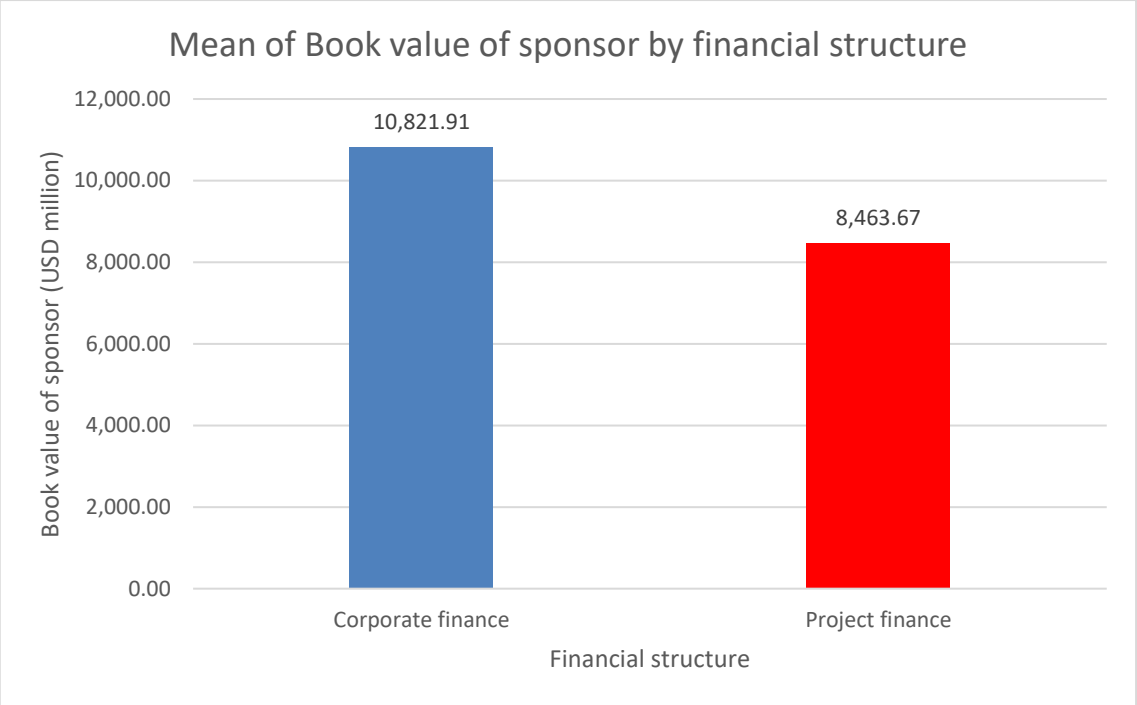

Figure 5-27: Means of book values of main sponsors per funding structure

Figure 5-28 below shows the median of book values of main sponsors of projects per funding structure.

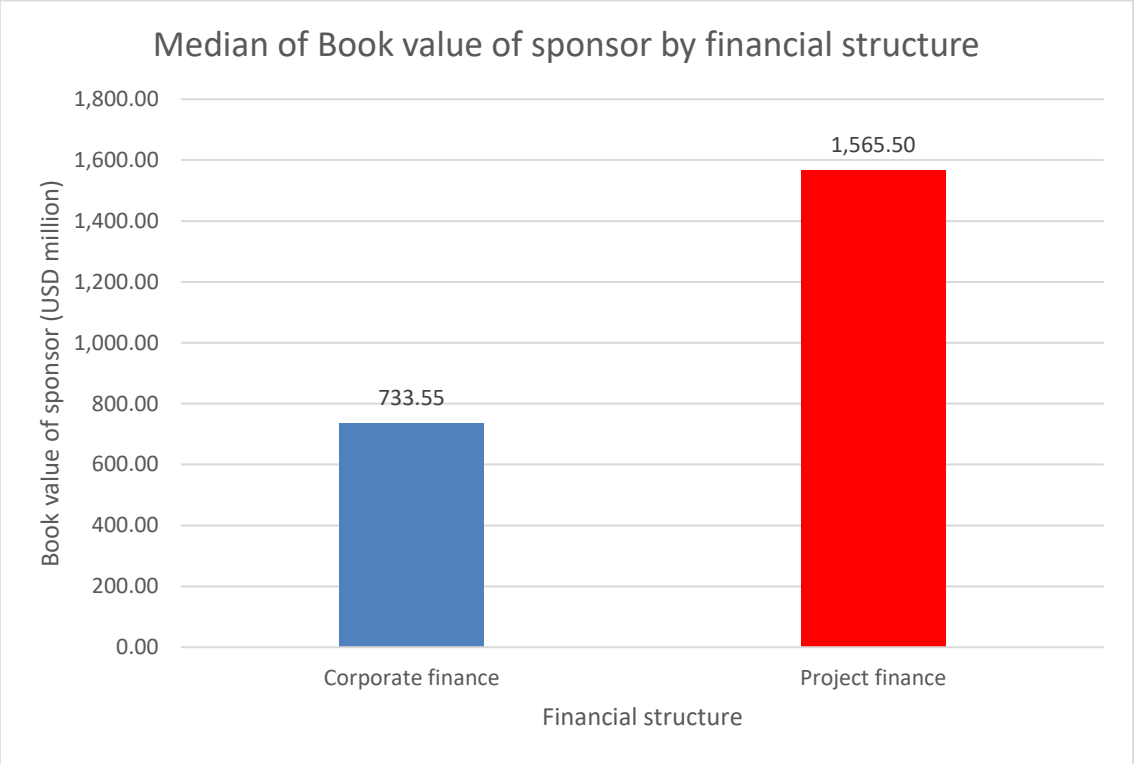

Figure 5-28: Median of book values of main sponsors per funding structure

Figure 5-29 below shows the mode of book values of main sponsors of projects per funding structure.

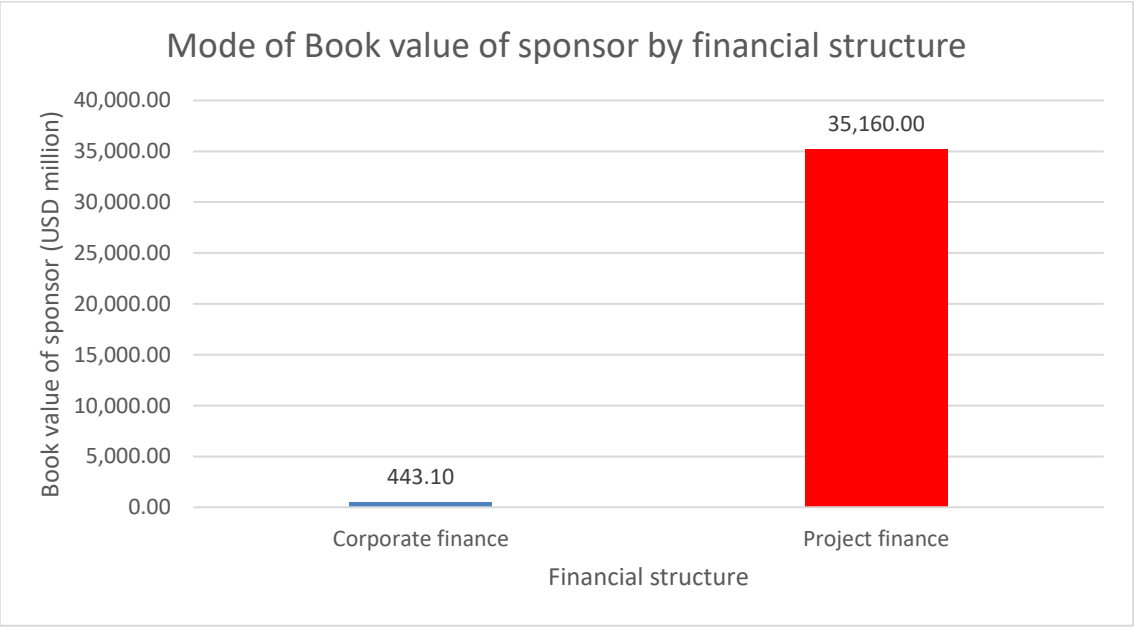

Figure 5-29: Mode of book values of main sponsors per funding structure

Figure 5-30 below shows the minimum of book values of main sponsors of projects per funding structure.

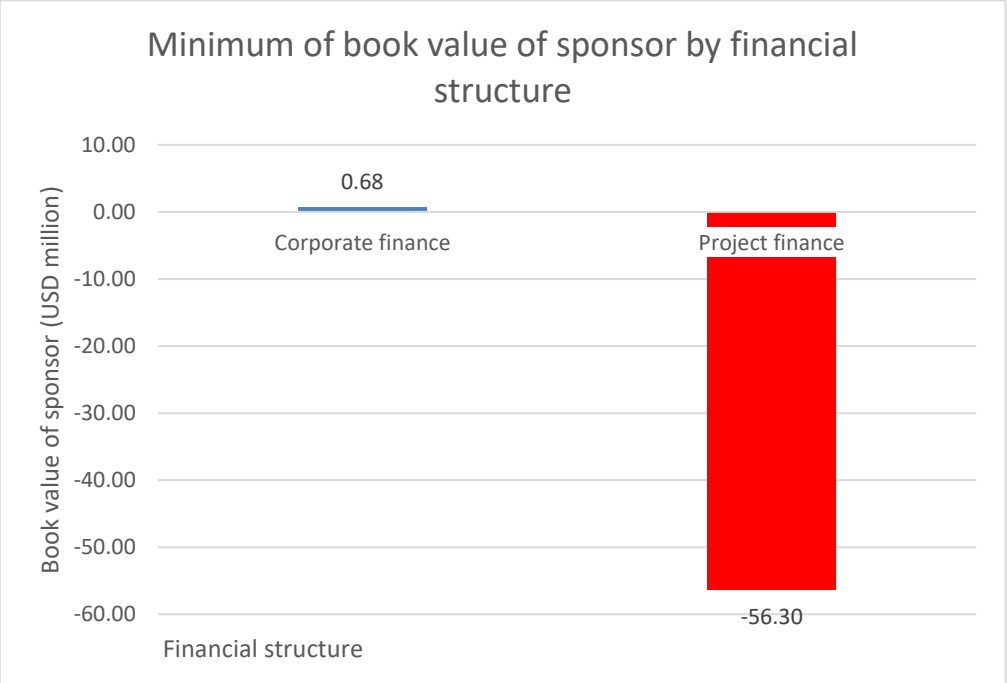

Figure 5-30: Minimum of book values of main sponsors

Figure 5-31 below shows the maximum of book values of main sponsors of projects per funding structure.

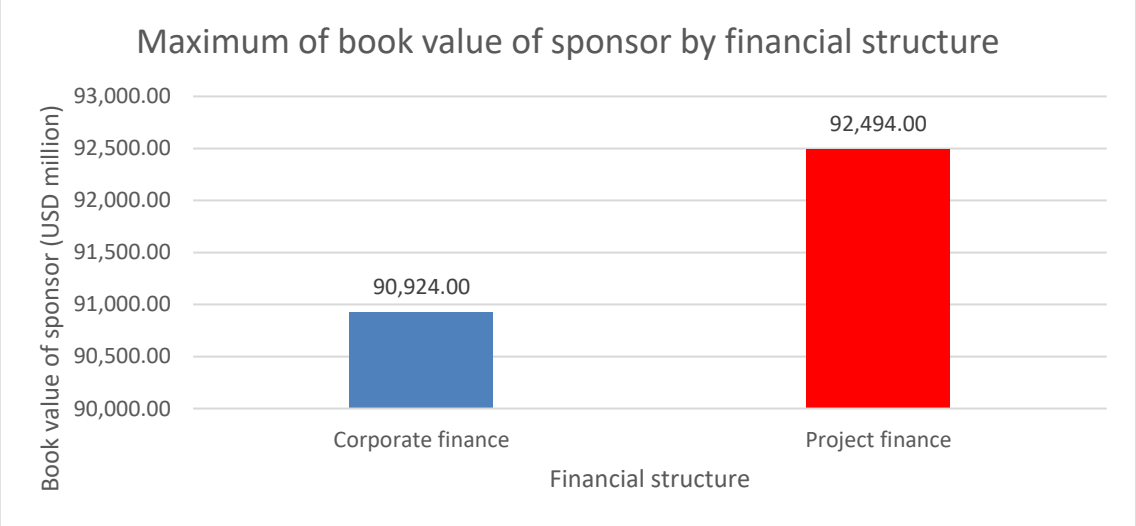

Figure 5-31: Maximum of book values of main sponsors per funding structure.

Leverage

Sponsor leverage relates to the ratio of long-term debt to total capital of the main sponsor firms according to their balance sheets.

