CLIMATE FINANCE, CLIMATE INVESTORS AND ASSETS FOR LOW EMISSION DEVELOPMENT

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Abstract

This research examines the relationship between climate finance, growth in climate investors and growth in climate assets for low emission development. It also evaluates the effect of climate policy evolution on the growth of climate investors and climate assets. Adopting a positivist paradigm, the paper makes use of a quantitative research approach and applies the causal and correlational research design. The paper made use of secondary data from the World Bank Carbon Finance Unit and from the Carbon Disclosure Project (ADP). The major objective was to examine the combined effect of climate finance and climate policy on the growth of carbon investors and carbon assets for the companies in the Carbon Disclosure Project which includes the 100 JSE companies. Findings from the test reveal that the combined effect of growth in climate finance and climate policy evolution has a significant relationship with growth in climate investors and climate assets. Given this result the paper proceeded to examine if the growth in climate finance has any correlation with South Africa's emission reduction trend. Results however indicate that South Africa's GHG emission trend does not correlate with climate finance availability; GHG emissions in South Africa have continued to soar despite a seeming growth in climate finance. The paper reasoned that the global climate finance might not be effectively available to corporates in South Africa at the expected level of financing to initiate the expected level of climate investment to effect a significant reduction in greenhouse gas emissions. This confirms literature assertions that global climate finance might not easily be accessible, at least to entities in developing countries. In conclusion, the paper suggests the establishment of a Southern African Climate Finance pool where the public and private sector can contribute and that such pool should be made easily available to carbon investors at a cheap rate with alluring tax incentives to funders and beneficiaries. The paper adds a modest nuance to the literature as no know previous research has dwelt specifically on the unique relationship of climate finance, climate policy and climate investors. The paper's implication is beneficial to green policy officials and for academic debate. It suggests an avenue for further research about climate investors' handicap in accessing global climate finance and to explore logistics to develop independent South African based climate finance.

Keywords: Climate Finance, Climate Policy, Climate Investment, Climate Assets, Low Carbon Economy

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1. Introduction

This research examines the relationship between climate finance, growth in climate investors and growth in climate assets for low emission development. It also evaluates the effect of climate policy evolution on the growth of climate investors and climate assets. This became apposite for two major reasons: firstly, and most importantly, is the continuous emission of carbon that has defied current human efforts toward carbon reduction; secondly is the growing opposing debates on whether climate finance or climate policy accords greater impetus to low carbon emission investment. Climate change is no longer a myth; its impact is being felt everywhere around the globe – there are ubiquitous news about unprecedented droughts, excessive rainfalls with concomitant flooding, extreme warming even to the extent of melting ancient ice sheets and/or polar ice cap in Antarctica. The Natural Resources Defence Council confirms and laments the reality of polar ice melting:

After existing for many millennia, the northern section of the Larsen B ice shelf in Antarctica -- a section larger than the state of Rhode Island -- collapsed between January and March 2002, disintegrating at a rate that astonished scientists. Since 1995, the ice shelf's area has shrunk by 40 percent (Natural Resources Defence Council 2015, 1). Africa is one of most vulnerable continents to the negative impacts of climate change. South Africa, in particular, is said to be the most vulnerable to climate change, given its coastal location and heavy dependence on fossil fuels for energy generation.

It is believed that since scientific confirmation points to human activities as contributing

significantly to climate change (Jang & Hart 2015; Zhou et al. 2015) the onus is also on humans to find solutions to lessen the negative impacts of climate change through a behavioural change (Whitmarsh et al. 2011) about human activities especially industrial manufacturing processes. Although South Africa is a Non-Annex 1 country – not bound by the Kyoto Protocol carbon ceilings, however, due to its heavy dependence on fossil fuels and its low coastal lying geography and hence its vulnerability to negative impacts of climate change, it has voluntarily committed to carbon reduction initiatives. Albeit the fact that the South African electricity company, Eskom, contributes a significant percentage of the country's greenhouse gas emission (GHG) (Department of Environmental Affairs South Africa 2015). Other industries and businesses have an important role to play (Whitmarsh et al. 2011) in South Africa's climate friendly initiatives and low carbon economy agenda. It is thus expected that business should support the climate action through a committed conversion to carbon investment; towards this move, investment in carbon assets becomes essential. However, business conversion to low carbon assets requires an enabling climate finance (Richardson 2009), but research indicates that climate finance is not readily available and therefore poses a hindrance to potential climate investors, which thus lowers acquisition of climate assets (Damodaran 2015). "*Despite the importance accorded by the global community for financing activities that address climate change issues, nothing much has been achieved in tangible terms"* (Damodaran 2015, 161). It has been very difficult to attract private funds to climate adaptation projects (Damodaran 2015). Private financiers such as banks are still sceptical about the viability of funding climate assets. This is more applicable to financiers in developing countries. The banks are risk averse to early stages of climate asset investments (Corsatea et al. 2014) as they fear loss of their investments; this therefore leaves potential and/or willing climate investors with like climate finance to invest in climate assets. Consequently, the World Bank Climate Finance unit has gathered a pool of private and public climate finance to assist climate investors in developing countries and this fund has continued to grow in size.

The problem that underpins this research is that although, with no binding carbon ceiling, South Africa is a signatory to global climate change initiatives; however, given South Africa's voluntary support to the global climate agenda, it has voluntarily initiated commitment to reduce its national greenhouse gas emissions: *"South Africa has committed itself to an emissions trajectory that peaks at 34% below a "Business as Usual" trajectory in 2020 and 40% in 2025*" (Department of Environmental Affairs South Africa 2015, 1), but this will be reliant on financial and technical support from developed nations (Carbon Disclosure Project 2010; Department of Environmental Affairs South Africa 2015). This indicates that climate policy must be backed by financial support to succeed (Kameyama et al. 2015). Commitment from government and business is needed to halt the rising global warming, mostly as South Africa is vulnerable. Scientific evidence released by the International Energy Agency in 2011 indicate that greenhouse gas emissions reached a historic highest height of 31.6 gigatonnes (Gt) in 2011 (International Energy Agency 2013) and there is a global commitment to cut emissions by 95% by 2050 (Carbon Disclosure Project 2010). South Africa is deeply concerned as over 59% (*2 859 372 Gg CO2eq*) of emissions for the period 2000 – 2010 came from main electricity producer (Department of Environmental Affairs 2013, 23). However there is no immediate alternative to coal based energy generation in the near future (Winkler 2006), hence meeting the country's short-term target emission reductions means that the corporate should get more involved and speed up its climate investment initiatives (Kameyama et al. 2015). However, finance is recognised as a major tool for achieving low carbon investment (Yu & Lo 2015; Kameyama et al. 2015; Lambe et al. 2015) nonetheless, climate finance may not be easily accessible to developing countries in sufficient amounts (Kameyama et al. 2015). Given that South Africa has signed the global convention on climate action, it can access the global climate fund, this thus means that South African business could access the World Bank Carbon Finance Unit to invest in climate assets. The World Bank Climate Finance has been growing and it could be expected that this growth in global climate finance should engender growth in climate investors and climate assets. Research that focusses on the examination of the interaction between the World Bank Climate Finance and growth in climate investors is still not common; to the best of the researcher's knowledge, no research in South Africa has as yet focussed interest on the growth of World Bank climate finance and its likely effect on the growth of carbon investors and carbon assets. Additionally, no South African research has also looked specifically at the linkage between the climate policy evolution and growth of climate investors and climate assets. This research thus attempts to bridge this gap in the literature and to contribute a modest nuance to climate finance and climate investment literature by looking at a combined impact of climate finance with climate policy evolution on the growth of climate investors and climate assets. Summarily therefore, the key issue is, given the advent of climate policies to which South Africa has acceded and the concomitant establishment of World Bank climate finance, which should be accessible to South Africa, how would a blend of climate policy and the global climate finance affect the growth of climate investors and climate assets. Given this problem therefore, this

paper attempts to provide answers to the following research questions and objectives.

