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Exploring determinants of green finance in small island economies—case study of Fiji

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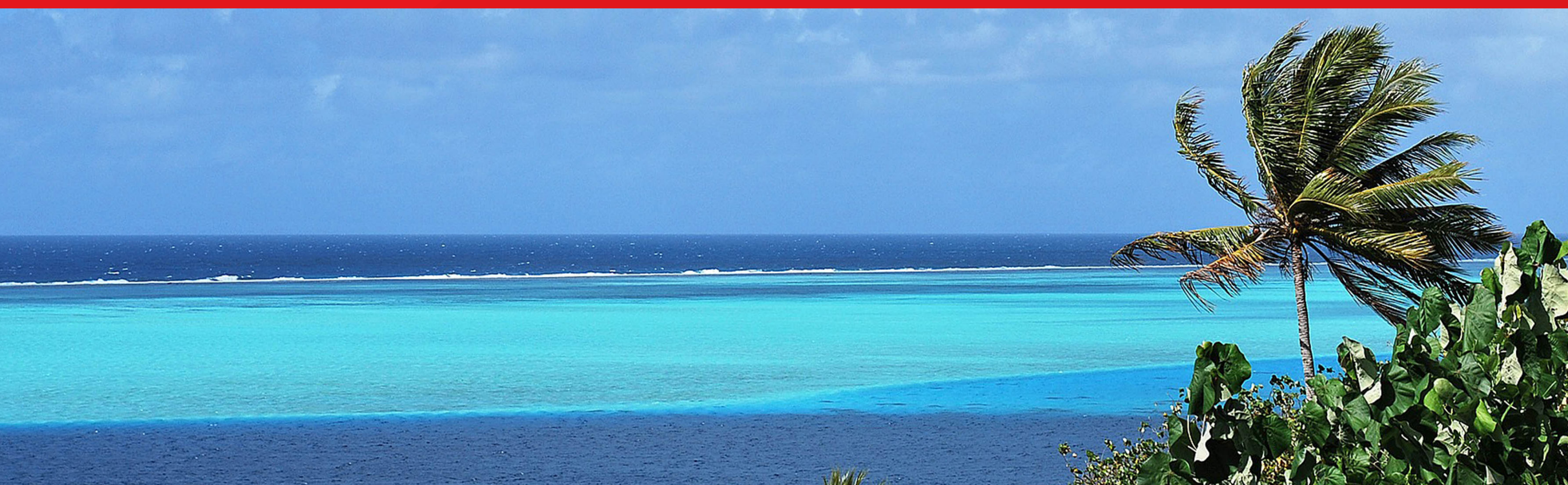

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Exploring determinants of green finance in small island economies—case study of Fiji

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Abstract

Advancing the green or sustainable finance agenda has gained global attention as, aside from COVID-19 recovery, many economies have also battled with ongoing climate change risks. The pace and scale of transitioning towards a sustainable or greener economy vastly differs by country and region. This paper attempts to examine the determinants of green finance (GF) i.e. gross domestic product (GDP), capital formation (CAPT), interest rate (Ir) and mineral fuel prices (FP) in small island economies such as Fiji, covering the period between 1990-2020. This paper utilises the time-series Vector Error Correction Model (VECM) approach via stationarity test, cointegration test, stability test and Granger causality Test. Impulse response function and variance decomposition have also been generated to explain the shock amongst the variables. The results show an unidirectional relationship among the independent variables in the short run (GDP impacts mineral fuel prices, subsequently capital formation and mineral fuel prices influence interest rates) as indicated by the Granger-cause results. Taking into account a long-term relationship, mineral fuel prices move negatively towards green finance or investment in renewable energy. The implication of this study is that, the increase in mineral fuel prices does not necessarily stir the demand for green finance or investment in renewable energy in the long-run.

Keywords: Gross domestic product (GDP), Capital formation (CAPT), Interest rates (IR), Fuel prices (FP), Vector Error Correction Model (VECM) and Impulse response function

1. Introduction

In this paper, we examine the potential determinants of green finance/investment that is, real gross domestic product, capital formation, interest rate and fuel prices in Fiji. Like other small island developing states (SIDS), Fiji would require extensive climate finance sources to meet long-term adaptation needs and work towards sustainable economic growth. There are rarely any studies in the Pacific region to highlight the macroeconomic factors that drive SIDS (such as Fiji) transition towards green finance[1]/green investment. Climate change threatens the key function of a central bank—ensuring monetary and financial stability. In 2016, one third of the value of Fiji's GDP was wiped out in 36 hours by severe category 5 Tropical Cyclone Winston.[2] Hence, the Reserve Bank of Fiji (RBF) recognised that climate-induced disasters such as TC Winston can set Fiji's economy back or roll back important development gains. This can also threaten its key function as a central bank via enormous shocks to monetary and financial stability.

Global investment requirements for addressing climate change are estimated in trillion of US dollars, with investments in infrastructure alone requiring about $6 trillion per year up to 2030 (OECD, 2017).[3] At the 26th United Nations Climate Change Conference of Parties (COP26) that was held in Glasgow in 2021, world leaders recognised the centrality of a sustainable recovery from COVID-19 and solidarity with vulnerable parties on global efforts to tackle climate change. While countries have reaffirmed their ongoing commitment to key principles from the Paris Agreement (PA)[4] and previous COPs such as limiting global temperature rises to 1.5 degrees, it was noted that the long-term finance pledged by developed countries—originally set at US$100 billion per year to deliver the goals of the PA by 2020 (next timeline will be by 2025)—have not been met.

SIDS such as Fiji remain the most vulnerable to the effects of climate change and recurring natural disasters. Hence many SIDS have made strong commitments towards climate action by enhancing their nationally determined contributions (NDCs)[5] and setting ambitious long-term, low-emission development strategies. According to the *Fiji Sovereign Green Bond Impact Report 2018*, Fiji will need an additional FJ$9.3 billion by 2028 to strengthen resilience to climate change. Similarly, in Fiji's NDC implementation roadmap which strives to eliminate 627,000 tonnes of CO_2 emissions annually by 2030, strategic investments in energy supply, energy demand and transportation sector will cost approximately FJ$6 billion.

The purpose of this paper is to explore the extent to which green finance/investment has evolved in small island economies such as Fiji, given the adverse climate change impact over the years—especially on the environment, livelihoods of people, economic activity and financial stability. While studies on investment policies in renewable energy, green banking and climate-related damages are abundant, studies that uncover the macroeconomic drivers of green finance for SIDS are limited, which this study seeks to discover.

A sneak peek into the literature has shown that green investment is boosted by economic growth—a sound financial system that is conducive to low interest rates and high fuel prices.[6] Some policy interventions such as the introduction of carbon pricing schemes or feed-in-tariffs which require the use of "green" energy, have a positive and significant impact on green investment while interventions, such as biofuel support, do not appear to be associated with higher green investment.

When considering policies that can promote renewable energy (as proxy for green investment), Azhgaliyeva, Kapsaplyyamova and Low (2018) revealed that fiscal and financial renewable energy policies can promote renewable energy however they are also costly for Governments. More specifically, feed-in-tariffs/premiums and loans are two of the most effective fiscal and financial policy instruments. Ganda, Ngwakwe and Ambe (2015), in their study on 100 South African carbon disclosure project (CDP) on the Johannesburg Stock Exchange (JSE), noted that profitability influences green investment practices in JSE listed firms. As a result, these listed firms have turned green programs into profit-generating business ventures.[7]

To test our hypothesis, we employed the log linear vector error correction model (VECM) to examine how national income (GDP), capital formation (CAPT), interest rates (Ir) and mineral fuel prices (FP) had impacted the total investment on green finance (GF). Green finance which is our dependent variable (proxied by: Total renewable energy investment—commercial bank and Government lending to renewable energy projects)—refers to Fiji's financial investment in renewable energy and is potentially influenced by several factors (independent variables) such as real GDP, capital formation, interest rates and mineral fuel prices.

A unit root test was carried out on each of the variables to determine their level of stationarity. A key feature of this model is that it allows us to test annual time series data over the period of 30 years (1990 to 2020) mainly to account for considerable observations. The analysis shot in the arm with the KPSS test of unit root test had identified the order of integration of the variables. This was followed by the cointegration test of long run relationship among the variables. Both the unit root test and the cointegration test met the preconditions of the VECM model for further analysis. In addition, the Granger causality was used to determine the direction of causality among the variables, the impulse response function and variance decomposition analysis was conducted for robustness of our analysis and also verified the result obtained from the VECM model.