Figure 5-32 below shows the mean of leverages of main sponsors of projects per funding structure.

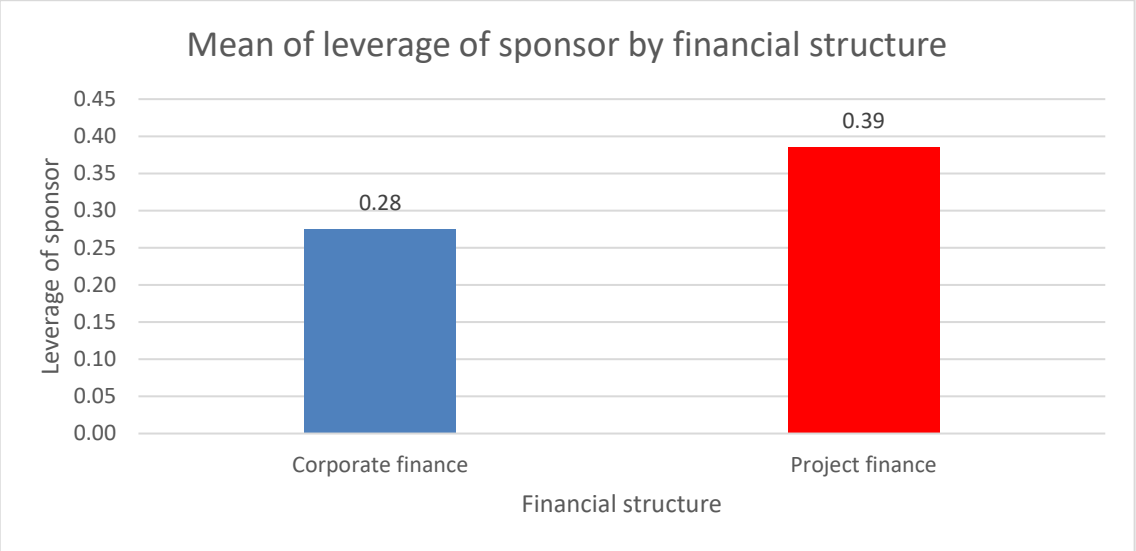

Figure 5-32: Mean of leverages of main sponsors

Figure 5-33 below shows the mean of leverages of main sponsors of projects per funding structure.

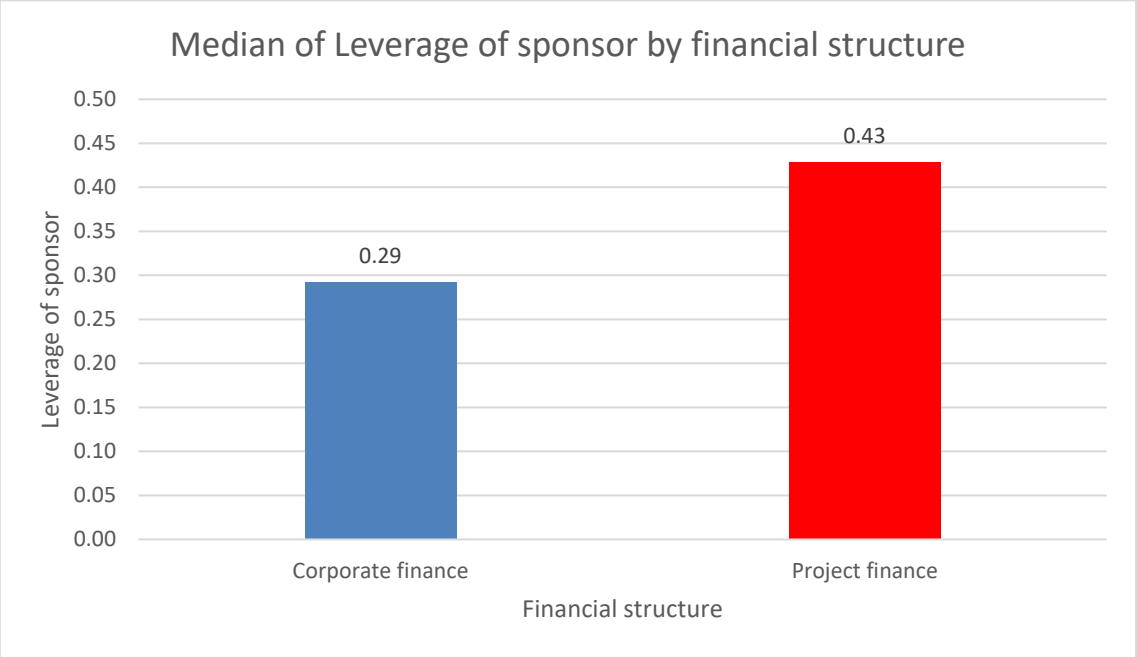

Figure 5-33: Mean of leverages of main sponsors per funding structure

Figure 5-34 below shows the mode of leverages of main sponsors of projects per funding structure.

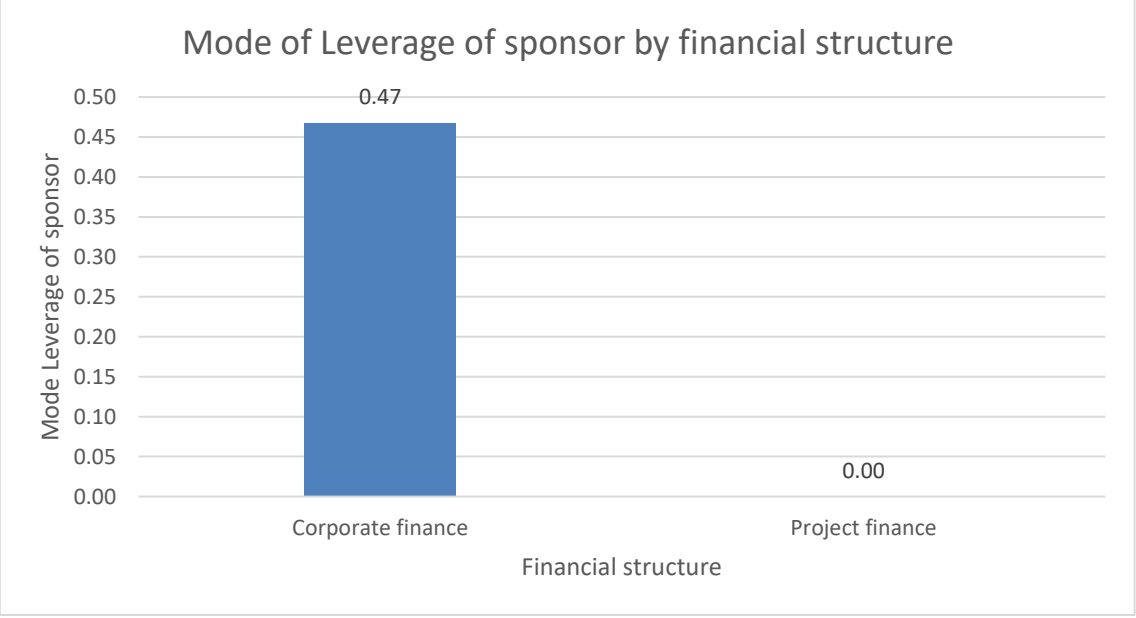

Figure 5-34: Mode of leveraged of main sponsors

Figure 5-35 below shows the maximum of leverages of main sponsors of projects per funding structure.

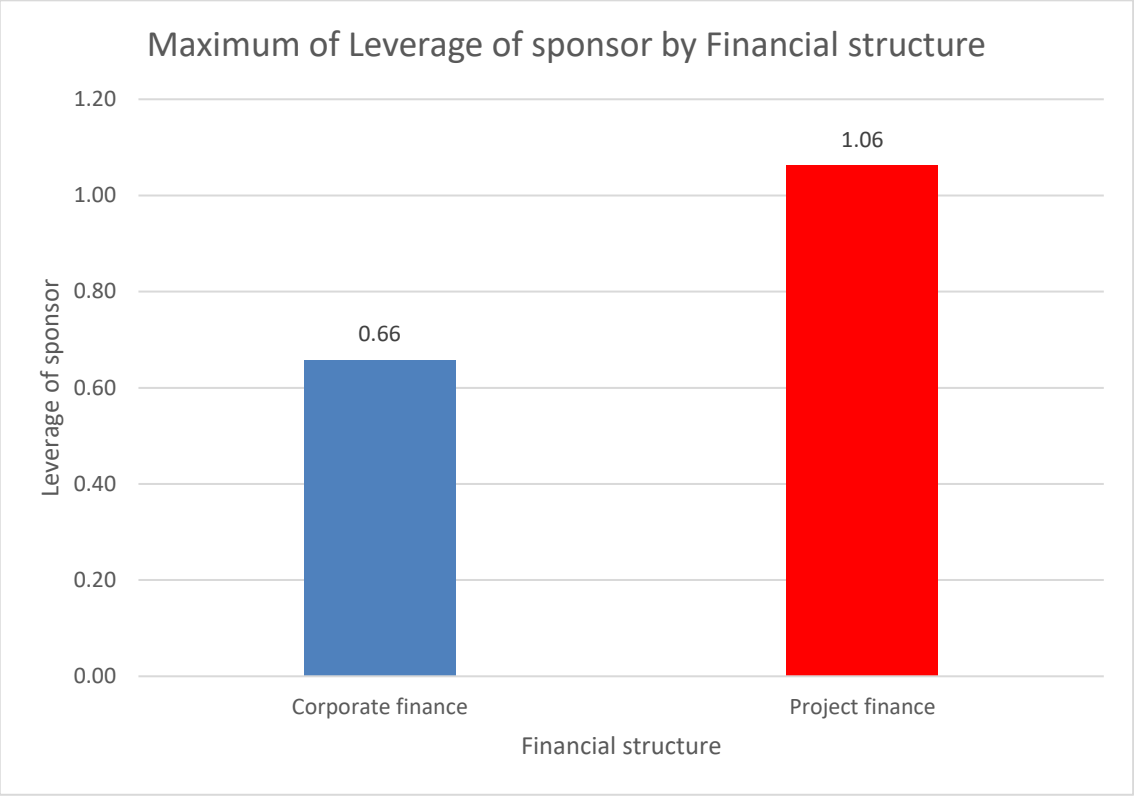

Figure 5-35: Maximum of leverages of main sponsors per funding structure

5.4.1.4 Additional insights

The insights gained from the graphs in this section do not relate to a specific research question but is relevant to the entire subject matter of the research. It is linked to findings that have national and regional policy implications.

Figure 5-36 below shows the sum of total investments made in power plants and the sum of plant capacities resulting per funding structure.

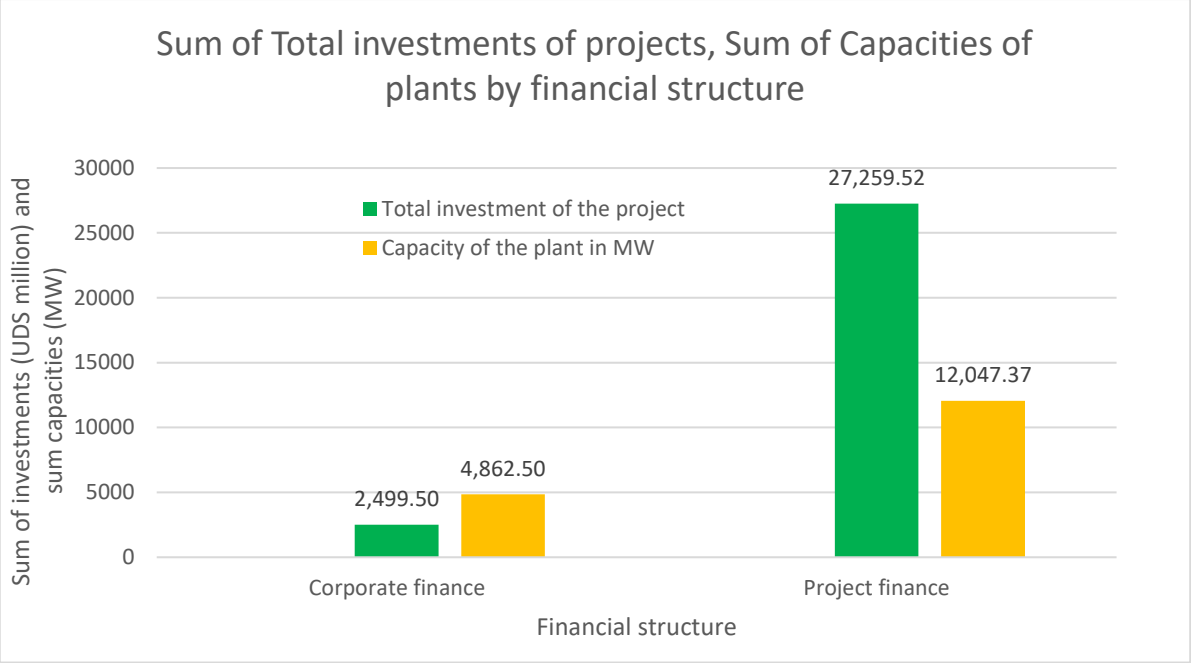

Figure 5-36: Sums of investments and capacities per funding structure

Figure 5-37 below shows the sum of total investments made in power plants and the sum of plant capacities resulting per funding structure per country.