Accordingly based on the above problem, this research is anchored on the following questions: how does climate finance relate to growth in climate investors and climate assets? Does climate policy relate to growth in climate investors and climate assets? Consequently this research aims to aheive the following objectives: to examine the relationship between climate finance and growth in climate investors and climate assets; and to evaluate the relationship between climate policy and growth in climate investors and climate assets.

The paper reveals that a combined effect of growth in climate finance and climate policy evolution has had a significant relationship with growth in climate investors and climate assets. Given this result the paper proceeded to examine if the growth in climate finance has any correlation with South Africa's emission reduction trend. Results however indicate that South Africa's GHG emission trend does not correlate with climate finance availability. GHG emissions in South Africa have continued to soar despite seeming growth in climate finance. An apparent reason appears to be that only 100 companies in the Johannesburg stock exchange have openly committed to carbon reduction through the Carbon Disclosure Project. It is believed that greater business participation to carbon reduction would significantly reduce South Africa's GHG emission trajectory. In line with previous research (Damodaran 2015; Rennkamp & Boyd 2015) the paper observes that access to climate finance might be limiting business initiative to climate investment, hence the growth in GHG emission in South Africa. The major provider of limited climate finance in South Africa is the Development Bank of South Africa (DBSA) (Buchner et al. 2011), however, this government owned bank cannot provide the needed climate finance to foster the needed climate investment to reduce South Africa's HGH emission. Adding to this problem, is that the global climate fund is significantly pooled by private funds and this makes it difficult for entities in developing economies to access this fund, thus, it is not surprising that only about 100 JSE firms are currently the major publicly known business players in climate investment. Given the financial bottleneck, the paper makes a nuance contribution in two distinct ways; firstly, this research is the first in South Africa to show that although the growth in climate finance and climate policy evolution correlates with growth in climate investors and climate assets, it has not translated positively to reducing South Africa's GHG emission. Secondly, it recommends that government, in tandem with the private sector, should establish a national climate finance pool where many private funders may contribute to the Climate Fund – sequel to the World Bank Climate Finance pool. Unlike the World Bank Climate finance pool, it is likely that a national Climate Finance Pool will be readily accessible to South African business and/or industries to invest in climate assets.

The rest of this paper is structured as follows: following this introduction, a theoretical framework using the Grasso's ethical approach to climate finance is presented. After the theoretical framework, a related literature review which in two major sections speaks to the research objectives is presented. The following section, after the literature, is the research methodology, analysis and interpretation. This is followed by a discussion section; the final section draws conclusions and makes recommendations.

2. Theoretical Framework

Given the importance of finance in galvanising climate investment and carbon reduction, this paper considers that if developing countries must effectively get involved in carbon emission reduction, they would need a more-than usual consideration from the carbon fund suppliers; this will involve some ethical consideration on the part of carbon fund suppliers like the World Bank. This is because, based on pure financial qualifications, most developing countries may not meet the criteria for qualifying to have access to carbon funds. Hence in this paper, the researcher considers the Grasso (2009) ethical approach to climate finance. In Grasso's (2009) seminal essay on "*ethical approach to climate adaptation finance"* (p.74), Grasso developed a structure of "*procedural and distributed justice"* (p.74), and aligned it to the international climate process of climate financing, Grasso theorises that climate financing ought to comprise all responsible entities. Most important in Grasso's theory which is applicable to this paper is the theorisation that climate funding should not be based on the financial affluence and influence of who can afford it, rather that climate funding allocation should be based on allocating it first to those countries that are most vulnerable and defenceless to negative climate change impacts. Doing so would mean that an ethical and altruistic stance would have been brought to bear on the process of climate fund distribution. In putting the theory of ethical approach to climate finance allocation, Grasso expounds on the ideologies of procedural and distributive justice, basing this premise thus, Grasso advances a broader theorisation that climate finance allocation should be based on equity and fairness, which should be the index for allocating climate finance. Grasso theorises further that the responsibility for contributing to climate finance should equally be based on the level of responsibility for climate effect. Grasso found root to his theory of ethics in climate finance in previous works of burden allotment, and individuation philosophies such as quoted by Jagers and Duss-Ottesträm (2008) and Page (2008). Given the raging argument on the responsibility for climate finance

and the important role of climate finance in building climate assets and hence emission reduction for required adaptation, Page (2008) offers a nuance theory of bringing in individualism – from shared unconsciousness to the consciousness, Page posits that only a mix of, or an amalgam of three different theoretical constructs for climate financing burden may be practical – "*contribution to problem, the ability to pay and beneficiary pays*". Being fair in understanding will equally allow critical thinkers to see some reasoning in Page's (2008) amalgamated theory of climate burden sharing. Accordingly, one can readily visualise that the fact that although some developing countries, such as South Africa, which is a Non-Annex 1 country – not legally bound to Kyoto Protocol– but given South Africa's heavy carbon emission stance in Africa, the onus falls on the companies in the country – being contributory to emissions (Page 2008), to begin to seek for climate finance to invest in climate assets and to reduce carbon emissions to enhance a climate of friendly economic development. However, the fairness and equity theory for climate finance (Grasso 2009) may mediate the contributory responsibility of Page (2008), if multinational responsibility is brought to the fore in the case of South Africa. The reason being that although Eskom (the South African Electricity Company) is a heavy carbon emitter, the majority of other heavy emitters in South Africa are multinational corporations, in this sense thus, the equity and fairness theory of Grasso (2009) in climate finance allocation deserves consideration for South Africa by climate finance funders like the World Bank. This is critical to enable climate finance access by South African companies in order to reduce rising emission in the country. Accordingly, the Department of Environmental Affairs, South Africa (2015) stresses the need for climate finance assistance from industrialised nations for it to be able to meet its voluntary carbon reduction targets of 34% by 2020 and 40% by 2040:

"While South Africa's effort to achieve these targets is not contingent on international support, as a developing country its ability to do so while meeting its urgent development priorities in job creation and poverty alleviation will, to some extent, depend on the existence of global agreements on the flow of financial and technical support from developed countries that have already industrialised. The onus therefore lies with developed countries to make and meet their commitments in providing financial, capacity-building, technology development and technology transfer support to developing countries" (Department of Environmental Affairs South Africa 2015, 1).