Our main contribution/finding therefore is that in the VECM result, the increase in mineral fuel price (FP) does not necessarily stir demand for GF or investment towards renewable energy in the long run. From the various regression results, we discovered that the cointegration test confirmed the existence of long run relationship on annual data of the variables, while the Granger causality shows a unidirectional relationship amongst the explanatory variables—rather than with GF. Our econometric results have important implications for the design of policies that encourage investment in renewable energy or GF. That is, the negative correlation between fuel price and investment in renewable energy suggests that Fiji is still heavily reliant on crude oil for its infrastructure, transport and public utilities. More than 86 percent of the current investments in the energy sector (around FJ$81 million)[8] are supporting projects to expand the grid and improve electrification. While an expanded grid may improve the resilience of villages on many outer lying islands and reduce green-house gas emissions, most off-grid generation is provided by emission-intensive sources such as diesel generators and kerosene lamps.

Additionally, the national budget allocation for electrical grid extensions, Energy Fiji Limited's subsidy program and electrical project more than outweigh the allocation for renewable (solar) sources. This somewhat ties with the International Energy Agency's (IEAs) outlook for renewable power generation to include up to one-third of the total global energy mix by 2023, where crude oil still comprises a major component. This is mainly because oil is primarily used for transport fuels, petrochemicals and electricity generation whereas renewable sources of energy (solar, wind, etc.) are primarily used for electricity generation. Crude oil is a major commodity and a primary raw material for industry, whereas renewables cannot be either. This creates a fundamental economic difference where oil and renewable are not substitutes[9] especially in SIDS such as Fiji as per the outcomes of this study.

The structure of the remaining sections of this paper is as follows: Section 2 discusses the context of the study. Section 3 provides a literature review on the determinants of GF while section 4 considers the research gaps. Sections 5 presents the methodology and data. It also outlines the model specification along with estimation technique. Section 6 reports the empirical results while Section 7 provides conclusion and a discussion on policy implications.

2. Context of the study

In some studies, green finance (GF) is used interchangeably with green investment (GI) /green banking (GB) and can be referred to as all forms of investment or lending that take into account environmental impact and enhance environmental sustainability. A key element is sustainable investment and banking, where investment and lending decisions are made on the basis of environmental screening and risk assessment to meet environmental sustainability standards.[10] In the Pacific region, SIDS—such as Fiji and its neighbouring islands—are some of the adversely affected countries in the world associated with the impacts of global carbon dioxide emissions and climate change-related catastrophes that decelerate economic growth and are therefore a potential threat to financial stability.

In light of these adverse circumstances, the RBF have assured its commitment to develop GF/sustainable finance and build resilience, supported by its policies on Financial Inclusion and climate change Initiatives which are aligned with RBF's mandate and Fiji's national development plans.[11] This is also linked to the nation's Financial Sector Development Plan 2016-2025 which recognises the need to support GF.

Throughout the last decade the RBF have witnessed and contributed to the achievement of a number of sustainable finance milestones including the issuance of Fiji's first sovereign green global bond, the introduction of unconventional monetary policies that support sustainable finance initiatives, the development of Fiji's first parametric climate insurance product and its international green finance commitments.

As a member of the Sustainable Banking and Finance Network (SBFN), the RBF co-hosted its first ever Sustainable Finance Initiatives Workshop, in September 2017 where the drafting of Fiji's Sustainable Finance Roadmap (SFR) commenced. The SFR which aims to guide the financial sector's transition to a green economy has been reprioritised with current efforts focussing on intensive capacity building regarding sustainable finance for the regulators, licensed financial institutions and relevant stakeholders. After which the SFR will be refined and aligned to the nation's most recent Climate Change Act (CCA). The CCA 2021 is a necessary framework that is developed to meet Fiji's international obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the PA.

Hence, financial sector regulators such as RBF play a crucial role in implementing the PA, specifically of the long-term goal in Article 2.1(c) to make financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. This is aligned with the need to look at all finance flows—public, private, local and abroad—in ensuring the transition to a carbon neutral and climate-resilient world.

While supervisory responses to climate change in the financial/banking sector are still in its early phases of development—especially for SIDS such as Fiji and its neighbouring small islands in the Pacific—milestone achievement towards climate change mitigation and adaptation have gained support from international investors. That is, the successful issuing of the green bond in October 2017 marked an historic moment for Fiji as the first emerging economy to offer a sovereign green bond, not only gaining recognition with the prestigious Green Bond Pioneer Award at the 2018 Climate Bonds Initiative Conference in London but also paved way for listing on the London Stock Exchange International Securities Market in April 2018.

Fiji is fortunate that the Government takes an active role in policy-setting to support climate change mitigation and adaptation efforts (which is beyond the scope of this study and may require a separate paper itself), this study will mostly focus on the RBF's (central banks) as well as financial institutions role towards green/sustainable finance.

3. Literature review

Before reviewing the literature on green finance (GF), we begin with a brief discussion on the role of finance in economic growth. We then consider climate change as a threat to financial stability and development in SIDS such as Fiji and extend this by looking at the commitments to the PA as well as the Sustainable Development Goals (SDGs). We then review the evolution and literature concerning the role and determinants of GF.

3.1 Role of finance in economic growth

Basically, financial institutions allocate private and public savings across firms and individuals. In the economic literature, there is varying perspectives on the role of finance towards economic growth. While there is ample empirical evidence that the financial system have some long-run relationship with economic growth[12] some studies hold contrasting views on the theoretical relationship between finance and growth.[13]

Some researchers highlight that the relationship between finance and growth varies across countries with no clear pattern regarding location, level of economic development and institutional features.[14] More particularly, Papaioannou (2007) gathered evidence that even the mechanism whereby finance affects growth differs with the degree of development.[15] For instance, in underdeveloped and emerging economies, financial development boosts aggregate growth via reducing the cost of capital whereas in advanced economies, it raises total factor productivity.

3.2 Climate change and the role of finance

Currently, there is wide consensus that the severity and frequent occurrence of climate change events is associated with the human-induced greenhouse gas emissions via fossil fuel combustion and changes in land use. Increasing temperatures reduce economic output in countries with hot climates by lowering productivity, investment and labour supply.[16] At the same time, the transition to a low-carbon emission society will require huge investments in alternative renewable energy sources mainly because green technologies such as wind turbines or solar panels are capital-intensive.[17]

The 2019 Financing for Sustainable Development Report (FSDR)[18] of the Inter-agency Task Force on Financing for Development forewarned that mobilizing sufficient financing remains a major challenge in implementing the 2030 Agenda for Sustainable Development. Despite signs of progress, investments that are critical to achieving the SDGs remain underfunded and parts of the multilateral system are under strain. The International Energy Agency (IEA) has estimated that up to US$53 trillion of investment is required by 2035 to meet projected energy demand within a credible emissions framework.[19] Global investment requirements for addressing climate change are estimated in trillions of US dollars, with investments in infrastructure alone requiring about US$6 trillion per year up to 2030.[20] Most of these investments are likely to be intermediated through the financial system.

Outcomes of the IEA 2022 World Energy Investment Report revealed that clean energy spending in emerging and developing economies (excluding China) remains stuck at 2015 levels. A key factor is that investment in many emerging and developing economies is more dependent on public sources where state-owned enterprises account for around half of energy investment in these economies. But public funds are typically scarce, many state-owned utilities are highly indebted and a worsening global economic outlook reduces governments' ability to fund energy projects. Of the stimulus spending mobilised to support a sustainable recovery, more than 90 percent remained in advanced economies. Furthermore, the report noted that the high costs of capital and rising borrowing costs threaten to undercut the economic attractiveness of capital-intensive clean technologies where an increase of 2 percentage points in the cost of capital for solar PV and wind can lead to a 20 percent increase in overall levelised costs.

Sancken (2020) noted that climate change poses an existential threat to small island developing states (SIDS) that are at risk of losing their territories to sea-level rise and severe weather events.[21] That is, these SIDS must make decisions about how to preserve their sovereignty and create a meaningful future in the face of imminent territorial loss. Global adaptation finance exists for short-term measures to preserve habitability, but long-term adaptation measures—like elevating existing islands, building artificial ones, or planned resettlement—are critically underfunded. Thus, SIDS are exposed to the inadequacy of existing climate finance sources to meet their long-term adaptation needs.