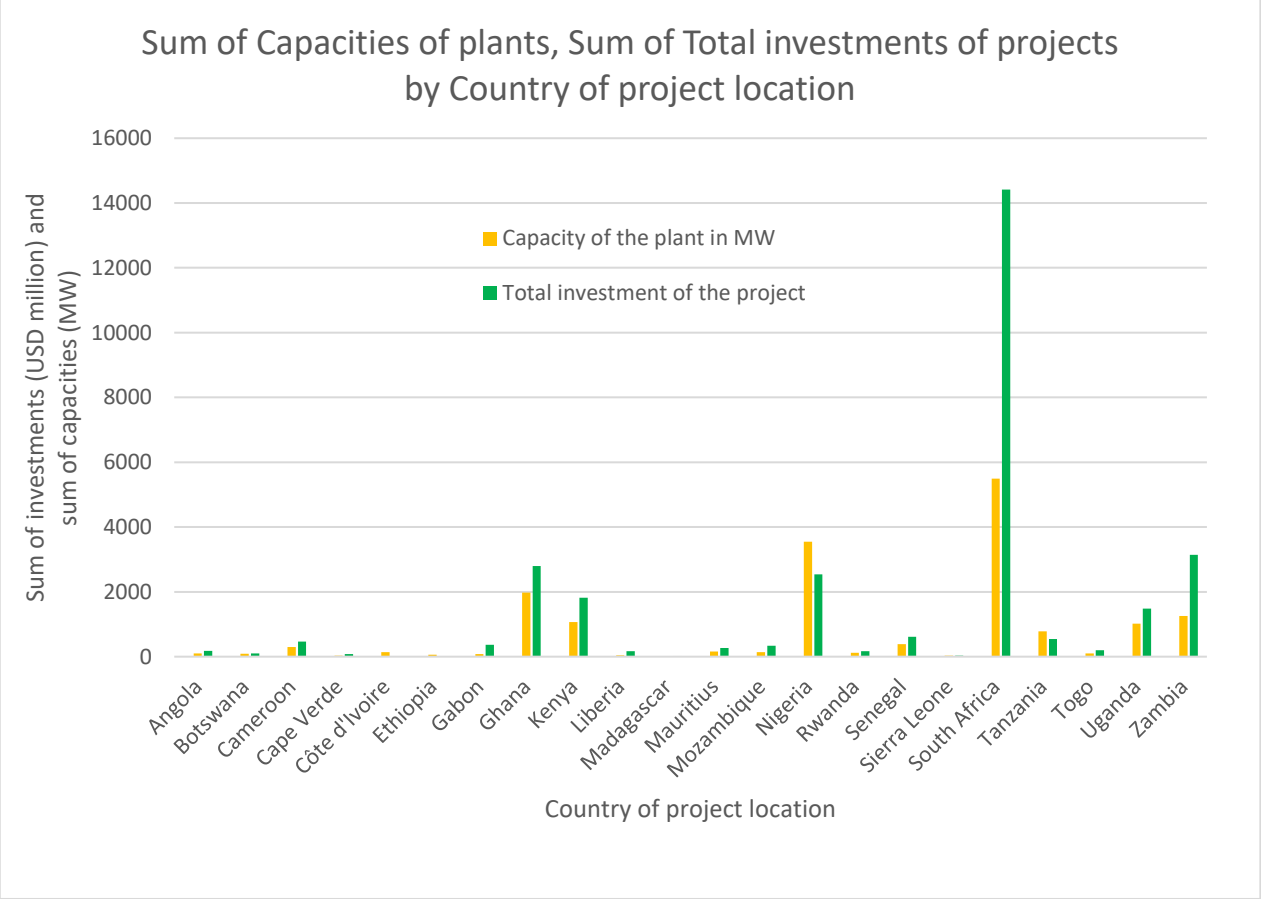

Figure 5-37: Sums of investments and capacities per funding structure per country

Figure 5-38 below shows the sum of total plant capacities per country split per funding structure.

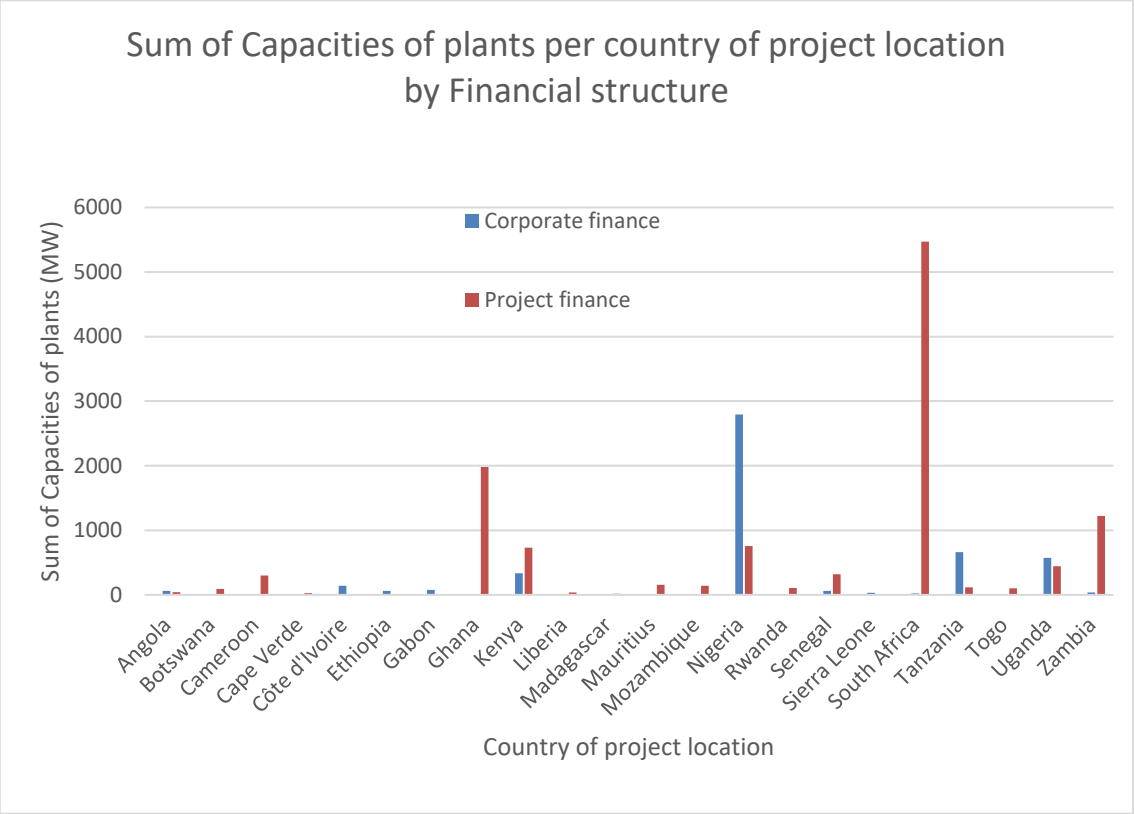

Figure 5-38: Sums of plant capacities per country per funding structure.

Figure 5-39 below shows the distribution of plant capacities in the study.

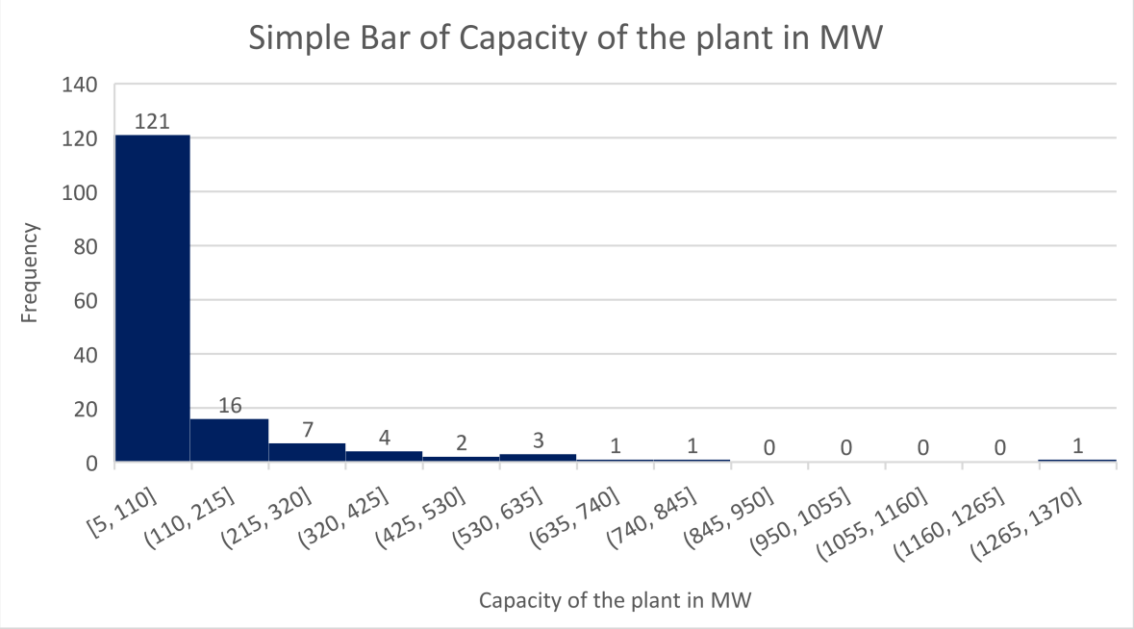

Figure 5-39: Distribution of plant capacities in the study.

5.4.1.5 Conclusion of descriptive analyses results

The descriptive analyses provide a comprehensive set of descriptive results that gave rich insight into the subject of the research. The sights from the various perspectives were combined, compare, contrasted and integrated to provide holistic answers to the research questions. Discussions of the results are contained in Chapter 6 below.

5.4.2 Bivariate correlation

A bivariate correlation was done to gauge the degree to which the study variables are correlated. This was based on the entire study data set. Table 5-4 below shows the results.

Table 5-4: Bivariate correlations

Correlations

		pfproject	investsize	ctryrisk	bookvalue	leverage	Capacity	Financial close year
pfproject	*r*	1	.300**	.349**	-0.055	0.189	-0.037	.495**
	Sig.		0.000	0.000	0.573	0.051	0.644	0.000
	N	156	156	149	107	107	156	156
investsize	*r*	.300**	1	0.085	-0.038	0.127	.561**	.215**
	Sig.	0.000		0.303	0.700	0.191	0.000	0.007
	N	156	156	149	107	107	156	156
ctryrisk	*r*	.349**	0.085	1	-0.154	.217*	-.224**	.259**
	Sig.	0.000	0.303		0.124	0.029	0.006	0.001
	N	149	149	149	101	101	149	149
bookvalue	*r*	-0.055	-0.038	-0.154	1	-0.080	.312**	0.023
	Sig.	0.573	0.700	0.124		0.415	0.001	0.816
	N	107	107	101	107	107	107	107
leverage	*r*	0.189	0.127	.217*	-0.080	1	0.073	-0.037
	Sig.	0.051	0.191	0.029	0.415		0.453	0.703
	N	107	107	101	107	107	107	107
Capacity of the plant	*r*	-0.037	.561**	-.224**	.312**	0.073	1	-0.105
	Sig.	0.644	0.000	0.006	0.001	0.453		0.193
	N	156	156	149	107	107	156	156
Financial close year	*r*	.495**	.215**	.259**	0.023	-0.037	-0.105	1
	Sig.	0.000	0.007	0.001	0.816	0.703	0.193	
	N	156	156	149	107	107	156	156

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

*. Correlation is significant at the 0.05 level (2-tailed).

5.4.3 Regression analysis

A regression analysis was done to estimate the extent of influence the independent variables have on the dependent variable.

Table 5-5 below provides the descriptive statistics of the regression variables.