3. Review of Related Literature

Extant literature on the role of carbon finance and climate policy on carbon investors and carbon assets abound (Blanco 2009; Couture & Gagnon 2010; Labatt & White 2011; Buchner et al. 2011; Li and Wang 2012; Corsatea et al. 2014; Wood et al. 2015).

3.1 Carbon Finance, Climate Investors and Climate Assets

Climate related disquiet has gripped some corporations as climate change issues have shifted from mere corporate environmental health and safety (EH&S) to a much more complex strategy of financial sourcing and investment in climate assets (Labatt & White 2011). The financial effect of a carbon controlled world has thus been seen as one of the determinant factors that engender business engagement to climate investment.

A lot of other constituent literatures have similarly examined the carbon finance aspects of carbon investors and carbon assets. These have focussed attention on the deterring factors of carbon financing which include the cost and tariff issues, see example in Blanco (2009) and Couture & Gagnon (2010). Yet other researchers have focussed attention on the sources of carbon financing (Buchner et al. 2011). They note that the private sector is a major funder of the pool of climate finance:

*"The amount of private finance is almost three times greater than public finance. Out of the estimated USD 97 billion in global climate funding, on average USD 55 billion is provided by the private sector, while at least USD 21 billion is provided by public budgets" (*Buchner et al. 2011, iii *)*

The above revelation becomes a concern, given the global call for developed countries to fund carbon reduction and climate adaption programmes and investments; thus Buchner et al. (2011) lament, that given the dominance of private finance in the pool of climate finance, it makes it more difficult for developing countries to access climate finance and they could only rely on development institutions (Buchner et al. 2011). Other researchers have looked into the effect of available climate finance options on the cost of acquisition of climate assets, for example, Wiser (1997) used the traditional cash flow analysis procedure to analyse the effect of various types of climate financing options on the cost of carbon assets. Similarly, Corsatea et al. (2014) evaluated the impact of public and private climate financing on the efficiency of climate investment. Their findings show that public sector participation boosts access to climate finance credits for climate investors.

Corsatea et al, (2014) highlight that corporate bonds are good alternatives for operating carbon investments, especially in developing countries where companies need a cheaper alternative source of climate finance. It is argued that the cost of servicing bonds or debts are far more reasonable than the cost of equity (see e.g. Corsatea et al. 2014; Harper et al. 2007). Nonetheless, Corsatea et al. (2014) argue persuasively that private funding is not readily

available, reason being that funders like the private banks are risk averse as regards the birth stages of carbon investments. At this stage the private funders have not yet tasted the market potential of carbon assets such as low green energy assets and its potential for profit. It is for this reason of the scarcity of private climate funds that Murphy and Edwards (2003) emphasize the importance of public participation in providing climate finance to enable the taking off of low carbon investments especially in developing countries.

Furthermore, according to Awerbuch's (2006) research, which adopts the portfolio theory, a mix of an assortment of energy portfolios that would result in low energy costs and thus low cost of sourcing climate finance? In a related research, Bekessy & Wintle 2008) conclude that an enabling environment where carbon off setters can receive carbon finance credits, may enable growth of carbon investors and carbon offset schemes. In his research, Bowen (2011) stressed the importance of raising climate finance for the growth of climate investors in developing countries. However, Bowen (2011) remained critical in his research in that he did not lay the burden of climate on the public sector alone; he rather highlighted the importance of private finance and the need to boost public climate finance by raising tax revenue to provide need climate funds to support climate investors. Whilst evaluating carbon footprint analysis, Wang et al. (2010) observed a relationship between financing and carbon investment. In support of previous research findings, Fischer and Newell (2008) found that investments in low carbon assets may be possible through an access to climate finance. Such climate funds may thus engender growth in climate assets such as energy efficient buildings, renewable energy and business operations including transportation. Developing countries such as South Africa has the opportunity to shift to climate investments to reduce the climate change impact and to avoid future negative impact on business operations. The author therefore states the following hypothesis:

Hypothesis 1: *H0: there is no relationship between climate finance, growth in climate investors and climate assets. H1: there is a relationship between climate finance, growth in climate investors and climate assets.*

3.2 Climate Policy, Climate Investors and Climate Assets

Others researchers have recognised the impact of climate policy on the cost of, and hence growth of, carbon assets (Blanco 2009). In their research on energy and climate policy in China, Li and Wang (2012) opine that effective climate policies, rather than mere pricing policies, play an operative role in accelerating low carbon investment. In another corroborative research, Fischer and Newell (2008) conclude that environmental technology policies are strong pathways to motivate growth in climate investors and climate assets. Whilst studying the role of climate policy – Clean Development Mechanism (CDM) on climate investment in a developing country, Tanzania−Wood et al. (2015) found that the efficiency of climate policy may make or mar climate investment in developing countries. In line with Wood, the UNFCCC. (2012) avow that climate policies are catalysts for growth of climate investors and climate assets; this is also in accord with UN (2011).

In their research Chaturvedi & Shukla (2014) found that efficient application of a climate change policy has an effective role to play in energy efficiency investment. Similarly, Carmin et al. (2012) present an in-depth analysis of climate adaptation strategies in Durban, South Africa which result from climate policy expectations. Similarly, Rennkamp & Boyd (2015) emphasise that South Africa is in dire for green technologies for it to realise targeted greenhouse gas emission reductions. They highlight that this technology may not be readily available locally, there is the need thus to imbibe climate technology transfer policy; whether this transfer policy is "*sales-driven or capability-driven" (p.1)*, the benefit is multifaceted for South Africa, much as it would drive the ultimate target of greenhouse gas reduction, green technology transfer policy would also enhance development of local industries, increase in local job formation, and poverty alleviation. According to Rennkamp & Boyd (2015), technology transfer is conditioned on a global climate policy within which developing nations must receive support from developed countries, they thus argue for the need to also bolster technology capability, which is internally based, such that, when combined with the international technology transfer policy, South Africa would achieve accelerated momentum toward carbon reduction and climate friendly development. Accordingly, Rennkamp & Boyd (2015) concur that a mix of local and international climate policy is sine qua non for achieving a low carbon and climate friendly development.