Like many other SIDS in the South Pacific, Fiji is vulnerable to the effects of climate change. In recent years, the country has experienced extreme weather events, such as cyclones, floods and drought, and rising sea levels have jeopardised the stability of coastal life. The intensity of these events has increased dramatically, with saltwater intrusion affecting water supplies and agriculture and displacing communities. For the Government, tackling these issues is an expensive undertaking. Although Fiji has always been vulnerable to extreme weather events, such as tropical cyclones and inland flooding, climate change is projected to increase the frequency and severity of these events. Fiji's recent experience with cyclones suggests that such events pose a significant, ongoing threat to Fiji's development potential.

Over the last decade, Fiji has sustained continued economic growth, including an average growth of 5.0 percent from 2013 to 2015. Similarly, its total gross domestic product increased from FJ$6.02 billion in 2010 to FJ$11.56 billion in 2018. This occurred despite Tropical Cyclone (TC) Winston, which hit as a severe category 5 standard storm in February 2016 and wiped out one-third of the value of Fiji's GDP in 36 hours. Fiji's economy was projected to have a broad-based growth of 3 percent in 2020, up by 0.4 percent compared to 2016, when TC Winston severely damaged the country, but instead it had contracted significantly due to the global coronavirus pandemic. Fiji's international borders were closed for more than a year and this also meant shutting down the nation's international tourism sector, which accounts for 40 percent of Fiji's GDP. Without the vital revenue from tourism, domestic climate finance is projected to have fallen by at least by 30 percent, and the economy is estimated to have contracted by 17 percent in 2020 and remain constrained until global tourism returns to pre-pandemic levels.

In the aftermath of TC Winston, the RBF recognised that climate-induced disasters can set an economy back and threaten to roll back important developmental gains. It also considered the prospect of an even worse case scenario: that climate change could threaten the key function of the central bank to ensure monetary and financial stability. If another major cyclone were to hit Fiji and its main industries and businesses were to close for a prolonged period, food security would become an issue, or imports and exports stalling and the ability of the RBF to maintain adequate levels of foreign reserves and keep inflation low would be affected. Loan repayments would perhaps need to be rescheduled and there could be an increase in non-performing loans. The flow-on effect on downstream industries in the value chain could exacerbate this situation.

Despite some pick-up noted in the third quarter of 2022, underpinned by increased visitor arrivals, it is anticipated that the economy will not return to pre-Covid level until 2024 as there has been permanent economic scarring, given the cumulative contraction of 22.1 percent over the last two years. There are also significant downside risks to the outlook, especially on the global front, such as ongoing geopolitical tensions and their impact on food and energy prices, inflation-induced monetary policy tightening in advanced economies, the associated appreciation of the US dollar, coupled with the heightened risk of a global recession. Domestically, climate change and natural disasters continue to remain inherent risks to the growth outlook.[22]

While Fiji's Climate Change Act (CCA) was passed in Parliament in September 2021, legal requirements of the Act[23] have yet to commence as the national authorities are currently liaising with relevant stakeholders in developing guidelines that will assist the implementation of the PA and align Fiji's updated NDCs[24] accordingly. Fiji's National Climate Finance Strategy (NCFS) which was recently launched on May 2022 is well aligned with the CCA and lays out the nation's main investment priorities for cultivating a climate-resilient, low-carbon economy from 2022 to 2029. It will be the climate finance blueprint for the Government and its development partners. That is, Fiji will not likely be expected to reduce emissions simply for the sake of reducing emissions unless economically favourable and linked to activities that specifically build resilience. This is also anticipated to guide the Reserve Bank of Fiji's future climate-related policies and supervision for the financial sector.

3.3 Role of green finance

The central focus of this study is to provide a motivation for the role of green finance. International recognition of the importance of the financial sector in delivering an orderly transition to a cleaner, more resilient economic growth and delivering global climate and environment objectives has led to the rapid growth of green finance globally.

There is consensus that financial resources need to be mobilised towards low-carbon, climate-resilient activities to achieve a greener world.[25] The pace of green capital accumulation has accelerated in recent years, mainly driven by technological progress, economies of scale, strong policy support and favourable public opinion at large. Green program had also gained importance amongst national fiscal stimulus plans during the 2008-2009 global financial crisis.

Over the past several years, there have been encouraging developments including significant advances in mobilising and mainstreaming green finance (GF) within financial institutions and financial markets. The PA which was established in 2015, re-iterated the need to mobilise significant funding from public and private sources to finance its investment requirements. This indeed marked a huge opportunity for GF. However, GF currently remains marginal to overall finance flows and rather inadequate for global needs. In the same year that the PA was adopted, the SDGs were also adopted by the United Nations (UN) and these are common goals for the international community targeted to be achieved by 2030, mainly aimed at the creation of a sustainable society through partnerships with diverse stakeholders. According to the UN Intergovernmental Panel on Climate Change (IPCC) 2019 Special Report, the transition to a low-carbon economy is expected to have a profound impact on the international economy and its financial systems.[26]

Article 6 of the PA recognised that countries can pursue voluntary cooperation in the implementation of their NDCs to allow for higher mitigation ambition and to promote sustainable development. More specifically, Article 6.2 of the PA outlines the possibility of cooperative approaches and the transfer of internationally transferrable mitigation outcomes (ITMOs) between different actors, including countries and private sector companies, through bilateral agreements such as those undertaken between Ghana, Vanuatu and Switzerland.[27] Closer to home—in Vanuatu—the implementation of a rural electrification project where the Department of Energy will partner with the Vanuatu National Green Energy Fund and enable the country's population currently without electricity to have access to reliable, affordable electricity through solar power. The United Nations Development Fund is supporting such co-operative approaches via designing and implementing projects under

Article 6.2 mechanism through its Carbon Payment for Development Facility (CP4D) which aims to leverage carbon markets so as to enable private investments in support of the SDGs. The CP4D is capitalised with US$125 million to allow for the implementation of more than 6 million ITMOs between 2022 and 2030.[28]

Financial institutions can help to move a country towards a low-carbon, climate-resilient economy by providing green financial products and services, financing technologies as well as practices that benefit the environment. The outcomes of a survey amongst 18 central banks in Asia and the Pacific that was conducted by the Asian Development Bank Institute in 2019 revealed that majority of these central banks envisioned that they should be playing a key role in promoting green finance and sustainable funding options either through adjusting the regulatory framework, encouraging green loans and products or introducing climate change considerations in their monetary and financial policy operations.

Fiji's Financial Sector Development Plan 2016–2025 aligns financial sector development with the Government's national development plans and the pursuit of the SDGs and GF. As part of the implementation, the RBF has institutionalised its work on financial inclusion and climate change. The Financial System Development Group (FSDG) is a separate department within the RBF that, in addition to other work, is responsible for financial inclusion and sustainable/green finance related development areas.

The RBF has also been a global champion for financial inclusion and climate change as a member of the Alliance for Financial Inclusion (AFI). As host of the 2016 AFI Global Policy Forum (GPF) in Nadi, the RBF made commitments under the Maya Declaration "to work with partners in developing and promoting sustainable business models to support communities' response to climate change". This was embedded in the NFIS 2016-2020. Additionally, at the 2019 GPF in Egypt, the Bank also endorsed the Sharm El Sheik Accord on Climate Change. Most recently, the new NFIS 2022-2030 have dedicated a special pillar on inclusive finance where, amongst its other strategic actions, have anticipated the need to develop and implement guidelines for inclusive green finance—such as national green finance taxonomies. That is, the need to establish a common definition for green and sustainable finance so that all stakeholders are able to understand, measure and price climate related risks accordingly. Furthermore, the new NFIS also plans to promote the design and implementation of financial products and services—such as credit lines, credit guarantee funds, savings solutions, remittances and insurance—for vulnerable segments (women, rural communities, youths, people with disabilities as well as micro and small business entrepreneurs) towards environmentally sustainable activities, adaptation to climate change and response to shocks. These commitments and endorsements mark RBF's dedication and commitment in the international arena and also drives its green finance development strategies.