Table 5-5: Descriptive statistics of regression variables

Descriptive Statistics

	Mean	Std. Deviation	N
pfproject	0.75	0.434	101
investsize	236.083267	298.6144765	101
ctryrisk	53.743069	6.6469248	101
bookvalue	9554.754851	18857.9105195	101
leverage	0.346298	0.2394216	101

Table 5-6 below presents the correlation analysis of the regression variables

Table 5-6: Regression variable correlations

Correlations

		pfproject	investsize	ctryrisk	bookvalue	leverage
Pearson Correlation	pfproject	1.000	0.324	0.436	-0.052	0.175
	Total investment	0.324	1.000	0.067	-0.054	0.169
	Country risk	0.436	0.067	1.000	-0.154	0.217
	bookvalue	-0.052	-0.054	-0.154	1.000	-0.059
	Leverage	0.175	0.169	0.217	-0.059	1.000
Sig. (1-tailed)	pfproject		0.000	0.000	0.304	0.040
	investsize	0.000		0.254	0.294	0.046
	ctryrisk	0.000	0.254		0.062	0.015
	bookvalue	0.304	0.294	0.062		0.279
	leverage	0.040	0.046	0.015	0.279	
N	pfproject	101	101	101	101	101
	investsize	101	101	101	101	101
	ctryrisk	101	101	101	101	101
	bookvalue	101	101	101	101	101
	leverage	101	101	101	101	101

Table 5-7 below contains a summary of the regression model.

Table 5-7: Regression model summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.529[a]	0.279	0.249	0.376	1.469

a. Predictors: (Constant), Leverage of sponsor, Book value of sponsor, Total investment of the project, Country political risk rating
b. Dependent Variable: Financial structure (Project finance or Corporate finance)

Table 5-8 below shows the results of the regression Anova analysis.

Table 5-8: Regression Anova analysis

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.255	4	1.314	9.304	.000[b]
	Residual	13.557	96	0.141		
	Total	18.812	100			

a. Dependent Variable: Financial structure (Project finance or Corporate finance)
b. Predictors: (Constant), Leverage of sponsor, Book value of sponsor, Total investment of the project, Country political risk rating

Table 5-9 below presents the regression coefficients and their levels of significance.

Table 5-9: Regression coefficients

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-0.826	0.314		-2.631	0.010
	investsize	0.000423	0.000	0.291	3.311	0.001
	ctryrisk	0.027	0.006	0.413	4.600	0.000
	bookvalue	6.927E-07	0.000	0.030	0.343	0.732
	leverage	0.069	0.163	0.038	0.422	0.674

a. Dependent Variable: Financial structure (Project finance or Corporate finance)

Table 5-10 below gives the statistics of the regression residuals.

Table 5-10: Regression residuals statistics

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	0.10	1.59	0.75	0.229	101
Residual	-0.839	0.742	0.000	0.368	101
Std. Predicted Value	-2.866	3.644	0.000	1.000	101
Std. Residual	-2.233	1.975	0.000	0.980	101

a. Dependent Variable: Financial structure (Project finance or Corporate finance)

5.5 Conclusion of results

This chapter has provided a comprehensive set of results that have distilled relevant insights from the study data set and the analyses run on it. These results, findings, and their interpretations discussed in the next chapter.

6 Discussion of results

This chapter contains a detailed discussion of the results presented in Chapter 5. The discussion is structured around the research questions. The literature reviewed in Chapter 2 provide guidance in interpreting findings and drawing conclusions.

The results of the research provide relevant insights that answer the research questions thus meeting the objectives of the research. Additional noteworthy insights on the subject matter of the research, but not directly linked to the research questions are also discussed in Section 6.4.1.4.

The chapter follows the same structure as Chapter 5. The results presented in Chapter 5 are referred to and discussed in corresponding sections in of this chapter.

6.1 Part 1: Data gathering and preparation

The data obtained for the study concurred with observations of previous studies that found that growth in investments in the power sector of the Sub-Saharan Africa region accelerated after 2000 (Eberhard et al., 2017; International Energy Agency, 2014a; Ouedraogo, 2017). The study data set showed that while there were on average 9.2 power plant projects per year between 2000 and 2016, there were only 2.2 such projects between 1990 and 1999.

6.2 Part 2: Data validity and reliability confirmation

Following a thorough data validity and reliability confirmation process (discussed in Section 4.5 above) 156 projects, with a total investment value of USD 29,759 million in Sub-Saharan Africa were confirmed for the study data set. The projects range in financial close year from 2000 to 2016. This aligns closely to Eberhard et al. (2017) who reported 151 projects worth USD 30 billion.

6.3 Part 3: Determination of study variables

Out of the 156 projects in the study sample, a full set of variable data was obtained for 101 projects, representing 65% of the sample. This was due to the unavailability of company data for some of the sponsor firms. Descriptive analyses, which did not require the missing company data, utilised all the 156 projects. Regression analysis required all the variables and so was done using the 101 projects. A similar situation was faced by Steffen (2018) who used the same research method. He got a full set of variable data for 73% of his study sample.

Following methods used by Sawant (2010); Steffen (2018), descriptive statistics of the study data set was done to provide an overview of the data set (see *Table 5-2*). This provided final confirmation that all the data points were within the stipulated study parameters. Statistics such as maximum values, minimum values and sums of the variables were found to be correct.

6.4 Part 4: Empirical analyses

Empirical analyses provided insights that gave answers to the research questions. The analyses incorporated descriptive, bivariate correlation and regression analyses.

6.4.1 Descriptive analyses

Descriptive analyses entailed graphical exploration of the study data set. They yielded insights that were relevant to both research questions. Analyses pertinent to either question are discussed below.

6.4.1.1 Research Question 1

Research Question 1 dealt with the prevalence of PF in power plant investments in Sub-Saharan Africa and required evaluation of the share of PF in the study data set. The evaluation was initiated by considering the share of PF at the Sub-Saharan Africa regional level in terms of number of projects. The assessment was then deepened by considering the prevalence of PF at the following levels:

- value of investments in power plant projects in Sub-Saharan Africa;
- projects per country in the region;
- projects per country income group;
- projects per financial close year;
- projects per project type;
- projects per power plant type; and
- projects per plant technology.

The level of detail and depth of the analysis provided insights that are of academic, business and national policy interest. Below, reference is made to the relevant results sections and the results discussed at the levels indicated above.

Number of projects

Figure 5-1 shows the number of projects in the data set that use corporate finance and those that use PF. There is a clear dominance of PF as an investment financing method

over corporate finance with 115 (74%) of the total 156 projects utilising PF. Only 41 projects (26%) were financed with corporate finance. This finding aligns with that of Steffen (2018) who found high dominance of PF in power plant projects driven mainly by the suitability of PF for power plant investments.

Value of investments

Considering the share of PF in terms of value of projects, *Figure 5-2* shows an even stronger dominance of PF. PF projects have a value of USD 27.3 billion out of the total USD 29.8 billion, giving it a share of 92%. Corporate finance projects have only a value of USD 2.5 billion (8%).

The findings in *Figure 5-1* and *Figure 5-2* together demonstrate that PF on average is used for higher value projects than corporate finance. The average value per PF project is USD 237 million while that for corporate finance is only USD 61 million. This agrees with literature that points to the non-recourse nature of PF leading firms to tend to use it more with increase in project investment size (Sawant, 2010; Steffen, 2018). PF has also been found to be the preferred funding structure for power plants, especially large complex ones (Gatti, 2013; Pinto, 2017).

Number of projects per country

To deepen the insight regarding the share of projects between corporate finance and PF, the assessment was turned from the Sub-Saharan Africa regional level to the level of individual countries in the region. *Figure 5-3* shows the distribution of power plant projects per country in the region. In line with literature, there is a clear dominance of South Africa in the number of projects (Eberhard et al., 2016, 2017). Out of the 22 countries represented, South Africa has 61 of the total 156 projects, followed by Uganda with 22, and Kenya with 11.

Figure 5-4 shows the split between corporate finance and PF projects at the country level. Again, PF finance dominates with 15 out the 22 countries covered having a higher prevalence of PF projects. The PF prevalence in South Africa is noteworthy as 59 out of her 61 projects are PF. This obviously sways the PF prevalence at the Sub-Saharan Africa regional level, but even without South Africa, PF still dominates in the region although to a lesser degree. Out of the 95 projects (excluding South Africa) 56 (59%) of them are PF.

Projects per country income group

Next, the question was considered in terms of country income groups to gauge the prevalence of PF in terms of incomes of the countries in the Sub-Saharan Africa region. See *Table 5-3* for country income groups definitions. *Figure 5-5* depicts the distribution of power plant projects in the region in terms of country income groups. Upper middle-income countries have a bigger share of projects at 71 with lower middle-income and low income almost at par with 42 and 43 projects respectively.

In terms of the corporate finance and PF slit, which is shown in *Figure 5-6,* PF dominates in the middle-income groups (for Sub-Saharan Africa, these are the highest income groups). The dominance is stronger in the upper middle-income group with 65 (92%) out of its 71 projects being PF. The numbers for the lower middle-income group are 29 (69%) PF out of 42 total number of projects. For the low-income group corporate finance has a slight edge with 22 (51%) of its 43 projects being corporate finance investments, which leaves 21 (49%) projects for PF.

This situation could be explained in several ways. PF's dominance in the higher income groups and lack thereof in the lower income group could be due to the predominant size of projects in the higher income group being more suited to PF. PF has traditionally been utilised for large, high-risk projects to protect sponsors from the ramifications of project failure (contamination risk). Further, PF has been popular with large complex power plant projects (Gatti, 2013; Pinto, 2017). However, this view was contradicted by Steffen (2018) who found that in Germany, PF was rather used for small renewable energy projects with low risk. Kann (2009) made a similar finding in Australia regarding wind power projects. Based on (Kann, 2009; Steffen, 2018), technology could also be another reason for the PF dominance in the higher income group countries, if they utilise PF-suited technology. An analysis of the projects in terms of individual countries and their technology choices, which is beyond the scope of this study, will clarify this issue.

PF is well suited for projects with reliable, transparent revenue that require long-term funding (Pinto, 2017; Sawant, 2010; Steffen, 2018). It could also be that the projects in the higher income countries have more reliable revenue streams explaining the PF dominance.

Lastly, the projects in the higher income groups could be more suited to PF in terms of project sponsors. Some project sponsors use PF irrespective of the type of project (Steffen, 2018). Steffen (2018) found that in Germany, financial investors in power plant

projects always used PF. Independent developers there also opted for PF to allow them to develop projects bigger than their corporate balance sheets could support.

Projects per financial close year

A discussion of the prevalence of PF in power plant projects in the Sub-Saharan Africa region in terms of time starts with *Figure 5-7.* The figure presents the trend and distribution of projects in the region by financial close year. The trend shows a steady rise in the number of projects in the region. However, the effect of the 2008 global financial crisis is noticeable. Following a peak in 2009 of 12 projects there was a sharp drop in 2010 to the 2007 level of 6 projects. A recovery begun in 2011 which saw the project numbers grow to 9 in 2011 and hit a new peak of 33 projects in 2012. The strength of the recovery in 2012 is indicative of pent-up projects that were waiting for a recovery of financial confidence. Most of the 2012 projects from the study data set (27 out of the 33) were from South Africa. The projects were mainly part of her Renewable Energy Independent Power Producer Procurement Programme (REIPPP). Although a detailed analysis of South Africa's power sector is beyond the scope of this research, given her dominance in the power sector of the region, it is important to note that her introduction of IPPs was delayed. Previous attempts to introduce IPPs in the country had been unsuccessful until 2012 (Eberhard et al., 2016). The high number of IPPs entering the sector in 2012 accounts for potential developers who had been waiting for several years for a successful IPP programme in the country to launch. The launching of the programme after the recovery of global financial confidence also probably helped the number of entrants to be so high. According to literature, factors that attract IPPs to countries include independent regulation, power planning that shows future power demand, and good procurement and contracting. These factors are present in South Africa with the taking over of the regulation of the power sector and power planning by the ministry of energy from the national power utility, Eskom. The REIPPP programme has also brought improvements into procurement and contracting, which has contributed to IPP success in the country (Eberhard & Gratwick, 2011; Eberhard & Shkaratan, 2012; Findt et al., 2014; Kapika & Eberhard, 2013).

Looking at the trend in projects over time in terms of the two funding structures, *Figure 5-8* presents the trend and number of projects per year, split into corporate finance and PF. The trends for both funding structures have been risings over the study period with corporate finance slightly leading in the earlier part of the period until 2011. Since 2012, however, PF has exhibited high dominance with 87 projects (2012-2016) compared to corporate finance's three. It is clear that the dominance of PF is a relatively recent event,

occurring in a sustained manner only since 2012. The dominance was probably delayed by the effects of the 2008 global financial crisis on PF specifically.