It should be highlighted that a climate policy without the enabling finance would yield no effective results. Whilst noting the first climate policy of South Africa, Rennkamp & Boyd (2015) observed that the financing element is missing from South Africa's climate policy on meeting the country's energy demand through a mixed energy policy plan, the Integrated Resource Plan for energy (IRP), and for meeting GHG reduction in 2010 to 2030 (Department of Energy, 2011). Rennkamp & Boyd (2015) also note that the financing perspective is absent in other climate policies. Related to the preceding literature on climate policy is Eom et al. (2015) who conclude that climate policy delays negatively affects investment in climate technology and the associated emission reduction. They suggest

that delayed policies should be accompanied by higher emission reduction expectations. In a closely related research Kalkuh et al. (2015) found that unlike renewable energy climate policies, carbon capture and storage climate policies are slow to achieve long run emission reduction goals. They thus recommend that carbon capture and storage may be made to assume lower social costs, in contrast however, renewable energy climate policies achieve a better emission reduction in the long run. Given that both carbon capture and storage and renewable energy climate policies assume different and unique risks of not meeting target emission reductions, Kalkuh et al. (2015) suggest that a merger of both policies might produce a much more robust climate policy for achieving a low emission development through climate investment. To the best knowledge of the author, none of the previous research literature has had a combined focus on the relationship between carbon finance, climate policy and climate investors and climate assets, at least not within the South African context. Hence this paper attempts to bridge this gap in literature and thus add a modest nuance to the literature. Based on the preceding reviews, the following hypothesis is therefore stated:

Hypothesis 2: *H0: there is no relationship between climate policy, growth in climate investors and climate assets. H1: there is a relationship between climate policy, growth in climate investors and climate assets*

4. Methodology

Given that the researcher intended to examine whether carbon finance relate with growth in carbon investors and climate assets, the research paradigm applicable to this research is thus a positivist paradigm. The concept of "*paradigm"* was originated by Thomas Kuhn in his seminal book, *The Structure of Scientific Revolutions.* According to his definition, a paradigm is '*an integrated cluster of substantive concepts, variables and problems attached with corresponding methodological approaches and tools'* (Kuhn 1962, quoted in Flick 2009: 69). Following this definition, other researchers, Guba and Lincoln explained the concept further and gave it a closer research connotation, thus they define a paradigm as '*a basic system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways'* (Guba and Lincoln 1994: 105). Major research paradigms include positivist, anti-positivist or critical theory, however, the research shall adopt the positivist paradigm. The reason for using the positivist paradigm is that a positivist paradigm relies on measurement of a linkage or association between variables such that associated variables may receive a tentative understanding within a limited environment. Since, therefore, positivist research is quantitatively based and involves measurement of relationship between variables; the research design adopted is quantitative using a combination of a causal and correlation approach. In causal design the research wishes to know if one variable may cause a change in the other (Creswell 2013). Contrastingly, in correlational design the research wishes to evaluate the relationship between two variables without necessarily inferring causation (Creswell 2013).

Therefore in the causal approach, the researcher attempts to evaluate the relationship between climate finance availability, climate investment and climate assets. In the same vein, it also evaluates the relationship between climate policy evolution, climate investment and climate assets. The concluding section of the discussion of the research results used the correlational approach in which the researcher examines the extent to which the availability of carbon finance has related with the South African greenhouse gas emission reduction. The study focussed on the carbon investors' and assets' growth as contained in the Carbon Disclosure Project (CDP), South Africa, which documented data on the growth of climate investors and climate assets covered in the JSE 100 climate investors and other global investors. Accordingly, quantitative data were collected from secondary sources (Carbon Disclosure Project 2012; Hagbrink et al. 2010; World Bank 2011; World Bank 2015; Department of Environmental Affairs South Africa 2013; UNFCC, 2014a). The analysis of data was therefore through the use of regression and correlation statics respectively.

Some previous research have applied a quantitative design in evaluating green investments or emission researches, for instance, Venkatesh et al. (2010) used the regression statistics to measure a possible relationship between GHG emission reduction and low carbon policies. Similarly, using the regression analysis, Huang et al. (2008) studied the relationship between climate policies, GHG reduction and GDP. In another related research, Ngo et al. (2009) used the regression statistics to study the determinants of climate investment behaviour of greenhouse gas reduction. Furthermore, Chae (2010, 205) used the correlation statistics to measure the relationship between "*quality management plan and greenhouse gas reduction strategies"*. Given the application of regression and correlation statistics in previously stated research, the researcher thus applies regression and correlation in examining the relationship between climate finance, climate investors and climate assets. The variables proxies are as follows: climate finance = carbon finance; climate investors = carbon investors; climate assets = carbon assets; climate policy = number of global climate policies issued per year.

The regression model: Relationship between climate finance, climate policy and climate investors:

$$Y = \beta_0 + \beta_1\chi_1 + \beta_2\chi_2 + \varepsilon$$

(With Y as climate investors) in the first test for hypothesis 1; and Y as Climate assets in the second test for hypothesis 2).

Where:

Y = level of growth in climate investors (shortened as: CLInv) [for test 1: hypothesis 1]

And

Y = level of growth in climate assets (shortened as: CLA) [for test 2: hypothesis 2]

β_0 = constant (Y intercept)

β_{1-2} = regression coefficient

χ_1 = growth in climate finance (shortened as: CLF)

since the literature indicates the importance of climate policy in spurring climate investors and climate assets, the researcher thus included the second independent variable (χ_2)

χ_2 = climate policy (shortened CLP)

e = error = 0

The model is thus rewritten as:

Climate investors = $\beta_0 + \beta_1$*CLF + β_2*CLP *(for test 1)*

And

Climate Assets = $\beta_0 + \beta_1$*CLF + β_2*CLP

Restating the Hypotheses

Hypothesis 1: H0: there is no relationship between climate finance, growth in climate investors and climate assets.

H1: there is a relationship between climate finance, growth in climate investors and climate assets.

Hypothesis 2. H0: there is no relationship between climate policy, growth in climate investors and climate assets. H1: there is a relationship between climate policy, growth in climate investors and climate assets.

Decision criterion:

The hypotheses are tested at 0.05 significance level; therefore, the decision rule for null hypotheses (H0) is:

Rejected H0 if $P \leq 0.05$; Accepted H0 if $P > 0.05$.

4.1 Findings from Statistical Test

Test 1: Hypothesis 1

H0: there is no relationship between climate finance, growth in climate investors and climate assets.

Climate Finance (CLF), Climate Policy (CLP) & Carbon Investors (CInv)

The regression output for test 1appears in Table 1 below.

Table 1. Relationship between Climate Finance (CF), Climate Policy (CLP) & Carbon Investors Growth

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.916548125
R Square	0.840060465
Adjusted R Square	0.804518346
Standard Error	122.7591285
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	712368.7	356184.3	23.63563	0.000261698
Residual	9	135628.2	15069.8		
Total	11	847996.9			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	-79.79440896	83.39107	-0.95687	0.363629	-268.438121	108.8493	-268.438	108.8493
CF US$M	0.203031145	0.050193	4.045038	0.002907	0.089487509	0.316575	0.089488	0.316575
CLP-Evo	91.26968132	38.16295	2.391579	0.040453	4.939099768	177.6003	4.9391	177.6003

Figure 1. Scatter Graph of Relationship between Climate Finance (CF), Climate Policy (CLP) & Carbon Investors Growth