Pacific Small Island Developing States (PSIDS) contribute negligibly to global emissions. Yet, under the PA, PSIDS have submitted highly ambitious conditional NDCs[29]. Fiji, for one, has conditionally committed to generating 100 percent of its electricity from renewables and to curbing overall emissions from the energy sector by 30 percent by 2030.[30] Meeting such national emissions reduction targets in the energy sector alone will require an estimated US$ 2.97 billion between 2017–2030, an amount which will need to flow from both private and public sources.[31] If Fiji chooses to not do anything then the nation will have to face the brunt of climate change with the cost of US$250 million annually, representing 5 percent of our GDP.[32] This has somewhat reshaped and renewed research interest on GF in Fiji particularly the need to scale green investments/banking or lending in order to support climate finance and the transition to a low carbon economy.

3.4 What drives green finance?

Literature has shown several empirical studies on the determinants of GF. Amongst these is the study conducted by Eyraud, Wane, Zhang and Clements (2011).[33] The outcomes of their study revealed that green investment is boosted by economic growth, a sound financial system that is conducive to low interest rates and high fuel prices. Some policy interventions such as the introduction of carbon pricing schemes or feed-in-tariffs which require use of "green" energy, have a positive and significant impact on green investment while interventions, such as biofuel support do not appear to be associated with higher green investment.

Besides considering the determinants of GF on small island economies, there is rarely any studies on this in the Pacific region but we can note an interesting finding on climate change disclosure. While the Asia-Pacific region has been one of the major regions affected by climate change, results of the study conducted by Amran, Periasamy and Zulkafli (2014)[34], highlighted that the level of climate change disclosure by firms is still low in the sustainability reports. That is, firms that originated from developed and advanced countries show consistent sustainability reporting in comparison with emerging-market countries in Asia Pacific. Some emerging market economies show high-quality disclosure in their sustainability reports, which is due to the regulations imposed in their country.

Ganda, Ngwakwe and Ambe (2015) in their study on 100 South African Carbon Disclosure Project (CDP) on the Johannesburg Stock Exchange (JSE)[35], noted that profitability influences green investment practices in JSE listed firms. As a result, these listed firms have turned green programs into profit generating business ventures. Schaltenbrand, Foerstl, Kach and Maier (2015) demonstrated that German and US managers respond differently to external pressures in their green investment decisions. Regarding the scope of green investments, German and US managers invest differently if end consumer pressure increases and partially differently if resource scarcity increases, but they act in a similar way if community pressure increases.

When considering policies that can promote renewable energy (as proxy for green investment), Azhgaliyeva, Kapsaplyyamova and Low (2018)[36] revealed that fiscal and financial renewable energy policies can promote renewable energy however they are also costly for Governments. More specifically, feed-in tariffs/premiums and loans are two of the most effective fiscal and financial policy instruments.

4. Research gaps

The economic literature on GF as well as climate change rarely looks at the macroeconomic determinants of GF. Most studies have focused on the design of policies to curb greenhouse gas emissions, emphasising the costs and benefits of limiting environmental damage.[37]

Some studies have looked at the determinants of energy-saving innovations at the firm level[38] or at the sector level.[39] Others have examined the determinants of low-carbon investment at the manufacturing firm level.[40]

Several researchers have highlighted the drawbacks of using cross-section models in their studies as such models are not able to account for time dimensions. That is, Chen (2008) was not able to observe the dynamic change of green core competence in the process of the development of the information and electronics industry in Taiwan. Similarly for Chuang and Huang (2018), despite of their results showing that investment of green IT has a positive influence on business competitiveness, its mediating effect on the relationship between environmental corporate social responsibility (ECSR) and business competitiveness was not fully supported, as it was difficult to make their causal interpretation.[41]

Thus, Singh (2016) suggested the use of panel data models as it combines both cross-sectional and time-series data. More importantly, it takes a longitudinal account of the association among the model series. As such, panel data models seem to reduce the model mis-specification problem wherein the individual-specific effects allow for unobservable heterogeneous factors—such as economic growth, country size, government policy reaction, population etc across different countries or regions, while the time-specific effects account for time-varying factors such as business cycles.[42]

Chen (2010) suggested that companies develop green banking in order to comply with environmental pressures, obtain competitive advantages, improve corporate image, seek new market opportunities and enhance their product value. However, he does not actually test the relationship between green banking and green image as his study mainly focused on information technology products rather than the banking sector.[43]

Petruzelli, Dangelico, Rotolo and Albino (2011) investigated whether and to what extent green innovations significantly differ from non-green ones in terms of inter and intra-organisational relationships leading to their development and technological characteristics as complexity and novelty.[44] The gap in their study lies in their sample size/period where the patent data collection stops in 2004 in order to have each patent with an equal time window of 5 years to be cited. Such approach does not account for the increasing policy interest towards sustainability issues, characterising recent years. Furthermore, not all possible organisational factors and technological features that could play a relevant role in the innovation development process have been considered—for instance through patent analysis, the authors were only able to study intra-organisational collaborations but were not able to evaluate the extent to which such collaborations were cross-functional. Perhaps, other indicators of innovation could be considered in future studies such as new products, especially in low-tech industries where patents do not represent a suitable proxy to capture innovative dynamics.

Schaltenbrand, Foerstl, Kach and Maier (2015) suggested that green investments are important mechanisms for translating green operation strategies into managerial action.[45] The study revealed that German and US managers respond differently to external pressures in their green investment decisions. In terms of the scope of green investments, German and

US managers invest differently if end consumer pressure increases and partially different if resource scarcity increases, but they act in a similar way if community pressure increases. However, the study did not control for the possibility that managers in the sample could work in multinational firms, even though such factors are known to be important determinants in environmental studies. Secondly, corporate green investments are affected by other factors that are not captured in the study, for instance, the authors controlled—e.g. industry, firm size and firm performance as part of the baseline scenario. Relaxing these aspects of the model may provide further insights into managerial green investment pattern. Further research can focus on more understanding of differences among countries and also how different green investment patterns are realised and applied in the manufacturing environment/other priority sectors in the economy.

When considering the effects of managerial experience on corporate green investments, Schaltenbrand, Foerstl, Azadegan and Lindeman (2018) noted that managers' years of experience, their employers' financial and market performance have greater bearing on managers' investment decisions under new and different set of circumstances.[46] The study had measured green investments as a first-order construct whereas other studies have applied formative measurement of GI as a dependent variable. As a means of developing a unified approach, the study could have further evaluated the effect of green investment operationalization (reflective vs formative) or develop green investment scenarios with an optimal solution to study subjects and incentivise them on their proximity to the optimal solution—e.g. increasing donations to the world wildlife fund). Furthermore, the study had largely focused on large European firms, ideally sample including data from both emerging and developed country managers would allow for wider coverage of findings.

Azhgaliyeva, Kapsaplyyamova and Low (2018) suggested that loans and feed-in tariffs are effective policy instruments in promoting private investment in renewable energy.[47] The study is limited as it focuses on the determinants of green private investment, excluding investments such as smart technologies, energy storage and electric vehicles. Additionally, the study does not distinguish between domestic and foreign private investment in renewable energy so further studies on green investment can consider such issues.

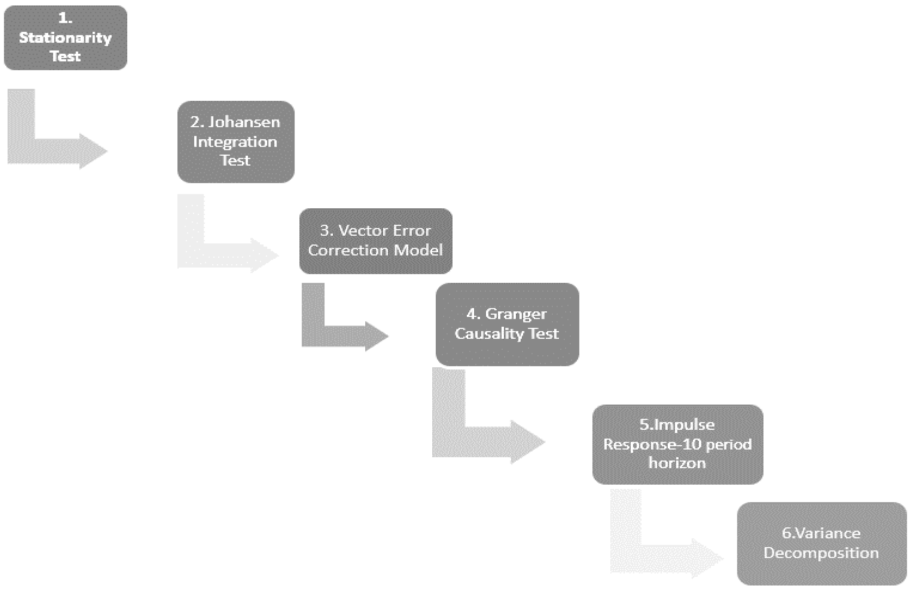
5. Data and methodology

5.1 Data

Time series data used in this study between the years 1990 and 2020 are sourced from the World Development Indicators and the Reserve Bank of Fiji Annual/Quarterly Reports.