The global financial crisis had an impact on PF globally. After a peak in PF deals globally in 2008, there was a slight drop in 2009 which was quickly recovered in 2010 (Pinto, 2017). There was a similar effect on PF in power plant investments in the Sub-Saharan Africa region. However, the recovery was slower, delayed by two years and only occurred in 2012 instead of 2010 as seen globally. It can be seen from *Figure 5-8* that PF started to surpass corporate finance in the region already in 2007. Like on the global scene, after a peak in 2008, PF experienced a drop in 2009 and only recovered in 2012. After 2012 the dominance of PF over corporate finance has been sustained, virtually all projects are being financed through PF.

Figure 5-8 also shows that corporate finance reacted faster than PF to the 2008 financial crisis. After a peak in 2007, corporate finance saw a decline in 2008 when the crisis started. PF only declined in 2009, by which time corporate finance was already reacting to the easing of the crisis with a sharp increase from the 2008 low of one project to eight projects in 2009. PF continued to decline in 2010, stayed flat in 2011 and only increased sharply in 2012. The slower nature of PF finds support in literature, that points to the higher complexity and length negotiations required to structure a PF deal compared to a corporate finance one (Gatti, 2013; Sawant, 2010; Steffen, 2018).

Projects per project type

The power plant projects in the study data set can be divided into three types:

- Greenfield: a completely new facility.
- Brownfield: an existing facility that is redeveloped.
- Divestiture: a state-owned facility that is bought and taken over by a private firm.

Figure 5-9 shows the categorisation of projects according to project type. The overwhelming majority,146 (94%) out of the total 156, of the projects are greenfields. Brownfield and divestiture projects are insignificant at 7 (4%) and 3 (2%) of projects respectively. This situation aligns with literature that points out that there has been an increase in the provision of new power plant infrastructure in the region since 2000 (Eberhard et al., 2017; EIA, 2014; Findt et al., 2014).

Figure 5-10 shows the split in the projects in terms of funding structure. There is a clear dominance of PF in the greenfield projects, with corporate finance showing a slight edge

over PF in the brownfields and divestiture projects. PF theory indicates that PF is utilised for risky projects that require large investments. It helps firms undertake lucrative but risky projects without fear of contaminating the core firm (Brealey et al., 1996; Byoun et al., 2013; Esty, 2004; Gatti, 2013; Nevitt & Fabozzi, 2001; Sawant, 2010, 2012; Steffen, 2018). This explains why PF would be preferred by sponsor of greenfields projects. Those projects tend to be riskier and require larger investments compared to brownfields and divestiture projects.

Projects per power plant type

The power plants in the study are categorised into rental (mobile) plants and permanent (fixed) plants. *Figure 5-11* shows the number of projects per plant type. A majority of the projects in the region utilise permanent plants 134 (86%), rentals are only used in 22 (14%) projects. All the countries in the region do not have adequate power generating capacity and this presents a permanent problem of poor supply. The solution for this is additional permanent plants to solve the permanent problem of under capacity (Eberhard et al., 2011; Eberhard & Shkaratan, 2012). Permanent plants provide more cost-efficient power than the rentals (Eberhard & Shkaratan, 2012). They are able to use cheaper sources of energy such as natural gas, hydropower, sun light and wind, while the rentals usually make use of diesel. As was pointed out by Eberhard and Shkaratan (2012) the use of rentals has resulted in the higher cost of electricity in the region. This explains why most of the projects involve the more cost-efficient permanent plants. The rentals are reserved only for emergency situations and for shorter durations. Further, the region has abundance of cheap permanent-plant-suited energy resources (Rosnes & Vennemo, 2012).

Figure 5-12 shows the share of corporate finance and PF in rental and permanent plant projects. As expected from theory (Sawant, 2010), PF is the overwhelming choice for the permanent plant projects with a share of 85%. This is because the permanent plant projects require larger investments, are of longer duration and have higher transaction costs due to the specificity of their use. They are connected to a specific power grid and cannot easily be deployed to other uses. These factors expose them to higher risk and make them well suited for PF (Gatti, 2013; Pinto, 2017; Sawant, 2010, 2012). Permanent plants are also usually governed by long-term power purchase agreements with power utilities, which combined with their fixed nature, makes them susceptible to SOE holdup and nationalisation. PF also provides protection against these. Their long-term contracts also assure the permanent plants of transparent long-term revenue, making them suitable for PF (Sawant, 2010; Steffen, 2018).

The rental plants on the other hand virtually always use corporate finance, 21 of the 22 projects use corporate finance. This is also in line with literature as these plants are usually deployed in emergency situations that lack the time required to put together a PF deal (Sawant, 2010). Further, the risks inherent in rental projects are low since the plants are mobile and can be easily deployed to other uses. They are not permanently committed to just one power grid or utility. The lower risk situation does not warrant PF. Furthermore, PF is better suited for long-term projects with large investments and transparent revenue (Sawant, 2010; Steffen, 2018). The rental projects are usually of a short duration and require lower investments compared to the permanent projects.

The high prevalence (86%) of permanent plants in the study and the suitability of PF for such plants, results in PF being the more prevalent funding structure. 74% of all the power plants in the study are PF funded.

Projects per plant technology

Figure 5-13 shows the distribution of projects by technology of plant. The dominant technologies are solar with 38 projects (24%), followed by diesel with 30 projects (19%), and wind and natural gas with 27 projects (17%) each.

Figure 5-14 presents the split between corporate finance and PF in the various technology types. PF clearly dominates in all the technology types except diesel. As discussed previously and shown in *Figure 5-12*, diesel is the technology of choice for the rental power plant projects. These projects by their nature are of short duration, require lower investments, and do not experience asset specificity. In line with theory and literature, these factors make them less suited for PF (Sawant, 2010; Steffen, 2018). Corporate finance is dominant in diesel technology with 63% prevalence.

PF is very prominent in the renewable energy technologies of solar, wind and hydro. PF has a prevalence of 97%, 96% and 75% in solar, wind and hydro respectively. This is in line with findings by Kann (2009); Steffen (2018). Their findings point to the prevalent use of PF in renewable energy plants even in the absence of a major PF driver, high risk. They find that for renewable energy plants, PF is used by small developers to secure larger projects than their balance sheets can support.

6.4.1.2 Discussion of Research Question 2

Research Question 2 dealt with the extent of influence of the drivers of PF in power plant projects in Sub-Saharan Africa. It required an analysis of the level of influence of the drivers of PF identified in Sawant (2010).

To help in answering Research Question 2, two hypotheses linked to the Sawant (2010) theoretical framework were tested:

H1: The use of PF increases as the size of project investments increase.

H2: The use of PF increases as country risk increases.

The results of the descriptive analyses apart from answering Research Question 1, provided some preliminary insights for Research Question 2. The results pertinent to Research Question 2 are discussed in this section. They are discussed in terms of the two hypotheses and the control variables.

Hypothesis 1

Hypothesis 1 tested the extent of influence of project investment size on the use of PF. The size of investments in the study projects range from USD 1 million to USD 2,000 million (see Figure 5-15). However, a majority of the investments were at the lower end of the range with 84% below USD 300 million.

The minimum PF investment size was USD 14 million, and the maximum was USD 2,000 million. The highest number of PF investments (the mode) was USD 150 million. The respective numbers for corporate finance are USD 1.18 million (minimum), USD 462 (maximum) and USD 4.7 million (mode). See Figure 5-15 to Figure 5-20.

This indicate that PF and corporate finance investments are behaving fundamentally as expected from theory with corporate finance being restricted to the lower investment projects, while PF handles the higher values (Sawant, 2010). However, PF seems not to be going strictly according to theory. Apart from handling the larger investments as expected, it is also being used for some of the relatively low investment projects. This concurs with studies in Australia (Kann, 2009) and Germany (Steffen, 2018) into the use of PF in power plant projects. They found, contrary to classical PF theory, that PF was frequently used for even low investment projects. This brings into question the use of PF to counteract core company contamination risk. This use of PF was especially prevalent in renewable energy power projects with long term contracts and fairly predictable revenue streams. The suggestion from this finding is that the strength of influence of investment size on the choice of PF for power plant projects is low in Sub-Saharan Africa.

The strength was more rigorously assessed with regression analysis and discussed in Section 6.4.3.1 below.

Hypothesis 2

Hypothesis 2 tested the extent of influence of country risk on the use of PF. *Figure 5-21* shows the mean political risk rating per country from the study data set. This shows the average of the political risk ratings of a country based on the projects in the country and the country's political risk rating at the time of financial close of the projects. The ratings may not reflect the current risk ratings of the countries as they are based on their ratings at the time of project financial close. The **lower** the rating, the **higher** the country risk. The results show the country with the least average risk to be Botswana with a rating of 67, followed by South Africa and Tanzania with 58, Ghana with 57 and Zambia with 56. The country with the highest risk is Cote d'Ivoire with an average risk rating of 34, followed by Nigeria and Togo with 37 and Liberia and Sierra Leone with 46.

The results show that contrary to classical PF theory, PF was not used for projects in higher risk locations compared with corporate finance (see Figure 5-22 to Figure 5-26). This contradicts some literature that indicate that PF is used for high-risk projects (Pinto, 2017; Sawant, 2010). However, this result confirms other literature that say that PF is used for low risk projects (Kann, 2009; Steffen, 2018). The issue of the strength of country risk in influencing the use of PF was more rigorously assessed by regression analysis and discussed in Section 6.4.3.2 below.

6.4.1.3 Control variables

In line with Sawant (2010)'s theoretical framework, sponsor book value and sponsor leverage have been included in the analysis as control variables. These control for other reasons apart from the identified drivers that would compel sponsors to use PF. Preliminary insights for these are also provided below.

Sponsor book value

The results do not indicate a clear pattern for the influence of sponsor book value on the use of PF (see Figure 5-27 to Figure 5-31). PF theory suggests that companies with bigger book values and thus can afford higher risk would opt for corporate finance instead of PF. Using corporate finance would afford them the advantage of coinsurance and cash flow commingling (Gatti, 2018; Sawant, 2010). However, the results show that PF was associated with both the company with the highest book value as well as the one

with the lowest. This would indicate that the effect of sponsor book value on the use of PF is not clearly definite.

Sponsor leverage

Leverage, defined in this study as the ratio of long-term debt to total capital (Sawant, 2010), also does not show a clear pattern (see Figure 5-32 to Figure 5-35). Classical PF theory suggests that companies with high leverage will go for PF in order to raise funding cheaper using project revenues as repayment guarantee rather than their own balance sheets (Sawant, 2010). However, in the study data set, the modal leverage for PF was zero. This indicates that majority of the projects with PF had sponsors with no leverage. The modal leverage for corporate finance was 0.47. However, the maximum leverage is higher for PF than corporate finance and so is the average leverage. This shows that the effect of leverage on the use of PF is also not clearly defined in the study data set.

6.4.1.4 Discussion of additional insights

In addition to the results discussed above, which have direct bearing on the study research questions, some additional noteworthy insights were also gained through the research.

Figure 5-36 shows that a majority of power plant capacity in the data set was procured though PF. 12 GW (71%) was procured from PF, and only 4.9 GW (29%) from corporate finance. However, this PF capacity came at a much higher cost. This is in line with literature that show that PF is a more expensive financing structure than corporate finance (Kleimeier & Megginson, 2000; Sawant, 2010). The higher cost of PF has resulted in countries that utilise PF predominantly paying more for the derived capacity. *Figure 5-37* and *Figure 5-38* show that countries like South Africa, Zambia, Ghana and Kenya that use more PF, pay much more for their derived power capacity, while Nigeria that uses more corporate finance pays less. The higher cost of PF projects is also influenced by the type and size of projects it is used for. PF is used more for bigger projects and fixed power plants. These cost more to install but might cost less to run than the smaller and rental plants that use more corporate finance.

6.4.2 Bivariate correlation

The results of a bivariate correlation among all the variables (see *Table 5-4*) in the data set showed no large correlations among the study regression variables. This indicates that the variables all measure different things and can be included in a regression model.

A non-regression variable (a variable not included in the regression analysis) *Capacity of plant* showed a large positive correlation with the *investment size variable*. This is expected as the capacity of a plant will correlate strongly with its investment size.

6.4.3 Regression analysis

To estimate the extent of influence the independent variables (investment size and country risk) have on the dependent variable (project financing structure, PF or corporate finance), a linear multiple regression analysis was carried out on the study data set. The analysis involved 101 projects that had a full set of data available for all the study variables.

The Pearson correlation coefficient, *r*, in the correlation matrix (see *Table 5-6*) gave a preliminary indication of the strength of relationship between the variables. There were no substantial correlations between the independent variables, $r < 0.9$ for all the variables. This indicated that each independent variable was measuring a different thing and there was no multicollinearity. The lack of multicollinearity makes the independent variables suitable for the regression model (Field, 2013).