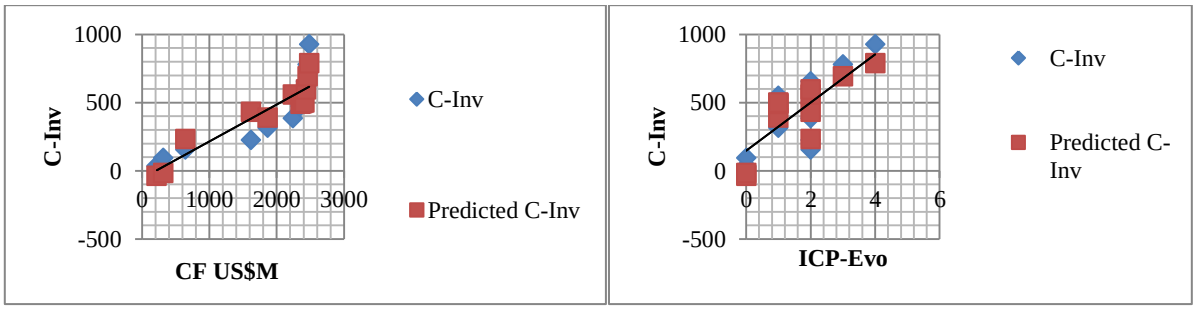


Table 2. Interpretation of the Findings in Table 2

Relationship between Climate Finance (CF), Climate Policy (CLP) & Carbon Investors Growth

Independent Variables	***P Value***	***Statistical Significance***
CF = Climate Finance β_1 = 0.02030 climate finance has a positive impact on the growth of climate assets	0.0029	The *P* value of 0.0029 is less than the significance value of 0.05, this shows a statistical significance, showing that climate finance and climate investors could have a linear relationship
CLP-EVo = Climate Policy Evolution B_2 = 91.2696 Climate policy evolution has positive impact on the growth of climate assets.	0.0404	The P value of 0.0404 is less than the significance value of 0.05, this therefore shows a statistical significance, showing that climate policy evolution and climate investors may have a linear relationship.
The findings from the regression test of hypothesis 1 in Table 1 above gives a coefficient of determination (R) of 0.8400; this shows that 84% of the growth in climate investors can be explained by growth in climate finance and climate policy evolution. With an adjusted (R^2) of 0.8045, which is 80%, the regression model is also strong. Furthermore, the overall significance value of the test, *P* = 0.0002 is way below the significance value of 0.05, thus the overall significance may be summarised as*: P < 0.05*. ***Decision Criterion***: Rejected H0 if ***P≤ 0.05***; Accepted H0 if ***P> 0.05***. Since therefore, *P < 0.05*, the first null hypothesis: carbon finance and climate policy are not related with growth in climate investors, is rejected. The alternative hypothesis, carbon finance and climate policy are related with growth in climate investors, is accepted. The regression model is thus: *Climate investors (CLI) = -79.7944* + 0.02030**CLF* + 91.2696**CLP*		

Test 2: for Hypothesis 2. *H0: there is no relationship between climate policy, growth in climate investors and climate assets.*

Climate Finance (CF), Climate Policy (CLP) & Carbon Assets Growth (CA).

The regression output for test 2 appears in Table 3 below.

Table 3. Relationship between Climate Finance (CF), Climate Policy (CLP) & Climate Assets Growth

SUMMARY OUTPUT

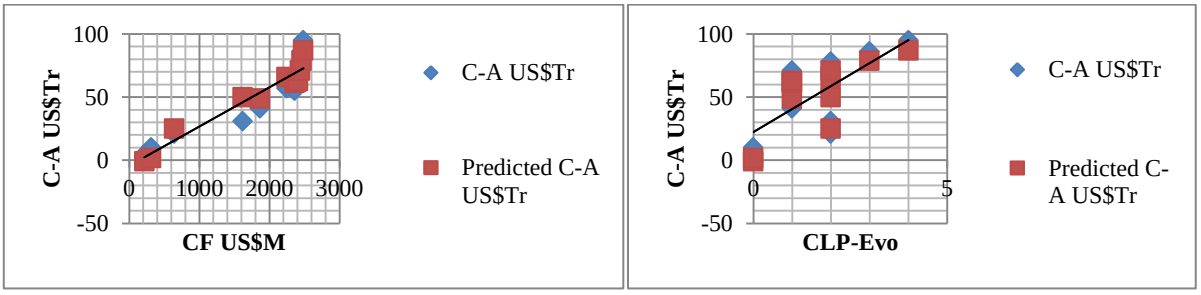
Regression Statistics	
Multiple R	0.953116724
R Square	0.90843149
Adjusted R	0.888082932
Standard E	9.961955257
Observatic	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regressior	2	8860.898	4430.448764	44.643532	2.12744E-05
Residual	9	893.165	99.24055255		
Total	11	9754.063			

	Coefficients	*andard Erı*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*Ipper 95.0%*
Intercept	-6.383061001	6.767221	-0.94323226	0.3701917	-21.6915781	8.925456	-21.6916	8.925456
CF US$M	0.025582197	0.004073	6.280685295	0.0001443	0.016368083	0.034796	0.016368	0.034796
CLP-Evo	7.443965432	3.096939	2.403652411	0.0396597	0.438202185	14.44973	0.438202	14.44973

Figure 2. Scatter Graph of Relationship between Climate Finance (CF), Climate Policy (CLP) & Carbon Investors Growth



4.2 Discussion

The preceding findings indicate a significant positive relationship between climate finance availability, growth in climate investors and growth in climate assets. It also shows a significant positive relationship between climate policy evolution, growth in climate investors and growth in climate assets. However, a closer look at the *P* values of the separate independent variables (climate finance and climate policy evolution) indicates that although climate policy is significant, it is not as strong as climate finance; this is also evident in the line-fit scatter graph (Figure 1 & 2). This signifies that climate policy alone, in the absence of enabling climate finance, may not achieve the desired climate investment and emission reduction. An effective blend of pragmatic climate policy accompanied by enabling climate finance to pursue greener and/or carbon reduction investments is required. This finding is consistent with previous literature findings about the importance of blending climate policy with enabling finance, (Kameyama 2015). This is why Rennkamp & Boyd (2015), as discussed in the literature, highlight that South Africa's energy policy lacks a climate finance strategy and stress the need to incorporate the sources of finance for a planned energy policy. This is apposite because without supportive climate finance to enhance pragmatic operationalisation of policies, emission reduction may be elusive (Ghisetti et al. 2015).