5.2 Methodology

In this study the estimation techniques to examine the determinants of GF used the following method (illustration below): firstly, we use KPSS test for conducting the stationarity test of the variables, after which Johansen & Juselius (1990) cointegration test is employed to check if there is a long run relationship between the variables.[48]



The Schwarz Information Criterion (SC) was used to select the optimal lag length. Once the cointegration relationship amongst the variables was confirmed, a Vector Error Correction Model was estimated before proceeding to the Granger Causality tests. Then an impulse response function and the variance decomposition was also generated in order to explain the response to shocks amongst the variables.

5.2.1 Theoretical model

The identified model theoretically establishes the relationships between our independent variables and the dependent variable which hypothesise that green finance as a function of gross domestic product, capital formation, interest rate and mineral fuel prices. Hence, the equations below have been formulated and simultaneously analysed:

$$GF = f(GDP, CapT, Ir, FP) \quad 1$$

Specifying equation (1) in an exponential regression model, we have;

$$GF = \alpha GDP^{\beta_1} CAPT^{\beta_2} Ir^{\beta_3} FP^{\beta_4} e^{ut} \quad 2$$

In this form, the coefficients $\beta_1\beta_2\beta_3\beta_4$ can be directly estimated by applying log-linear regression techniques via logarithmic transformation; and those coefficients will be the elasticities. Taking natural logs of both sides of the equation, we have:

$$\log GF = \log \alpha + \beta_1 \log GDP + \beta_2 \log \text{CAPT} + \beta_3 \log \text{Ir} + \beta_4 \log \text{FP} + u_t \qquad 3$$

Where;
α = is the autonomous parameter (or the intercept)
GF= represent green finance
GDP = represent real gross domestic product
CAPT = represent capital formation
Ir = represent long term real interest rate
FP = represent mineral fuel price
u_t= represents the stochastic error term

Dependent variable

GF: (proxied by: Total Renewable Energy Investment—commercial bank and Government lending to renewable energy projects)—Fiji's financial investment in renewable energy is potentially influenced by several factors (independent variables) such as: national income, capital formation, interest rate and mineral fuel prices.

Independent variable

GDP: Economic growth and income level—expectation that economic activity (in this study is proxied by national income- real gross domestic product (GDP)) can stir demand for energy and investment in the energy sector. According to the Environmental Kuznets Curve (EKYC) —at higher levels of development, structural change towards information-intensive industries and services, international relocation of manufacturing industries, increased environmental awareness and better enforcement of environmental regulations can result in larger environmental expenditures and a gradual decline of environmental degradation. While this is debatable, several authors have stated that while increases in GDP can be associated with worsening environmental conditions in poor countries, economic growth tends to be connected with lower pollution once a critical level of income is reached.[49]

CAPT: Technological progress and innovation (proxied by: Investment-gross fixed capital formation—CapT)—The expansion of GF has also been made possible by innovation. For instance, new techniques to store energy have fostered the use of intermittent energy sources, like solar or wind power. We expect GF to be positively related to R&D spending and human capital variables.

Ir: High interest rates reflect the relative scarcity of financing and tend to reduce investment. Renewables can be particularly sensitive to interest rates because the bulk of the cost of producing renewable energy is upfront, and because their capital intensity is generally high compared to traditional technologies. We expect a negative relationship between interest rates and GF.

FP: Cost of fossil energy sources—proxied by mineral fuel imports (FP) in this study—High fossil energy prices are expected to foster GF, not only because GF proxy encompasses investment in other renewable energy (biomass/biofuel) industry, but also because higher fuel prices lower the cost of the electricity produced from renewables and nuclear power relative to that generated through fossil fuel combustion. This effect is reinforced when carbon emissions are taxed. Newell, Jaffee, and Stavins (1999) show that oil price hikes boosted innovations in green technologies that made air conditioners more energy efficient. More polluted or energy-dependent countries may face stronger incentives to invest in green technologies.[50]

5.2.2 Stationarity test

It is important to note that the level at which time series variables change overtime are different from each other. Therefore, examining the linear relationship between those variables will lead to some issues. Such issue is called stationarity problem. Stationarity of a series is an important phenomenon because it can influence its behaviour. Considering a simple model:

$$Y_t = Y_{t-1} + U_t \qquad 5.1$$

Y_t is non-stationary when the mean, variance and covariance are not constant overtime. Hence, there is a need to apply differencing operator (Δ) to it. In a non-stationary series, Y_t must be differenced d times before it becomes stationary, then it is said to be integrated of order. We write $Y_t \sim I(d)$. Therefore I(0) means the series is stationary at level, I(1) means the series is stationary at first difference and I(2) shows a stationarity of a series at second difference or integration of order (0), (1) and (2) respectively.

Three standard procedures of unit root test namely the Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests have been commonly used in literatures. In this study, we have used KPSS to test the stationarity of the variables.

5.2.3 Johansen Integration Test

If two or more series are individually integrated (in the time series sense) but some linear combination of them has a lower order of integration, then the series are said to be cointegrated. This study uses two tests to determine the number of cointegration vectors: the Maximum Eigenvalue test and the Trace test.

The Maximum Eigenvalue statistic tests the null hypothesis of r cointegrating relations against the alternative of r t1 cointegrating relations for r= 0, 1, 2…n-1.
Such test statistics are computed as:

$$\text{LRmax}\ (r/n+1) = \text{-T*log}(1-\lambda) \qquad 5.2$$

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

On the other hand, Trace statistics investigate the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations, where n is the number of variables in the system for r=0,1,2…n-1. Its equation is computed according to the following formula:

$$\text{LR}_{tr}\ ((r/n) = \text{-T*}\sum_{i=}^{n} r+1 \qquad \log(1-\pi i) \qquad 5.3$$

In some cases, the Trace and Maximum Eigenvalue statistics may yield different results. In this case, the results of the Trace test should be preferred.

5.2.4 Vector Error Correction Model (VECM)

A vector error correction model is a way to model nonstationary variables that appear to converge to a long-run cointegrating relationship. In the VEC model the adjustment parameters show how each variable deviates in the short-run from the long-run equilibrium relationships given by the cointegrating vectors. Therefore, to study both the short-run and the long-run dynamics between them one should estimate a VEC model and make inferences using this system. A vector autoregression (VAR) model of order p with n variables can be represented by the following equation:

$$Y_t = a_1Y_{t-1} + a_2Y_{t-2} + \ldots\ldots + a_pY_{t-p} + \beta X_t + \mu_t \qquad 5.4$$

Where Y_t is an (*nl*) vector of endogenous variables, X_t is an (*ml*) vector of deterministic terms, β is an (nm) matrix of coefficients on the deterministic term, *a*/s for ɩ = 1, 2…*p* are (nm) matrix of autoregressive coefficients, and an (*nl*) vector of non-autocorrelated disturbances (innovations) with zero mean and contemporaneous covariance matrix E$(\varepsilon t\ \varepsilon t)$= π

The Var(*p*) model defined in the above equation 6.4 can be appropriately reparametrised as:

$$\Delta Yt = \Omega\, Yt - 1 + \sum_{i-1}^{p-1} \Omega i \Delta\, Y_{t-1} + \beta Xt + \mu_t \qquad 5.5$$

Where now:

$$\Omega = \text{-(I -}\sum_{i=1}^{p} a \text{ and } \Omega\text{i} = \sum_{k=i+1}^{p} a\ t$$

are (*n x n*) matrix of coefficients and I is an (*n x n*) identity matrix.

The rank of matrix **Ω** equals to the number of independent cointegrating vectors. The rank of this matrix (denoted by *r*) could be between 0 and n. If rank of matrix **Ω** is equal to 0, all of the n variables are unit root processes and are not cointegrated. In such case, the VAR should be solely specified in first differences. It is clear from this discussion that, a VAR model in first differences should not be estimated unless there are no cointegrating relationships between the I(1) variables involved. At the other extreme, if rank of **Ω** equals to *n*, then the VAR model consists of all stationary variables. In the interim cases, where the rank **Ω** of is between 1 and (*n*-1), there are multiple cointegrating vectors. In this last case, it is appropriate to work with the vector error correction model (VECM) formulation of the VAR model given in equation 5.5.