From *Table 5-7* and *Table 5-8* the regression model obtained was significant at the 95% confidence level. The coefficient of determination of the model, $R^2 = 0.279$ indicated that 28% of the variation in the dependent variable was explained by the independent variables. $Adjusted\ R^2 = 0.249$ also indicated that the model can explain 25% of the variation in the dependent variable if the model were applied to the population of the sample. The Durbin-Watson statistic was between 1 and 3, confirming that the assumption of independence of errors had been met (Field, 2013).

As seen on *Table 5-9*, the coefficients of both independent variables (investment size and country risk) are statistically significant at the 95% confidence level. This signals that they each make a unique contribution to the prediction of the dependent variable.

6.4.3.1 Hypothesis 1

Hypothesis 1 concerns the propensity for firms to use PF as project investment size increases. From *Table 5-9*, the coefficient of the *investment size* independent variable is statistically significant at the 95% confidence level and positive. This means that as investment size increases there is an increased propensity towards the use of PF. This supports Hypothesis 1, which hypothesizes that the use of PF increases as the size of project investments increase. The result also agrees with PF theory. As the investment size increases there is an increased risk of contamination of the core firm if the project

were to fail. Failure of a large power plant project with significant sunk costs could seriously hurt the financial stability of the sponsor if it is liable for the repayment of financing debt. To protect the core firm, the non-recourse nature of PF debt becomes more attractive as the investment size increases (Pinto, 2017; Sawant, 2010; Steffen, 2018) Due to the size of the projects, debt is required at a high level (typically 75% debt/25% equity). The balance sheet of the firms is not sufficient to finance these projects. The project cash flows, with predicable long-term revenue, can justify these debt levels. The lenders take security over the project, in case of any default. Large developers, like international utility firms, could possibly use their corporate finance if this cost was lower than the cost of project debt that they could obtain for the specific project (Byoun et al., 2013; Finnerty, 2013; Vaaler et al., 2008).

6.4.3.2 Hypothesis 2

Hypothesis 2 deals with the propensity for firms to use PF as country risk increases. *Table 5-9* shows that the *country risk* independent variable is statistically significant at the 95% confidence level and positive. This means that as the country risk rating's numerical value increases, the propensity for firms to use PF also increases. This result contradicts Hypothesis 2, which hypothesizes that the use of PF increases as country risk increases. The country risk rating measures the level of risk in a country. The **higher** the rating's numerical value for a country, the **lower** the country's risk. An increase in the risk rating's numerical value thus indicates a reduction in country risk.

This result goes against classical PF theory, which expects the use of PF to increase with an increase in risk (Brealey et al., 1996; Byoun et al., 2013; Esty, 2004; Gatti, 2013; Nevitt & Fabozzi, 2001; Sawant, 2010, 2012; Steffen, 2018). The result also contradict Sawant (2010) who studied the propensity for firms to use PF to mitigate country risk. He found support, albeit limited, for this propensity after studying 200 investments in 128 countries. The result also contradicts Hainz and Kleimeier (2012) who studied 4,978 projects in 64 different countries and found clear evidence that the use of PF increase with country political risk.

A fundamental requirement of PF is that the project must have a transparent, long-term, assured revenue stream, which will be the source of debt repayment. The project cash flows must be adequate to cater for project operations and debt repayments (Gatti, 2018; Pinto, 2017). The off takers of power plant projects in Sub-Saharan Africa are power utilities. Most of these utilities in the region have poor financial health and credit ratings. They are also very inefficient. Their distribution losses and uncollected revenue amount

to half of their turnover on average (Eberhard et al., 2017). This presents a major hinderance to PF in power plant projects in the region due to the lack of security of revenue for such projects. The lack of security of revenue has already been identified as a major risk to IPP in the region (Eberhard et al., 2017). The results of this research, indicating that the use of PF reduces with an increase in country risk, could be due to lenders being uncomfortable to provide the long-term debt required for PF deals in high risk countries in the region because of the poor bankability of the utility off takers there.

6.5 Conclusion of discussion of results

The results of the research in terms of each research question and their hypotheses have been discussed. The varied insights from the study have been highlighted in the context of theory and literature. Beyond meeting the objectives of the study, additional insights that resulted from the study were also discussed.

The main highlights of the results include:

- PF was found to be widely prevalent in power plant projects in Sub-Saharan Africa. Its prevalence has dramatically increased since 2012.
- The size of project investment has a significant influence on the use of PF. As expected from theory, PF use increases with increase in investment size.
- Country political risk has a significant influence on the use of PF. However, its influence is opposite to that expected from PF theory. The use of PF increases with a decrease in country political risk. This could be because of a lack of reasonable assurance of repayment of long-term debt, required by PF deals, in the higher risk countries in Sub-Saharan Africa.

The next chapter concludes this research report. It consolidates the research results into a coherent set of findings and distils them into implications for stakeholders and recommendations for further research.

7 Conclusion

This research aimed to understand the prevalence of PF as well as the extent of influence of its drivers in power plant projects in Sub-Saharan Africa. A data set created from the World Bank's PPI database complemented with project sponsor company information from other sources was used for the study. The prevalence of PF in power plant projects in Sub-Saharan Africa was assessed. Applicable PF drivers identified in Sawant (2010) were also evaluated for the extent of their influence on the use of PF in power plant projects in Sub-Saharan Africa.

Power generation is under developed in the Sub-Saharan Africa region and will require significant sustained investments in order to meet demand. This level of investment will not come from governments alone, a significant portion will have to be private sector led. The question of funding structure (corporate finance or PF) will play an important role in project execution, cost efficiency and ultimate success in adequately powering the region.

7.1 Principal findings

The research was approached in terms of the two research questions. The principal findings are also categorised in terms of the research questions:

1. What is the prevalence of PF in power plant investments in Sub-Saharan Africa?
2. What is the extent of influence of the drivers of PF in power plant projects in Sub-Saharan Africa?

7.1.1 Prevalence of PF

Research Question 1 dealt with the prevalence of PF in power plant investments in Sub-Saharan Africa and required an evaluation of the share of PF in the study data set. The principal finding in terms of the prevalence of PF included:

- PF has a high prevalence in power plant projects at the Sub-Saharan Africa regional level in terms of both number and value. Value per project is higher for PF than for corporate finance.
- The region is made up of middle-income and low-income countries. PF is more prevalent in the middle-income countries of the region, while corporate finance is more prevalent in the low-income countries.
- PF in power plant projects in Sub-Saharan Africa reacted slower to the 2008 financial crisis than corporate finance. This was both in terms of slowing down in response to the start of the crisis and in picking up after the easing of the crisis.

- Greenfields power plant projects in the region are usually funded through PF while brownfields and divestiture projects are typically funded through corporate finance.
- Permanent power plants in the Sub-Saharan Africa region are typically funded through PF while temporary plants are usually funded by corporate finance.
- PF is the dominant funding structure for renewable energy projects. It is used for even small, low risk renewable energy projects that theoretically should be more suited for corporate finance.

Overall PF is the dominant funding structure in power plant projects in Sub-Saharan Africa. In the study sample PF had a prevalence of 74% in terms of number of projects and 92% in terms of the value of investments. The prevalence of PF in the sector has increased since 2007. Its dominance over corporate finance was interrupted by the 2008 global financial crisis but returned in 2012 and has been sustained since then. The results show that PF is an effective means of investing in power plant projects in the Sub-Saharan Africa region under the right conditions.

7.1.2 Extent of influence of drivers of PF

The research also tested the extent of influence of PF drivers. The drivers tested were *investment size* and *country risk*. The principal findings in terms of the extent of influence of these drivers are:

- PF is used for both large and small investments in power plant projects in Sub-Saharan Africa. Classical PF theory would expect PF to be reserved for large investments.
- Investment size has a statistically significant (95% confidence level) influence on the use of PF in power plant projects in Sub-Saharan Africa. As investment size increases, the use of PF also increases.
- Contrary to classical PF theory, PF is not used more for projects in higher risk countries in Sub-Saharan Africa compared to corporate finance. This could be a result of the higher risk countries in the region not being in a position to provide the required assurance of long-term debt repayment from power plant projects that would be required for PF deals. The higher risk countries in the study tend to have lower investments in power plants projects because they have to rely only on corporate finance for them. Corporate finance is limited as it depends heavily on the inherent value of the sponsoring firm. Only projects that can be supported by sponsor balance sheets can be undertaken.

- Reduction in country risk increases the use of PF in power plant projects in Sub-Saharan Africa.

7.2 Implications for management

Based on the study findings, the following implications have been identified for management:

- Funding of power plant projects in Sub-Saharan Africa does not follow the typical decision criteria for choosing between corporate finance and PF. PF is preferred, irrespective of project risk and size, provided the project requires long-term funding, and has transparent long-term revenue source.
- PF is a useful mechanism for small developers to develop power plant projects bigger than what their corporate balance sheets can support.
- Banks and insurance companies play an important role in the structuring of PF deals. Their roles affect the cost of structuring the deals. The study shows that PF is not reserved for large projects, it is also being used by small projects. The financial institutions involved in PF can help reduce the time required and cost of structuring PF deals by streamlining and standardising their procedures. These would make the process more affordable for the smaller firms.

7.3 Implications for government policy

The findings of the study have the following implications for government policy:

- New power plant infrastructure projects (greenfields) in Sub-Saharan Africa are typically funded through PF. PF deals are by nature more difficult and expensive to structure than corporate finance deals. PF is, however, preferred by sponsors for projects due to their suitable for such projects. Governments interested in encouraging investments into new power plant infrastructure in the Sub-Saharan Africa region, should put policies in place to facilitate quicker and easier structuring of PF deals. These will include a legal framework that aids quick enforcement of contracts and resolution of commercial disputes. Setup of specialist commercial courts for the speedy adjudication and disposal of commercial cases will be advantageous.
- Brownfields and divestiture power plant projects in Sub-Saharan Africa are usually funded through corporate finance. Governments should setup such projects to suit corporate finance.
- PF is the dominant funding structure for renewable energy power plants. This is irrespective of size and risk. Governments planning to implement such plants

should allow adequate time in their plans to cater for the structuring of the required PF deals. These will take longer than typical corporate finance deals.

- Transparent revenues streams are important for PF deals. Governments should incorporate these in the setup of power plant projects to make them attractive to PF. This will help competent but small developers take up such projects without the need for a balance sheet commensurate to the project size to support fund raising for the project. They can raise funding for the project through PF.
- PF is an effective investment mechanism for power plant projects in Sub-Saharan Africa. However, high country political risk is a major hinderance to PF in the region. Governments should work to reduce country pollical risk to encourage PF. This will encourage the much-needed investments in power plants needed in the region to improve electricity supply and drive economic growth.

7.4 Limitations of the research

The study considered some variables that have been identified in Sawant (2010) to influence the propensity for firms to use PF. There could be other drivers such as some geopolitical considerations that have not been considered. The level of insight provided by the study could be limited by the exclusion of these other factors.

The study's scope is limited to power plant infrastructure in the Sub-Saharan African context. Although it is likely to highlight the intricacies and nuances in that context, its insights' applicability could be limited to that region and industry.

The effects of host country's GDP was not considered in the study, this could be an influential variable in the funding structure decision of firms.

The presence of an SOE in the makeup of the project sponsoring consortium can also have an influence on the project funding choice. This was not considered in the study.

7.5 Suggestions for future research

This study has highlighted PF as an effective mechanism for power plant investments in Sub-Saharan Africa by showing its overwhelming prevalence. However, the use of PF is very much restricted to countries in the region with relatively low political risking ratings. Further research into the reasons that prohibit PF in high risk countries will be beneficial in understanding the issue and finding ways to address it.

The research tested the extent of influence of two identified drivers of PF in power plant projects in Sub-Saharan Africa. The regression model established indicated that these drivers explained 25% of variance in the population of the sample. Further research to identify other drivers of PF in Sub-Saharan African power plant projects will aid in the

formulation of strategies and policies to increase investments into power plants in the region to improve electricity supply.

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9 Appendices

9.1 Appendix 1: Ethical Clearance Approval Letter

Gordon Institute of Business Science
University of Pretoria

19 July 2018

Anafi James

Dear James

Please be advised that your application for Ethical Clearance has been approved.

You are therefore allowed to continue collecting your data.

Please note that approval is granted based on the methodology and research instruments provided in the application. If there is any deviation change or addition to the research method or tools, a supplementary application for approval must be obtained

We wish you everything of the best for the rest of the project.