Table 4. Interpretation of the Findings in Table 3

Relationship between Climate Finance (CF), Climate Policy (CLP) & Climate Assets Growth

Independent Variables	***P Value***	***Statistical Significance***
CF = Climate Finance β_1 = 0.02558 climate finance has a positive impact on the growth on climate assets	0.0001	The *P* value of less than 0.01, which is less than the significance value of 0.05, shows a statistical significance, showing that climate finance and climate assets could have a linear relationship
CLP-EVo = Climate Policy Evolution β_2 = 7.4439 Climate policy evolution has a positive impact on the growth of climate assets.	0.0396	The P value of 0.0396 is less than the significance value of 0.05, this therefore shows a statistical significance, showing that climate policy evolution and climate assets may have a linear relationship.
The findings from the regression test of hypothesis 2 in Table 3 above gives a coefficient of determination (R) of 0.9084; this shows that 90% of the growth in climate assets can be explained by growth in climate finance and climate policy evolution. With an adjusted (R^2) of 0.8880, which is 88%, the regression model is also strong. Furthermore, the overall significance value of the test, *P* = 0.00001 (less than 1%) is way below the significance value of 0.05, thus the overall significance may be summarised as*: P < 0.05.* ***Decision Criterion***: Rejected H0 if ***P≤ 0.05***; Accepted H0 if ***P> 0.05***. Since therefore, *P < 0.05,* the second null hypothesis: carbon finance and climate policy are not related with growth in climate assets, is rejected. The alternative hypothesis, carbon finance and climate policy are related with growth in climate assets, is accepted. From the above therefore the regression model is written as: *Climate Assets (CLA) = -6.3830* + 0.02558**CLF* + 7.4439**CLP*		

Since the preceding sections show that there is a relationship between carbon finance and carbon investment, the corresponding expectation should be that carbon investors and assets growth in South Africa should enhance reduction in the greenhouse gas emission trend of South Africa, but this does not appear to be the case. The latest Green House Gas inventory data released by the Department of Environmental Affairs (DEA) show in Table 5 below that, albeit corporate South Africa's emerging commitment to GHG reduction efforts as shown in the Carbon Disclosure Project (CDP) carbon investors growth and carbon asset growth, the GHG level for South Africa has contrariwise been on the rise since the year 2000. This is concerning considering the country's target emission reduction level by 2020, coupled with the vulnerability of the country to negative impacts of climate change such as warming, erratic rainfall, flooding and diseases such as malaria (in some province). The CDP indicates that only about 100 companies from the Johannesburg Stock Exchange (JSE) participate fully in the carbon reduction initiatives and disclosure project (Carbon Disclosure Project 2012 and 2014). However, despite their level of effort in carbon commitment and reduction, it cannot be reasonably anticipated that 100 companies may effectively reduce the quantum of GHG emission to enable the country to achieve its target emission level by 2020. Although South Africa (a Non-Annex 1 country) (UNFCCC 2014b) is not legally bound by the Kyoto Protocol regarding compulsory carbon reduction, but the country is playing an important international role in climate change issues. It is also one of the countries that has voluntarily committed to carbon reduction initiatives. Investment in carbon assets is required for the country to turn the trajectory of carbon emission around to its expected plummeting trend in GHG emissions. However, it does seem though, that effective investment in climate assets has not taken off as expected to give impetus to carbon reduction in the country. This is evident by the 100 JSE companies that are currently engaging in carbon reduction initiatives. One of the obstacles, similar to other developing nations, might be that companies and other entities are still struggling with carbon finance to hoist desirable assets toward carbon reduction (Kameyama 2015). Climate policies are useful, but as discernible from the preceding analysis, there has to be a combination of climate policies, together with enabling climate finance, to enhance effective investment in carbon assets. This effort should not be left in the hands of few companies such as the JSE 100 companies; effective emission reduction should involve all businesses. The World Bank has developed a portfolio of carbon funds, the South African entities need to avail themselves of this

opportunity to install effective carbon assets to make the noble ambition of emission reduction achievable.

"The Carbon Finance unit at the World Bank Group supports putting a price on carbon by providing assistance on and piloting innovative cost-effective climate change mitigation approaches in World Bank client countries. Such approaches include international mechanisms, emissions trading schemes, carbon taxes, and results- based finance (Hagbrink et al. 2014).

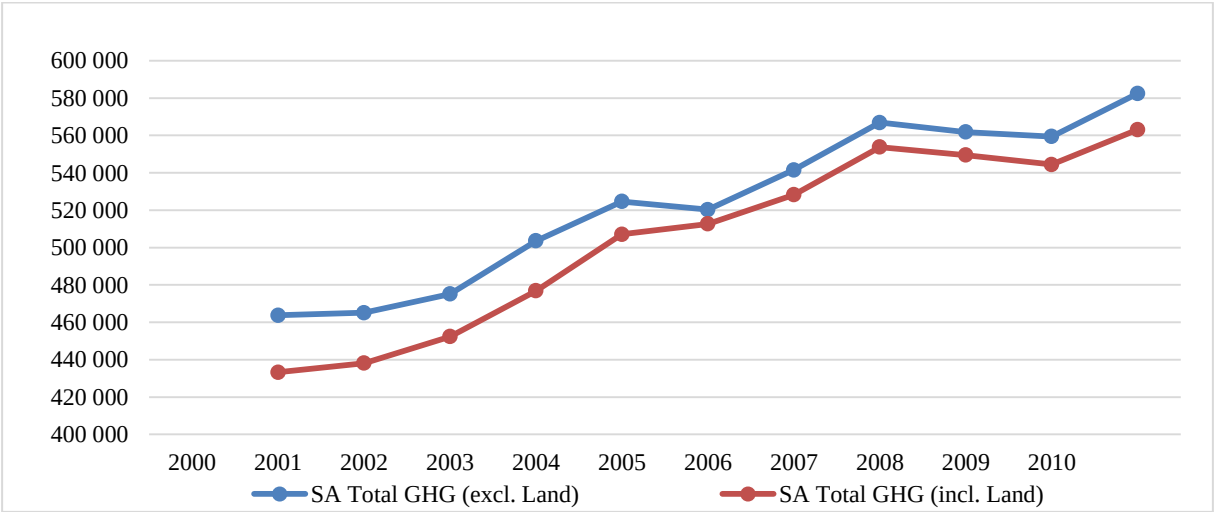
The World Bank climate finance is available to World Bank client countries which include South Africa as a signatory to the Global Climate Convention. However, the problem as highlighted in previous literature might be the ease of accessing these funds by developing nations. Evidence from previous research indicates that it has been difficult for developing nations to access the climate finance effectively (Kameyama, 2015). The difficulty of accessing global funds is made worse due to the dominance of private funds (with its stringent demands) in the pool of the climate funds. It is therefore not surprising to see a very few in South Africa investing in carbon assets, hence the high emission level of the country has continued. Table 5 below presents the greenhouse gas emission trend for South Africa 2000 – 2010. The trend is compared with the growth in climate finance to see if the growth in climate finance has had any correlation with the level of emission reduction in South Africa. This is to assist in concluding whether these finances have effectively been available and accessible to South African business and what needs to be done.