Therefore, this paper employs a Vector Error Correction Mechanism technique after cointegration has been established among the variables. The VECM is adopted to estimate the effects of national income, capital formation, interest rate and mineral fuel prices on GF in Fiji. According to Ang and McKibbin (2007), once the variables are cointegrated; it becomes easy to distinguish between the short-run dynamics and long-run relationship. The estimation is conducted using the econometric software package, E-views version 9.5. Annual time-series spanning: 1990 to 2020 are adopted. This is to ensure enough data points to cater for loss of degree of freedom.

5.2.5 Granger Causality Test

A simple definition of Granger Causality, in the case of two time-series variable, *X* and *Y* is: "*X* is said to Granger-cause *Y* if *Y* can be better predicted using the histories of both *X* and *Y* than it can by using the history of *Y* alone."

We can test for the absence of Granger causality by estimating the following VAR model:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \ldots. + \alpha_p Y_{t-p} + b_1 X_{t-1} + \ldots. + b_p X_{t-p} + \mu_t \qquad 5.6$$

$$X_t = c_0 + c_1 X_{t-1} + \ldots. + c_p X_{t-p} + d_1 Y_{t-1} + \ldots. + d_p Y_{t-p} + v_t \qquad 5.7$$

Then, testing H_0:$b_1 = b_2 = \ldots. = b_p$, against H_1: 'Note H_0', is a test that *X does not* Granger-cause Y.

Similarly, testing H_0:$d_1 = d_2 = \ldots. d_p = 0$, against H_1:'Note H_0', is a test that *Y does not* Granger-cause X. In each case, a rejection of the null implies that there is Granger causality.

6. Empirical results and discussion

6.1 Unit root test

Table 1: Unit root test results

	INTERCEPT	TREND & INTERCEPT
STATIONARY @ LEVEL		
GF	0.374566***	0.125160***
GDP	0.655670***	0.128616***
CAPT	0.708893**	0.146775***
Irate	0.606876**	0.099571
FP	0.627880**	0.165112**
STATIONARY @ 1ST DIFFERENCE		
GF	0.081372*	0.066223*
GDP	0.165612*	0.115046*
CAPT	0.303205*	0.330230
Irate	0.482759	0.500000
FP	0.309794*	0.208788*
STATIONARY @ 2ND DIFFERENCE		
CAPT	0.129256*	0.127789*
CRITICAL VALUE		
10%	0.347	0.119
5%	0.463	0.146
1%	0.739	0.216

*Author's computation. Notes: *** indicates rejection of the null of stationary at 10% level of significance, ** indicates rejection of the null of stationary at 5% level of significance, * indicates rejection of the null at of stationary at the strongest 1% level of significance.*

From Table 1, the results of the KPSS techniques of unit root test shows that all the variables in the model are not stationary at level at both intercept and considering trend and intercept. In other words, the null hypothesis of stationary of the variables at levels can be rejected and the acceptance of the alternative hypothesis of the non-stationarity of the data at level. Further application of KPSS on the first difference as well as the second difference shows that the null hypothesis of stationarity of the variables cannot be rejected. It then means that the data are integrated of order one, I(1).

6.2 Lag selection criteria

The Schwarz Information Criterion (SC) was used to select the optimal lag length. Based on the SIC, it was found that 4 lags are optimal. SC is used for model selection such as determining the lag length of a model, with smaller values of the information criterion being preferred.

Table 2: Lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1969.984	NA	2.36e+57	146.2951	146.5351	146.3665
1	-1900.348	108.3237*	8.98e+55	142.9887	144.4285	143.4169
2	-1880.830	23.13272	1.67e+56	143.3948	146.0344	144.1797
3	-1846.555	27.92716	1.59e+56	142.7078	146.5473	143.8495
4	-1773.760	32.35336	2.60e+55*	139.1647*	144.2068*	140.6659*

* indicates lag order selected by the criterion
LR: Sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

6.3 Cointegration test results

Table 3: Cointegration test result at 5% level of signifcance

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.948606	152.9239	69.81889	0.0000
At most 1 *	0.719450	72.78161	47.85613	0.0001
At most 2 *	0.557172	38.46453	29.79707	0.0039
At most 3 *	0.420634	16.47106	15.49471	0.0356
At most 4	0.062200	1.733906	3.841466	0.1879

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesised No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.948606	80.14225	33.87687	0.0000
At most 1 *	0.719450	34.31707	27.58434	0.0059
At most 2 *	0.557172	21.99348	21.13162	0.0378
At most 3 *	0.420634	14.73715	14.26460	0.0421
At most 4	0.062200	1.733906	3.841466	0.1879

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

With the unit root result depicted in Table 1, there is a clear indication that all the variables are integrated of the same order therefore an indication of a possible long run relationship among the variables. This suggests the need for conducting a cointegration test, a test to confirm the existence of long run relationships among the variables. The Johansen-Juselius maximum likelihood procedure was applied in determining the cointegrating rank of the system and the number of common stochastic trends driving the entire system. We report the trace and maximum Eigen-value statistics and its critical values at both one percent and five percent in table 3. The result of the multivariate cointegration based on Johansen and Juselius cointegration technique reveal that both trace and maximum Eigen statistic shows four cointegrating equations at 5 percent level of significance. These results suggest that the appropriate model to use is the VECM specification with more than one cointegrating vector in the model.

6.4 Vector Error Correction Model (VECM) framework

The presence of cointegration between the variables suggest a long term relationship among the variables under consideration; hence the long run relationship between green finance, gross domestic product, capital formation, interest rate and mineral fuel prices for SIDS such as Fiji in the period 1990-2020 is displayed below, standard errors in ( ) and t-stat in [ ] .

$$LGF_{t-1} = 0.4517\ GDP_{t-1} + 2.0354\ CAPT_{t-1} + 0.0365\ IR_{t-1} - 1.2859\ FP_{t-1} - 10.1113$$

s.e	(0.7089)	(0.6147)	(0.1470)	(0.1944)
t-stat	[0.6371]	[3.3114]	[0.24825]	[-6.6142]

From the equation above, only 2 of the variables (GDP, CAPT) showed the correct signs/magnitude and were in line with theoretical underpinnings, that is, a 1 percent increase in GDP and CAPT is likely to increase investment in GF by 0.4517 and 2.0354 respectively in the long-run, unfortunately these changes were rather insignificant.

The other variable (FP) was significant but had the negative sign/magnitude. That is a 1 percent increase in mineral fuel prices is unlikely to foster transition towards green finance or investment in renewable energy/cleaner technologies. The negative correlation between fuel price and investment in renewable energy could very well support the evolution of the co-relation between crude oil and renewable energy[51] (Bonaire, 2015). That is, the case where crude oil and renewable energy are not direct substitutes, and therefore when the price of one increases, the demand for the other does not also increase. Since Fiji is still heavily reliant on crude oil for its infrastructure, transport and public utilities, the increase in oil prices will not necessarily stir the demand for sustainable/green finance or investment in renewable energy.

6.5 Granger Causality test results

As the cointegration test did not specify the direction of a causal relation, if any, between the variables, economic theory guarantees that there is always Granger Causality in at least one direction. After carrying out the cointegration and VECM, a notable issue is to determine causality between the dependent variable (GF) and the explanatory variables (GDP, CAPT, IR and FP).

Table 4 provides the results of pair wise analysis. Significant probability values denote rejection of the null hypothesis. This study rejects the null hypothesis if the probability is less than 1 percent, 5 percent and 10 percent level at most. Interestingly, it was found that there was no causal relationship between the dependent variable (GF) and the independent variables (GDP, CAPT, IR & FP) and vice-versa meaning that GF does not follow its mature counterparts in the short-run and vice versa. Moreover, these findings suggest that changes in the short term level of; economic activity (GDP), technological progress and innovation (CAPT), interest rates (IR) and mineral fuel prices (FP) does not impact GF in the short run and vice-versa. However, there was causal relationships amongst few of the independent variables. That is, there is unidirectional causality running from GDP to FP, implying that past values of GDP have a predictive ability in determining the present values of mineral fuel prices. Similarly, the past values of CAPT and FP have an ability in determining the present values of IR.