Kind Regards

GIBS MBA Research Ethical Clearance Committee

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9.2 Appendix 2: Study data set extract

Country	IncomeGroup	Project Code	Financial closure year	Project name	Type of PPI	Subtype of PPI	Project status	Segment	Location	ContractPeriod	Total Equity	Totall nvestment	CapacityType	Capacity	Technology	Sponsors	TotalDebtFunding	DebtEquityGrantRatio	ProjectBanks
Angola	Upper middle income	AGO_1	2003	Chicapa Hydroelectric Plant	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Chicapa River	40		45	MW	16	Hydro, Small (<50MW)	ALROSA Co. Ltd. (The Almazy Rossii-Sakha Company) (Not Available / 55% / Russian Federation)			Vneshneconombar
Angola	Upper middle income	AGO_2	2006	Aggreko Cabinda First Temporary Power Station	Greenfield project	Rental	Active	Electricity generation	Cabinda	5		4.7	MW	30	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Angola	Upper middle income	AGO_3	2006	Aggreko Caminhos de Ferro de Angola	Greenfield project	Rental	Active	Electricity generation	Luanda	4		4.7	MW	30	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Angola	Upper middle income	AGO_4	2009	Luapasso Mini Hydropower Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Luapasso region of no	Not Available		120	MW	26	Hydro, Small (<50MW)	ESCOM (Not Available / Not Available% / Portugal), Empresa Nacional de Electricidade de Angola (ENI			N/A
Botswana	Upper middle income	BWA_1	2011	KSE Orapa and Mmashoro IPP	Greenfield project	Build, lease, and transfer	Active	Electricity generation	Orapa and Mmashoro	15	0	104	MW	90	Natural Gas	Kalahari Energy (Not Available / 50% / Botswana), TUTEN (Not Available / 50% / Turkey)	104	Not Available	N/A
Cameroon	Lower middle income	CMR_1	2009	Dibamba Power Plant	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Doula	20		126	MW	86	Diesel	AES Corporation (Not Available / 56% / United States)			N/A
Cameroon	Lower middle income	CMR_2	2010	Kribi Power Plant	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Mpolongwe, Kribi, 03(	20	50.62	342	MW	216	Natural Gas	AES Corporation ($50.624 / 56% / United States)			Standard Charter
Cape Verde	Lower middle income	CPV_1	2010	Electra Cabeolica Wind Project	Greenfield project	Build, own, and operate	Active	Electricity generation	Cape Verde	20	0	80	MW	28	Wind	InfraCo, Electra (Not Available / Not Available% / Cape Verde),	62	72/28	N/A
Côte d'Ivoire	Lower middle income	CIV_1	2010	Aggreko Vridi Temporary Power Station	Greenfield project	Rental	Active	Electricity generation	Vridi Canal, Abidjan-P	Not Available		5.5	MW	70	Natural Gas	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Côte d'Ivoire	Lower middle income	CIV_2	2010	Aggreko Vridi Temporary Power Station	Greenfield project	Rental	Active	Electricity generation	Vridi Canal, Abidjan-P	Not Available		5.5	MW	70	Natural Gas	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Ethiopia	Low income	ETH_1	2009	Aggreko 30MW temporary power plant	Greenfield project	Rental	Active	Electricity generation	Adama (Nazareth)	2		2	MW	30	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Ethiopia	Low income	ETH_2	2009	Encom 30MW Temporary power plant	Greenfield project	Rental	Active	Electricity generation	Bishoftu (Debre Zeit)	2		2	MW	30	Diesel	Encom (Not Available / 100% / Kenya)			N/A
Gabon	Upper middle income	GAB_1	2011	CODER FE II SHPP	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Okano River, North G	30		234	MW	36	Hydro, Small (<50MW)	CODER (Not Available / Not Available% / Gabon)			N/A
Gabon	Upper middle income	GAB_2	2012	CODER Ngounie Imperatrice SHPP	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Ngounie River	30		134	MW	42	Hydro, Small (<50MW)	CODER (Not Available / Not Available% / Gabon)			United Bank for A
Ghana	Lower middle income	GHA_1	2007	Sunon-Asogli Gas Fired Power Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Heavy Industrial Area,	Not Available		200	MW	200	Natural Gas	Shenzen Electric (Not Available / 60% / China),			N/A
Ghana	Lower middle income	GHA_2	2007	Sunon-Asogli Gas Fired Power Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Heavy Industrial Area,	Not Available		360	MW	560	Natural Gas	Shenzen Electric (Not Available / 60% / China),			N/A
Ghana	Lower middle income	GHA_3	2009	Tema Osonor Plant Limited	Greenfield project	Build, own, and operate	Active	Electricity generation	Tema, Greater Accra,	Not Available		140	MW	126	Natural Gas	Gecad (Not Available / 100% / United States)			N/A
Ghana	Lower middle income	GHA_4	2013	Takoradi 2 Thermal Power Expansion	Brownfield	Build, rehabilitate, operate, and tra	Active	Electricity generation	Aboadze	25	110	440	MW	330	Natural Gas	Abu Dhabi National Energy Company (TAQA) ($99 / 90% / United Arab Emirates)	330	Not Available	IFC (Multilateral /
Ghana	Lower middle income	GHA_5	2014	Kpone Independent Power Project	Greenfield project	Build, own, and operate	Active	Electricity generation	Kpone	Not Available	250	900	MW	340	Natural Gas	Africa Finance Corporation ($132.5 / 53% / Nigeria), Macquarie Infrastructure Group (MIG) ($18.75 / 8% /	650	70/30	RMB(South Afric
Ghana	Lower middle income	GHA_6	2016	Amandi Energy Power plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Western region, Aboa	Not Applicabl	134	552	MW	200	Natural Gas	Amandi Founder Group ($32.83 / 25% / ..), Endeavour Energy ($68.34 / 51% / ..), Aldwych International Ltd	418	76:24	OPIC (Bilateral / In
Ghana	Lower middle income	GHA_7	2016	Karadeniz Powership Aysegul Sultan	Greenfield project	Rental	Active	Electricity generation		Not Available	50	200	MW	225	Diesel	Karadeniz Energy Group ($50 / 100% / ..)	150	75:25	Deutsche Bank (C
Kenya	Lower middle income	KEN_1	2006	Aggreko Embakasi and Eldoret Power Stations	Greenfield project	Rental	Active	Electricity generation	Embakasi and Eldoret	3		23.7	MW	100	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Kenya	Lower middle income	KEN_2	2008	Mumias Power Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Not Available	Not Applicabl		50	MW	35	Waste	Mumias Sugar Company Limited (Not Available / 100% / Kenya)			PROPARCO Inte
Kenya	Lower middle income	KEN_3	2008	Rabai Power Plant	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Rabai	20		155	MW	90	Diesel	Aldwych International Ltd (Not Available / Not Available% / United Kingdom), Mitsui Engineering & Shipb			FMO (Not Availab
Kenya	Lower middle income	KEN_4	2009	Aggreko 140 MW temporary rental power plant	Greenfield project	Rental	Active	Electricity generation	Embakasi (80MW) an	2		22	MW	140	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Kenya	Lower middle income	KEN_5	2011	Aggreko Western Kenya Temporary Power Station	Greenfield project	Rental	Active	Electricity generation	Muhoroni, Western Ke	1	0	4.7	MW	60	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)	4.7	Not Available	N/A
Kenya	Lower middle income	KEN_6	2012	Athi River II Medium Speed Diesel (MSD) Power P	Greenfield project	Build, own, and operate	Active	Electricity generation	Machakos County	20	27	108	MW	80	Diesel	Multiple Hauliers ($13.5 / 50% / Kenya), Gulf Energy ($13.5 / 50% / Kenya)	81	80/20	IFC (Multilateral /
Kenya	Lower middle income	KEN_7	2012	Thika Thermal Power Project	Greenfield project	Build, own, and operate	Active	Electricity generation	Thika District, Nairobi	20	28	112	MW	87	Heavy oil	Melec Group ($25.2 / 90% / Lebanon)	84	75/25	Other Commercia
Kenya	Lower middle income	KEN_8	2012	Triumph HFO Power Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Kitengela, Athi River, (	20	37	140	MW	93	Diesel	Broad Holding (Not Available / Not Available% / Kenya), Southern Inter-trade (Not Available / Not Availa	103	74/26	Industrial & Comm
Kenya	Lower middle income	KEN_9	2013	Aeolus - Kinangop Wind Project	Greenfield project	Build, own, and operate	Active	Electricity generation	Kinangop Plateau, Kei	Not Available		150	MW	60.8	Wind	Aeolus Kenya Limited (Not Available / 100% / Kenya)	Not Availa	60/40	N/A
Kenya	Lower middle income	KEN_10	2013	Kwale Sugar plantation	Greenfield project	Build, own, and operate	Active	Electricity generation	South of Mombasa	Not Available	80	200	MW	18	Biomass	Omnicane Holdings (Not Available / 25% / Mauritius), Pabari Family Investment Trusts (Not Available /	120	60/40	Standard Bank (C
Kenya	Lower middle income	KEN_11	2014	Aldwych Lake Turkana Wind Farm	Greenfield project	Build, own, and operate	Active	Electricity generation	Lake Turkana	20	154	**853**	MW	310	Wind	Industrial Development Corporation ($38.09 / 25% / South Africa), Norfund ($19.6 / 13% / ..), Aldwych Inte	609	Not Available	AFDB (Multilatera
Liberia	Low income	LBR_1	2009	Buchanan Biomass Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	near Kakata, around 5	Not Available		170	MW	36	Waste	Buchanan Renewables BV (Not Available / 100% / Netherlands)	50	70/30	OPIC (Not Availab
Madagascar	Low income	MDG_1	2007	Hydelec Madagascar S.A.	Greenfield project	Build, operate, and transfer	Active	Electricity generation	Not Available	15		17.8	MW	15	Hydro, Small (<50MW)	Hydelec Madagascar (Not Available / 100% / Madagascar), Energy Engineering Investment Limite of Ma			N/A
Mauritius	Upper middle income	MUS_1	2004	St. Aubin Power Project	Greenfield project	Build, own, and operate	Active	Electricity generation	St. Aubin, southern M	20		50	MW	34	Waste	Mon Tresor Mon Desert (Not Available / 19% / Mauritius), Savannah Sugar Estates (Not Available / 15%			Barclays (Not Ava
Mauritius	Upper middle income	MUS_2	2005	La Baraque	Greenfield project	Build, own, and operate	Active	Electricity generation	L'Escaller			150		90	Biomass	Mon Tresor Mon Desert (Not Available / 19% / Mauritius),			
Mauritius	Upper middle income	MUS_3	2014	Suzlon Plaine Sophie Wind Farm	Greenfield project	Build, own, and operate	Active	Electricity generation	Plaine Sophie, next to	Not Available	20.85	69.5	MW	30	Wind	PADGreen (Not Available / 74% / Mauritius)	48.65	70/30	N/A
Mozambique	Low income	MOZ_1	2013	Kuvaninga Energia power plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Chokwe, in Gaza Prov	16	25	98.67	MW	40.29	Natural Gas	Enventure Partners (Not Available / 28% / United States), Public Investment Corporation (Not Available	74	75/25	Industrial Develop
Mozambique	Low income	MOZ_2	2014	Ressano Garcia Gas-Fired Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Ressano Garcia	15	40	235	MW	100	Natural Gas	Gigajoule Pty Ltd ($16.8 / 42% / South Africa), WBHO ($10.4 / 26% / South Africa), Old Mutual ($12.8 / 32	160	80/20	Standard Bank (C
Nigeria	Lower middle income	NGA_1	2001	AES Nigeria Barge Limited	Greenfield project	Build, own, and operate	Active	Electricity generation	Lagos State	Not Available		240	MW	306	Natural Gas	Yinka Folawiyo Group (Not Available / Not Available% / ..), AES Corporation (Not Available / 95% / Unite			RMB(South Afric
Nigeria	Lower middle income	NGA_2	2002	Okpai Independent Power Project	Greenfield project	Build, own, and operate	Active	Electricity generation	Okpai, Delta State	Not Available		462	MW	450	Natural Gas	ConocoPhillips (Not Available / 20% / United States), ENI (Not Available / 20% / Italy)			N/A
Nigeria	Lower middle income	NGA_3	2005	Afam Power Project	Brownfield	Rehabilitate, operate, and transfer	Active	Electricity generation	Port Harcourt	15		238	MW	400	Natural Gas	Shell (Not Available / 100% / Netherlands)			N/A
Nigeria	Lower middle income	NGA_4	2005	Afam Power Project	Brownfield	Rehabilitate, operate, and transfer	Active	Electricity generation	Port Harcourt	15		302	MW	624	Natural Gas	Shell (Not Available / 100% / Netherlands)			N/A
Nigeria	Lower middle income	NGA_5	2013	KEPCO Egbin Power Plant	Divestiture	Partial	Active	Electricity generation	Lagos	Not Available		407.3	MW	1320	Natural Gas	Korea Electric Power Company (KEPCO) (Not Available / 100% / Korea, Rep.)	Not Availa	75/25	N/A
Nigeria	Lower middle income	NGA_6	2015	Azura-Edo Gas-Fired Power Plant Phase 1	Greenfield project	Build, own, and operate	Active	Electricity generation	Edo State, Benin City	20	190	895	MW	450	Natural Gas	Asset & Resource Management Ltd (ARM) ($11.4 / 6% / ..), Amaya Capital Partners ($47.5 / 25% / ..), Am	690	79:21	IFC (Multilateral /
Rwanda	Low income	RWA_1	2005	Aggreko 10 MW Power Station Rwanda	Greenfield project	Rental	Active	Electricity generation	Not Available	6		1.58	MW	10	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Rwanda	Low income	RWA_2	2011	KivuWatt	Greenfield project	Build, own, and operate	Active	Electricity generation	Lake Kivu	25	50.5	142	MW	100	Natural Gas	ContourGlobal ($50.5 / 100% / United States)	91.5	64/36	FMO (Bilateral / In
Rwanda	Low income	RWA_3	2014	Agahozo-Shalom Youth PV Solar Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Agahozo-Shalom You	25	0.4	24.1	MW	8.5	Solar, PV	Scatec (Not Available / 40% / Norway), Norfund (Not Available / 40% / Norway), Others (Not Available / 2	23.7	98/2	FMO (Bilateral / In
Senegal	Lower middle income	SEN_1	2005	Aggreko Dakar Temporary Power Station	Greenfield project	Rental	Active	Electricity generation	Dakar	4		6.31	MW	40	Diesel	Aggreko Plc (Not Available / 100% / United Kingdom)			N/A
Senegal	Lower middle income	SEN_2	2005	Kounoune I IPP	Greenfield project	Build, own, and operate	Active	Electricity generation	Kounoune, Dakar	15		46.6	MW	67.5	Diesel	Matelec (Not Available / Not Available% / Lebanon), Mitsubishi (Not Available / Not Available% / Japan)			Agence Francaise
Senegal	Lower middle income	SEN_3	2014	Senegal Thermal Facility	Brownfield	Rehabilitate, operate, and transfer	Active	Electricity generation	outside of the capital	Not Available	172	172	MW	53	Natural Gas, Other	ContourGlobal ($172 / 100% / United States)	Not Availa	Not Available	N/A
Senegal	Lower middle income	SEN_4	2014	Tobene IPP	Greenfield project	Build, own, and operate	Active	Electricity generation	Taiba Ndiaye	20	40	165	MW	96	Heavy oil	Matelec ($36 / 90% / Lebanon), International Finance Corporation ($4 / 10% / ..)	125	76/24	IFC (Multilateral /
Senegal	Lower middle income	SEN_5	2015	Cap des Biches Oil-Fired Power Plant I	Brownfield	Other	Active	Electricity generation	Rufisque	20	23.15	114.15	MW	53	Diesel	ContourGlobal ($23.15 / 100% / ..)	91	80:20	OPIC (Bilateral / In
Senegal	Lower middle income	SEN_6	2016	Bokhol Solar PV Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Bokhol, Dagana depa	Not Available	6.95	29.25	MW	20	Solar, PV	GreenVish Partners ($6.95 / 100% / ..)	22.3	76:24	Other Green Africa
Senegal	Lower middle income	SEN_7	2016	Ten Merina PV plant	Greenfield project	Merchant	Active	Electricity generation	Thies region, East of I	Not Available	9.14	46.26	MW	30	Solar, PV	Meridiam ($3.04 / 34% / ..), Elfage Group ($3.04 / 34% / ..), Solairedirect S.A. ($3.04 / 34% / ..)	37.12	80:20	Agence Francaise
Senegal		SEN_8	2016	Ten Merina PV plant	Greenfield project			Electricity generation				37.7	MW	22	Solar, PV				
Sierra Leone	Low income	SLE_1	2007	GTG Freetown 15 MW Emergency Power	Greenfield project	Rental	Concluded	Electricity generation	Freetown	3		1.18	MW	15	Diesel	Global Trading Group NV (GTG) (Not Available / 100% / Belgium)			N/A
Sierra Leone	Low income	SLE_2	2011	Addax Biomass Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Bombali and Tonkolili	Not Available	11.7	30	MW	15	Biomass	Addax & Orgi Group ($11.7 / 100% / United Kingdom)	18.3	61/39	AFDB (Multilatera
South Africa	Upper middle income	ZAF_1	2001	AES Kelvin Power	Divestiture	Partial	Active	Electricity generation	Johannesburg	20		28.4	MW	600	Coal	AESNedbank Capital (Not Available / Not Available% / South Africa),			Investec Bank (No
South Africa	Upper middle income	ZAF_2	2006	Darling Wind Farm	Greenfield project	Build, own, and operate	Active	Electricity generation	Darling, Western Cape	20		9.9	MW	5	Wind	Darling Independent Power Producer Pty Ltd (Not Available / 26% / South Africa)			Danish Internation
South Africa	Upper middle income	ZAF_3	2010	NewCogen power plant	Greenfield project	Rental	Active	Electricity generation	KwaZulu-Natal	5	0	8	MW	15	Natural Gas	IPSA Group PLC (Not Available / 100% / United Kingdom)			N/A
South Africa	Upper middle income	ZAF_4	2012	Abengoa Kaxu Solar I CSP Solar Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Pofadder, Northern C	20	211	844	MW	100	Solar, CSP	Industrial Development Corporation ($103.39 / 49% / South Africa), Abengoa ($107.61 / 51% / Spain)	633	75/25	RMB(South Afric
South Africa	Upper middle income	ZAF_5	2012	Abengoa Khi Solar I CSP Solar Plant	Greenfield project	Build, own, and operate	Active	Electricity generation	Northern Cape	20	256	424	MW	50	Solar, CSP	Industrial Development Corporation ($128 / 49% / South Africa), Abengoa ($128 / 51% / Spain)	168	70/30	EIB (Multilateral /
South Africa	Upper middle income	ZAF_6	2012	ACED Cookhouse Wind Farm	Greenfield project	Build, own, and operate	Active	Electricity generation	Eastern Cape, South /	25		300	MW	139	Wind	AFPOC (Not Available / 50% / Mauritania), Macquarie Infrastructure Group (MIG) (Not Available / 25% /	Not Availa	92/08	Standard Bank (C
South Africa	Upper middle income	ZAF_7	2012	Biotherm - Aries Solar PV	Greenfield project	Build, own, and operate	Active	Electricity generation	Southwest of Kenhard	20	10	34	MW	10	Solar, PV	BioTherm Energy ($9 / 90% / South Africa)	24	75/25	Nedbank (Comme
South Africa	Upper middle income	ZAF_8	2012	Biotherm - Dassieklip Wind	Greenfield project	Build, own, and operate	Active	Electricity generation	Dassieklip	20	14	85	MW	27	Wind	BioTherm Energy ($12 / 60% / South Africa)	71	84/16	Standard Bank (C