Table 5. Trends and levels in GHG emissions for South Africa between 2000 and 2010 (Gg CO2eq)

Energy		IPPU	AFOLU (excl. Land)	AFOLU (incl. Land) (Gg CO2 eq.)	Waste	Total (excl. Land)	Total (incl. Land)
2000	381 790	29 961	39 565	9 037	12 434	463 750	433 221
2001	383 620	28 652	39 725	12 772	13 122	465 118	438 166
2002	392 107	30 368	38 916	16 060	13 789	475 180	452 324
2003	421 121	30 987	36 995	10 310	14 477	503 581	476 895
2004	439 835	32 548	37 049	19 545	15 179	524 611	507 107
2005	433 719	33 400	37 235	29 667	15 907	520 262	512 693
2006	453 536	34 190	37 148	23 869	16 649	541 523	528 244
2007	479 058	33 871	36 522	23 435	17 409	566 860	553 773
2008	475 817	30 229	37 580	25 280	18 170	561 797	549 497
2009	476 346	27 456	36 658	21 688	18 989	559 450	544 480
2010	495 432	29 634	37 577	18 248	19 806	582 449	563 120

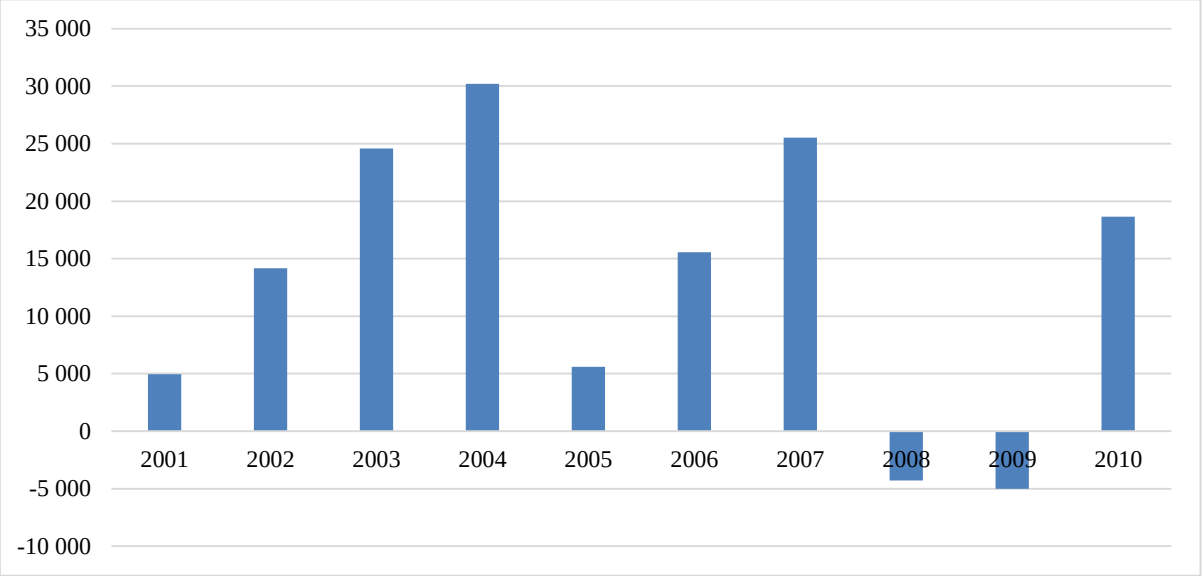
Source: Department of Environmental Affairs (DEA) South Africa (2013, p. xviii) GHG inventory for South Africa: 2000 – 2010. Available at: https://www.environment.gov.za/sites/default/files/docs/ greenhousegas_invetorysouthafrica.pdf (accessed on April 20, 2015).

Figure 3. Line Chart of South Africa Total GHG Emission 2000 - 2010 (Gg CO2eq)



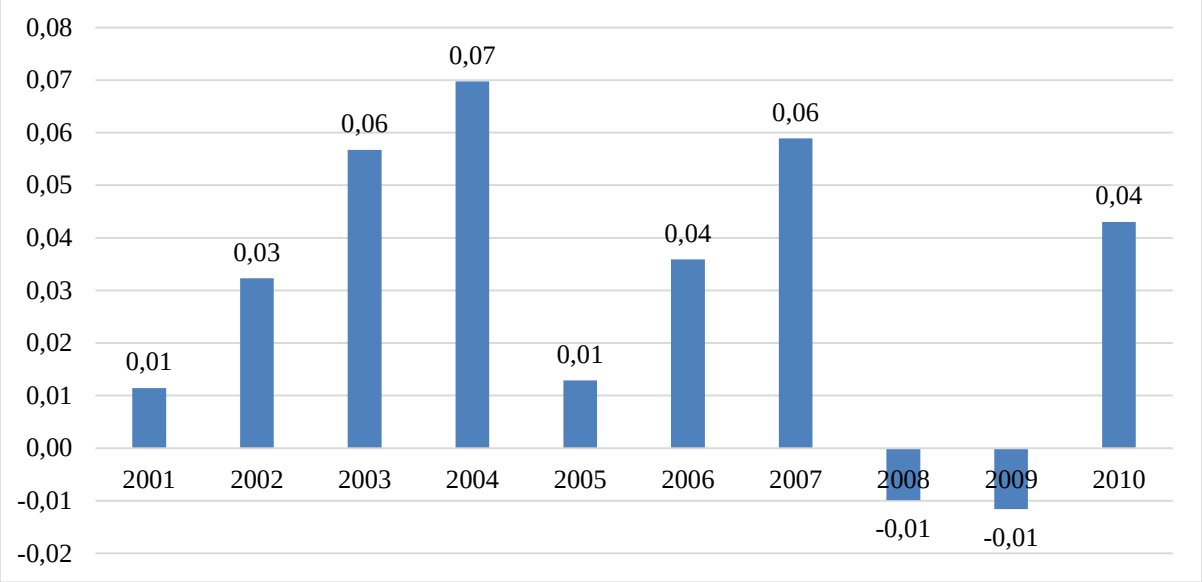
Source: author's Line chart: with data from: Department of Environmental Affairs (DEA) South Africa (2013, p. xviii) GHG inventory for South Africa: 2000 – 2010. Available at: https://www.environment.gov.za/sites/default/files/docs/greenhousegas_invetorysouthafrica.pdf (accessed April 20, 2015).

Figure 4. Increase on SAs C02 Emission on Preceding Year Base **(Gg CO2eq)**



Source: *author's graph computed from Table 5, on preceding year basis*

Figure 5. % Decrease/Increase in SAs C02 Emission on Preceding Year Base



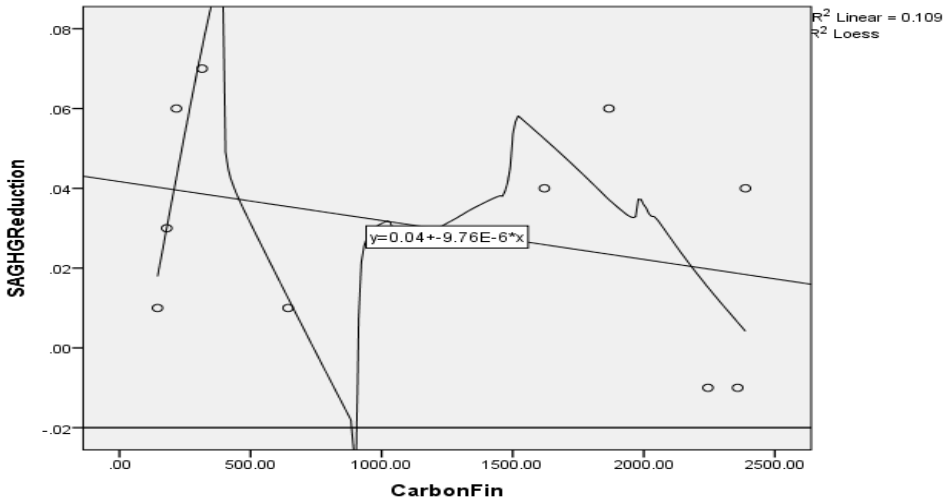
Source: *author's graph computed from Table 5, on preceding year basis*