Table 4: Granger causality test result

Pairwise Granger Causality Tests Sample: 1990 2020 Lags: 2				
Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
GDP does not Granger Cause GF	29	1.20646	0.3168	Do not reject
GF does not Granger Cause GDP		2.33850	0.1181	Do not reject
CAPT does not Granger Cause GF	29	0.79808	0.4618	Do not reject
GF does not Granger Cause CAPT		0.82489	0.4503	Do not reject
IR does not Granger Cause GF	29	1.46220	0.2516	Do not reject
GF does not Granger Cause IR		0.62414	0.5442	Do not reject
FP does not Granger Cause GF	29	1.22575	0.3113	Do not reject
GF does not Granger Cause FP		0.49114	0.6179	Do not reject
CAPT does not Granger Cause GDP	29	1.92233	0.1681	Do not reject
GDP does not Granger Cause CAPT		0.81509	0.4545	Do not reject
IR does not Granger Cause GDP	29	1.37724	0.2715	Do not reject
GDP does not Granger Cause IR		1.31245	0.2878	Do not reject
FP does not Granger Cause GDP	29	0.33146	0.7211	Do not reject
GDP does not Granger Cause FP		4.55386	0.0211**	Reject
IR does not Granger Cause CAPT	29	0.03627	0.9644	Do not reject
CAPT does not Granger Cause IR		4.02395	0.0311**	Reject
FP does not Granger Cause CAPT	29	1.30762	0.2890	Do not reject
CAPT does not Granger Cause FP		0.01692	0.9832	Do not reject
FP does not Granger Cause IR	29	3.40357	0.0500***	Reject
IR does not Granger Cause FP		0.48683	0.6205	Do not reject

*Author's computation. Notes: *** indicates rejection of the null of "no granger causality" at 10% level of significance, ** indicates rejection of the null of "no granger causality" at 5% level of significance, * indicates rejection of the null at of "no granger causality" at the strongest 1% level of significance.*

6.6 Impulse response

The impulse response describes the reaction of the system as a function of time (or possibly as a function of some other independent variable that parameterises the dynamic behaviour of the system). It analyses dynamic effects of the system when the model received the impulse. In our VECM model, we have five variables, the responses between these variables are presented in Table 5. A ten-period horizon is employed to convey a sense of the dynamics of the system that is how far into the future we want to check the reaction of each of the variable with another. The first figure in Table 5 will be explained as the base of this study.

Table 5: Impulse response result

From Figure 1 in the illustration above, GF response to the shock in GDP is negative initially up to the second year, becomes positive in years 3, 5, 7, 9 and negative again in the alternate years (4,6,8,10). Similarly, a one standard deviation shock in FP affects GF negatively up to the second year, positively from the third to the sixth year and negative again from the seventh to the tenth year.

On the other hand, a one standard deviation shock in CAPT, initially produced a positive response of GF but respond negatively after the seventh year. Furthermore, a one standard deviation shock in IR affects GF negatively up to the sixth year before turning positive in year 7, 9 (while turning negative in the alternate years 8 and 10).

6.7 Variance decomposition

The variance decomposition shows the amount of information each variable contributes to the other variables in the autoregression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. We employ a ten-year forecasting time horizon and observed the relevance of the variables over time.

Table 6: Variance decomposition

Period	Variance Decomposition of GF: S.E.	GF	GDP	CAPT	IR	FP
1	298160.4	100.0000	0.000000	0.000000	0.000000	0.000000
2	552231.2	89.61270	3.284092	4.091230	2.773799	0.238176
3	717207.8	83.05101	6.006827	7.981783	2.130285	0.830098
4	814165.4	78.22792	7.635279	10.01695	2.535239	1.584619
5	858540.1	70.36627	13.71138	11.84572	2.465078	1.611548
6	900454.2	64.71645	16.18488	12.13806	5.017062	1.943555
7	993297.2	64.11887	19.32448	10.40445	4.190822	1.961382
8	1087801.	56.10500	27.08131	8.767266	6.408474	1.637945
9	1168751.	55.27365	29.29431	7.629559	5.560779	2.241705
10	1243308.	48.84332	35.79090	6.810932	6.558036	1.996811
Period	Variance Decomposition of GDP: S.E.	GF	GDP	CAPT	IR	FP
1	833348.1	4.893118	95.10688	0.000000	0.000000	0.000000
2	880824.4	4.479877	87.32132	2.222452	1.432312	4.544034
3	1027585.	4.116655	84.28399	6.361733	1.383124	3.854500
4	1094251.	4.328895	74.43944	10.81772	3.665052	6.748885
5	1402451.	2.993387	82.19519	8.436220	2.233157	4.142044
6	1495565.	6.138510	75.60277	9.198122	4.706798	4.353803
7	1680500.	5.400857	76.92007	9.369083	3.889633	4.420354
8	1879895.	12.93822	65.70373	10.47643	7.312078	3.569542
9	2144683.	10.47105	71.19601	9.963373	5.618059	2.751507
10	2401350.	13.56968	66.83405	9.864075	7.184157	2.548043

Variance Decomposition of CAPT: Period	S.E.	GF	GDP	CAPT	IR	FP
1	1.84E+08	14.76036	14.39671	70.84293	0.000000	0.000000
2	2.24E+08	33.95188	9.836390	49.69985	5.903476	0.608403
3	3.27E+08	18.32792	42.77440	29.99550	7.679158	1.223025
4	3.69E+08	15.71676	33.72972	25.91734	9.404069	15.23210
5	4.20E+08	14.04541	35.99469	24.98186	8.215897	16.76214
6	4.35E+08	13.12189	33.44026	27.96812	9.891285	15.57844
7	4.60E+08	12.15266	34.77414	27.97931	11.09885	13.99504
8	4.68E+08	11.82442	33.53896	28.36870	12.25645	14.01148
9	4.88E+08	10.91011	36.76078	27.88991	11.42833	13.01087
10	5.10E+08	12.13283	33.68970	28.05499	13.98784	12.13464
Variance Decomposition of IR: Period	S.E.	GF	GDP	CAPT	IR	FP
1	0.626982	7.619753	0.828125	9.754861	81.79726	0.000000
2	0.808363	13.66431	0.809820	12.74050	69.13585	3.649518
3	0.968181	16.75420	20.26642	11.77662	48.64388	2.558871
4	0.984917	16.51099	22.48316	11.50106	47.01824	2.486546
5	1.001825	16.04132	23.24069	11.12868	46.16039	3.428921
6	1.055740	16.02413	24.70837	10.66973	41.56608	7.031700
7	1.108342	14.66158	26.99822	11.77575	39.87592	6.688525
8	1.243182	16.01070	33.92395	10.50822	31.69528	7.861848
9	1.272660	16.46718	32.81535	10.30648	31.91355	8.497444
10	1.361954	18.11797	37.30654	9.014178	28.09088	7.470438
Variance Decomposition of FP: Period	S.E.	GF	GDP	CAPT	IR	FP
1	1.73E+08	0.412908	1.167820	0.173931	6.623779	91.62156
2	2.37E+08	0.220537	36.68107	6.316706	7.565852	49.21583
3	3.32E+08	10.20171	51.75339	5.172101	4.012019	28.86078
4	3.74E+08	14.27884	46.11408	5.200548	7.411010	26.99552
5	4.59E+08	27.21250	45.47479	3.450794	5.790065	18.07185
6	4.98E+08	25.13743	50.01909	2.976179	6.042665	15.82464
7	6.09E+08	21.34392	61.69540	2.021446	4.229029	10.71020
8	6.64E+08	19.29818	63.15161	1.837138	6.579228	9.133840
9	7.75E+08	14.48844	70.09092	1.563527	6.804115	7.052994
10	8.64E+08	16.62323	67.70769	1.902714	7.740390	6.025975
Cholesky Ordering: GF GDP CAPT IR FP						

Table 6 above gives the fraction of the forecast error for each variable that is attributed to its own innovation and to innovations in another variable. The own shocks of GF constitute a significant source of variation in its forecast error in the time horizon, ranging from 100.0 percent to 70.4 percent after five years and 48.8 percent after ten years. The variation in GF is accounted for by GDP (13.7 percent and 35.8 percent), CAPT (11.8 percent and 6.8 percent), IR (2.5 percent and 6.6 percent) and FP (1.6 percent and 2.0 percent) after 5 years and 10 years respectively. It can be noted here that GDP gives the highest variation in GF after the ten years and this is in line with the result of the VECM model that 1 percentage increase in GDP is associated with a 0.4517 percentage increase in GF or investment towards renewable energy in the long run but was rather insignificant. Interestingly, the impact of mineral fuel prices was found to be negative and significant whereby a 1 percentage increase in FP is associated with a 1.2859 percentage decline in GF.