9.3 Appendix 3: Analysis Output

9.3.1 Descriptive Statistics

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Book value of sponsor	107	92550.30	-56.30	92494.00	966927.10	9036.7019	1782.73150	18440.71807	340060082.8
Country political risk rating	149	36.33	30.24	66.57	7992.67	53.6421	.50460	6.15943	37.939
Financial close year of project	156	15	2001	2016	313693	2010.85	.305	3.805	14.475
Financial structure (Project finance or Corporate finance)	156	1	0	1	115	.74	.035	.442	.195
Total investment of the project	156	1998.82	1.18	2000.00	29759.02	190.7629	20.74978	259.16466	67166.321
Leverage of sponsor	107	1.06	.00	1.06	38.40	.3589	.02428	.25120	.063
Capacity of the plant in MW	156	1315.00	5.00	1320.00	16909.87	108.3966	13.12270	163.90251	26864.032
Type of plant	156	1	0	1	134	.86	.028	.349	.122
Presence or not of SOE	156	0	1	1	156	1.00	.000	.000	.000
Valid N (listwise)	101								

9.3.2 Bivariate correlation

Correlations

		Financial structure (Project finance or Corporate finance)	Total investment of the project	Country political risk rating	Book value of sponsor	Leverage of sponsor	Capacity of the plant in MW	Financial close year of project
Financial structure (Project finance or Corporate finance)	Pearson Correlation	1	.300**	.349**	-.055	.189	-.037	.495**
	Sig. (2-tailed)		.000	.000	.573	.051	.644	.000
	N	156	156	149	107	107	156	156
Total investment of the project	Pearson Correlation	.300**	1	.085	-.038	.127	.561**	.215**
	Sig. (2-tailed)	.000		.303	.700	.191	.000	.007
	N	156	156	149	107	107	156	156
Country political risk rating	Pearson Correlation	.349**	.085	1	-.154	.217*	-.224**	.259**
	Sig. (2-tailed)	.000	.303		.124	.029	.006	.001
	N	149	149	149	101	101	149	149
Book value of sponsor	Pearson Correlation	-.055	-.038	-.154	1	-.080	.312**	.023
	Sig. (2-tailed)	.573	.700	.124		.415	.001	.816
	N	107	107	101	107	107	107	107
Leverage of sponsor	Pearson Correlation	.189	.127	.217*	-.080	1	.073	-.037
	Sig. (2-tailed)	.051	.191	.029	.415		.453	.703
	N	107	107	101	107	107	107	107
Capacity of the plant in MW	Pearson Correlation	-.037	.561**	-.224**	.312**	.073	1	-.105
	Sig. (2-tailed)	.644	.000	.006	.001	.453		.193
	N	156	156	149	107	107	156	156
Financial close year of project	Pearson Correlation	.495**	.215**	.259**	.023	-.037	-.105	1
	Sig. (2-tailed)	.000	.007	.001	.816	.703	.193	
	N	156	156	149	107	107	156	156

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

*. Correlation is significant at the 0.05 level (2-tailed).

9.3.3 Regression analysis

Descriptive Statistics

	Mean	Std. Deviation	N
Financial structure (Project finance or Corporate finance)	.75	.434	101
Total investment of the project	236.083267	298.6144765	101
Country political risk rating	53.743069	6.6469248	101
Book value of sponsor	9554.754851	18857.91052	101
Leverage of sponsor	.346298	.2394216	101

Correlations

		Financial structure (Project finance or Corporate finance)	Total investment of the project	Country political risk rating	Book value of sponsor	Leverage of sponsor
Pearson Correlation	Financial structure (Project finance or Corporate finance)	1.000	.324	.436	-.052	.175
	Total investment of the project	.324	1.000	.067	-.054	.169
	Country political risk rating	.436	.067	1.000	-.154	.217
	Book value of sponsor	-.052	-.054	-.154	1.000	-.059
	Leverage of sponsor	.175	.169	.217	-.059	1.000
Sig. (1-tailed)	Financial structure (Project finance or Corporate finance)	.	.000	.000	.304	.040
	Total investment of the project	.000	.	.254	.294	.046
	Country political risk rating	.000	.254	.	.062	.015
	Book value of sponsor	.304	.294	.062	.	.279
	Leverage of sponsor	.040	.046	.015	.279	.
N	Financial structure (Project finance or Corporate finance)	101	101	101	101	101
	Total investment of the project	101	101	101	101	101
	Country political risk rating	101	101	101	101	101
	Book value of sponsor	101	101	101	101	101
	Leverage of sponsor	101	101	101	101	101

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.529[a]	.279	.249	.376	1.469

a. Predictors: (Constant), Leverage of sponsor, Book value of sponsor, Total investment of the project, Country political risk rating

b. Dependent Variable: Financial structure (Project finance or Corporate finance)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.255	4	1.314	9.304	.000[b]
	Residual	13.557	96	.141		
	Total	18.812	100			

a. Dependent Variable: Financial structure (Project finance or Corporate finance)

b. Predictors: (Constant), Leverage of sponsor, Book value of sponsor, Total investment of the project, Country political risk rating

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.826	.314		-2.631	.010
	Total investment of the project	.000423	.000	.291	3.311	.001
	Country political risk rating	.027	.006	.413	4.600	.000
	Book value of sponsor	6.927E-7	.000	.030	.343	.732
	Leverage of sponsor	.069	.163	.038	.422	.674

a. Dependent Variable: Financial structure (Project finance or Corporate finance)

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.10	1.59	.75	.229	101
Residual	-.839	.742	.000	.368	101
Std. Predicted Value	-2.866	3.644	.000	1.000	101
Std. Residual	-2.233	1.975	.000	.980	101

a. Dependent Variable: Financial structure (Project finance or Corporate finance)