Table 6. Correlation between South Africa's Carbon Emission Reduction & Carbon Finance

Correlations			
		CarbonFin	SAGHGReduction
CarbonFin	Pearson Correlation	1	-.330
	Sig. (2-tailed)		.352
	N	10	10
SAGHGReduction	Pearson Correlation	-.330	1
	Sig. (2-tailed)	.352	
	N	10	10

Source: *author's SPSS Correlation Analysis Output*

Figure 4. Scatter Graph between South Africa GHG Reduction & Carbon Finance

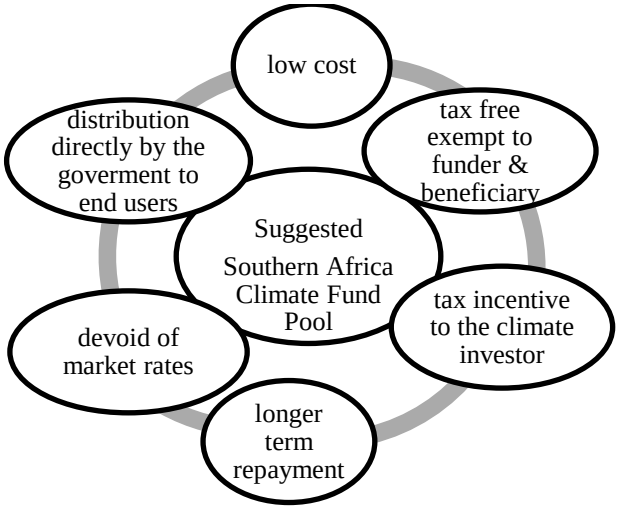


Source: *author's SPSS Correlation Analysis Output*

Insight from the above correlation scatter analysis between climate finance and South Africa's GHG emission trend shows that growth in global climate finance has not translated to GHG reduction in South Africa. As pointed out in the literature, given the private fund dominance of the global climate finance (Buchner et al. 2011) and hence its stringencies. The global climate finance may not have been easily accessible to the South African corporate who needs it to engage in climate investment. The Development Bank South Africa – a publicly owned bank, has limited climate funds and cannot meet the climate finance demands of the South African corporate and other entities requiring climate investment. According to Buchner et al. (2011) it is clear that even at the global pool of climate finance, the public fund is very low, with the private fund constituting about "*three times greater than public finance*" (p. iii). This thus shows that within the South African context, reliance can't be placed neither in the World Bank Climate Finance nor in the Development Bank of South Africa. A rethink is needed in the Southern African context to take climate action that balances climate policy and the climate finance strategy (Rennkamp & Boyd 2015). It therefore becomes apposite to design a Southern African climate fund pool that will be readily accessible to the South African corporate to get involved with desired climate investments and emission reduction. Such a fund pool should be a standalone, different from the multifaceted funds from the Development Bank of Southern Africa. The suggested characteristics of the suggested Southern African Climate Fund include:

Low cost; tax exemption to the funder and the beneficiary; tax incentive to the climate investor; longer term repayment; distribution by government directly to end users; be devoid of market rates. These characteristics appear graphically below in Figure 5:

Figure 5. Characteristics of Suggested Climate Fund for Southern Africa



4.3 Policy Implication of this Paper

This research offers a nuance, practical and an academic insight. This is because none of the previous research in South Africa have focussed on the relationship between carbon finance, carbon investors and carbon asset growth. The paper thus becomes even more useful for practical purposes in South Africa, given that the country is still at an embryonic stage of greening its development, hence the study highlights that climate policy alone cannot achieve desirable reduction in GHG as policy alone may not foster the needed climate investment. Climate finance should rather match climate policies to foster climate asset investment and thus carbon reduction. The result of the preceding section implies that although climate finance is growing at the international level, its growth has not translated into any significant reduction in South Africa's greenhouse gas emission. A possible reason might be that little climate finance is accessible for South African entities, this thus highlights the need to widen the sources of climate finance. Much as the country expects assistance from the developed countries (Department of Environmental Affairs South Africa 2015), there is also the need to motivate the involvement of the private sector financing. This is apparent from the World Bank portfolio of climate funds as a greater percentage of the climate funds come from private sources (World Bank 2015). It has become pertinent therefore that the South African national government needs to come up with a persuasive and attractive climate policy to capture the involvement of private sector climate financing in the country.

5. Conclusion and Recommendations

This paper set out with the aim of ascertaining possible linkages between growth in climate finance, growth in climate investors and growth in climate assets. It also aimed to evaluate the relationship between climate policy evolution and the growth of climate investors and climate assets. Using a positivist research paradigm, a quantitative research approach coupled with a causal and correlational research design was utilised. This design was adjudged fitting since previously related research had utilised the relational approach. The paper made use of secondary data from the World Bank Carbon Finance Unit and from the Carbon Disclosure Project (ADP). The major purpose was to examine the combined effect of climate finance and climate policy on the growth of carbon investors and carbon assets for the companies in the Carbon Disclosure Project which includes the 100 JSE South African companies. The Regression analysis reveals that a combined effect of growth in climate finance and climate policy evolution has a significant relationship with growth in climate investors and climate assets. From this result the researcher proceeded to assess if the growth in climate finance has had any positive correlation with South Africa's emission reduction trend. Disappointingly the correlation scatter graph shows that South Africa's GHG emission trend does not correlate with climate finance availability. This is evident with the GHG emissions of South Africa which has continued to soar despite seeming growth in climate finance. The paper reasoned and avows previous literature such as Kameyama (2015) that the global climate finance might not be effectively available to the corporate in developing countries such as South Africa to initiate the expected level of climate investment to effect a significant reduction in greenhouse gas emissions; This confirms literature assertions that global climate finance might not easily be accessible, particularly to entities in developing countries. The findings of the paper are also consistent with previous research findings that climate policy must blend with availability of climate finance to achieve the emission reduction objective. This confirmation is novel for the South African context, as no previous research in South Africa has examined this combined phenomenon, hence the nuance offered by this research within the South African context. In conclusion, the paper suggests the establishment of an independent Southern African Climate Finance pool where the public and private sector can contribute climate funds and that such a pool be made easily available to carbon investors at a cheap rate with alluring tax incentives to funders and beneficiaries. The paper adds a modest nuance to the literature as no known previous research has dwelt specifically on the unique relationship among climate finance, climate policy and climate investors. The paper's implication is beneficial for green policy officials and for academics. The research suggests an avenue for further research about climate investors' handicap in accessing global climate finance and to further explore the logistics of establishing a Southern African based climate fund pool. It is anticipated that this recommendation should galvanise academic debate to develop the idea raised in this research.

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