7. Conclusion and policy implications

7.1 Conclusion

The main objective of the study is to examine the determinants of green finance such as gross domestic product, capital formation, interest rate and mineral fuel prices in Fiji. Annual data of these variables were collected and analysed in turn. The analysis shot in the arm with the KPSS test of unit root test had identified the order of integration of the variables. This was followed by the cointegration test of long run relationship among the variables, after which the result of the unit root test and the cointegration test met the preconditions of the VECM model for further analysis. Also, Granger causality was used to determine the direction of causality among the variables, impulse response function and variance decomposition analysis was conducted for robustness of our analysis and verify the result obtained from the VECM model. Overall, all these approaches indicated the existence of long run relationship among the variables where FP (mineral fuel prices) had a negative and significant impact on GF.

From the various regression results, we found that the cointegration test confirmed the existence of long run relationship among the variables, while the Granger causality shows a unidirectional relationship amongst the explanatory variables (rather than with the dependent variable). In the results of the VECM model, the increase in mineral fuel price (FP) does not necessarily stir demand for GF or investment towards renewable energy in the long run. Though the variables, GDP and CAPT were insignificant in the VECM however both showed a positive relationship with GF in the long-run. The impulse response function also depicted this relationship meaning similar conclusion can be reached. In the same vein, GDP accounted for the highest percentage of variation in GF given the variance decomposition with 13.7 percent and 35.8 percent in the fifth and tenth year.

Hence, given the important role that green finance play in enhancing sustainable development and economic growth, there is room for additional research in the valuation of green finance. For instance, there is a special need for research on understanding of differences between Fiji versus other SIDS in the region as well as in other jurisdictions in terms of how green investment patterns are realised and applied in the manufacturing environment or other sectors in Fiji. Also, further research is encouraged on the nexus between financial inclusion and green finance, impact of green finance measures on bank lending for SIDS such as Fiji and fostering green investments and tackling climate-related financial risks and which role for macro prudential policies.

Another important aspect that can improve this study or provide further insights is undertaking tests for structural breaks. That is, being able to detect when the structure of the time series changes can give us insights into the determinants of GF. In other words, structural break tests help us to determine when and whether there is a significant change in our data.

7.2 Policy implication

Since mineral fuel prices (FP) is negative and statistically significant, it must be noted that the transition towards cleaner/smarter energy/technologies will take some time hence it is recommended that the financial sector will need to play a key role in scaling up sustainable/green finance not via market forces alone but also through financial governance to ensure that financial firms seriously consider the threats posed by climate change and integrate physical and transition risks into their lending and investment frameworks

It is also recommended that incentivising the financial sector—embedding climate risk in financing and investing decisions–also include regulatory and prudential incentives whether they are on capital or liquidity requirements, and carbon or pollution tax or levies. This will have flow on linkages to financial monetary and financial stability.

Green finance and sustainable financing are still relatively new subject areas for the financial sector especially in SIDS such as Fiji where bankers are not climate change or green finance experts. Hence the need for intensive capacity building amongst regulators and LFIs /relevant stakeholders to lead and inform the green finance policy development process. The regulators need internal capacity building to be able to develop relevant and practical sustainable finance policy and guidelines for the financial sector. A fine balance between economic recovery and environmental, social, governance and health consideration poses a trade-off that envelops the transition towards a low carbon/greener economy. The typical challenges for financial institutions that require the need for capacity building include: lack of expertise and designated committees; lack of professional service providers; limited access to resources; and developing products.

Leveraging digital financial services to promote green financial products. Product innovation involves the development and implementation of novel solutions to enhance the mobilisation of finance towards sustainable development needs. This area is needed to address the present short-falls of traditional financing which include the absence of environmental, social and governance considerations.

Undertaking of a diagnostic study is highly recommended where market research covering key economic sectors in Fiji to consider the market potential for these sectors and evaluate which sectors are commercially viable in Fiji. Also, stock-take projects/initiatives that are currently underway from other donor and development agencies regarding climate change and SDGs so that wastage of resources is minimised and targeted areas can be enhanced with concerted effort.

We anticipate oil price volatility to continue to be absorbed and not trigger a robust market response unless significant transfer of technology occurs in such SID as Fiji and for this to occur, several conditions will need to be improved to support competition in this space (for instance the review of certain legislations such as the Electricity Act) as well as the needs that are targeted at the specific types of clean/green technology and financial mechanisms that work at such scale. While market dynamics alone are unlikely to create logical shifts for SIDS such as Fiji without some sort of additional inputs, it is interesting to note that through Article 6.2 of the Paris Agreement, we can expect ITMOs or co-operation approaches/ investment by larger economies (as done by Switzerland with Ghana & Vanuatu) towards Fiji's energy transition in exchange for a share in the mitigation outcomes in order to achieve their own 2030 targets.

Finally, a key recommendation for RBF and LFIs is that lessons from capacity building and diagnostic study should be incorporated into the development of policies as well as viable products and services that will be tailored to Fiji's needs on GF. There are opportunities for collaboration between financial institutions, government, non-government organisations and representatives of critical sectors such as energy, agriculture and construction. Private-public partnerships can also be explored akin to other previous RBF stakeholder collaboration so as to strengthen the design of new financial instruments to improve the bankability of sustainable/green projects through mitigation of risk and information asymmetries.

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Appendix 1: Further studies on green finance

Author(s) (year)	Sample countries and time periods	Methodology and estimators	Dependent variable(s)	Independent variable (s)	Main results and conclusions
Kassinis and Vafeas (2002)	US pre-lawsuit profile of 209 violators to a sample of matched control firms between 1994-1998.	Univariate differences for each variable between the experimental and control firms. Also used parametric t-test and the nonparametric signed-ranks Wilcoxon test.	Environmental litigation	Board size, Director affiliation, Director reputation, inside ownership and outside stakeholder pressures: • political/ legislative environment • community preferences • regulatory stringency of state.	The likelihood of becoming a lawsuit defendant increased with board size and the fraction of directors in peer firms.
Chen (2008)	Taiwan, 2006, companies in the information and electronics industry, 600 questionnaires. Also, regression analysis was used.	An empirical study, which was based from companies in the information and electronics industry of Taiwan.	Model 1: Green product innovation performance Model II: Green process innovation performance Model III: Green image	Model 1: Green core competence, Model II: Green core competence, Model III: Green core competence, green product innovation performance, green process innovation performance.	Green core competences of firms were positively correlated to their green innovation performance and green images.
Nocke and Yeaple (2008)	Based on firm-level data from the Bureau of Economic Analysis—investment by multinationals whose mainline business is a traded good over the five-year period 1994-1998.	The authors estimated a logit model of US parent firms' mode choice. Also, a general equilibrium model of the world economy is used.	Firms engaging in greenfield FDI or firms engaging in cross-border acquisition.	USSALE, EMP Other controlled variables: RDSALE, DIV, EXP INTRAIM, COUNT, RDDPPC, POP, OPEN and DIST.	Cross-border acquisitions involve firms trading in heterogeneous corporate assets to exploit complementarities, greenfield FDI - involves setting up a new production division in the foreign country.
Stalley (2009)	2005 on firms within the Jiangsu Province (3 cities namely Taizhou, Changzhou and Nanjing) in China and is based on the China Green Watch Program.	Variety of criteria to determine the colour rankings including: • compliance with various discharge standards and hazardous waste disposal requirements; • recent history of accidents, administrative etc.	Green Watch Rank	FIEs Controlled Variables: • company age • san tongshi • ownership • size • industry type • profitability.	There is only modest market-induced enhancement of environmental performance among Chinese companies.

Author(s) (year)	Sample countries and time periods	Methodology and estimators	Dependent variable(s)	Independent variable (s)	Main results and conclusions
Tularam, Roca and Wong (2010)	7 January 1994 to 25 December 2009 and analysed the dynamic correlation of the Australian Socially Responsible Investment (SRI) with 14 other markets.	Dynamic conditional correlation multivariate GARCH (DCC-MVGARCH) model by Engle (2002) while the SIC model is employed to determine the optimal DCC-MVGARCH specifications.	Australian SRI market	SRI markets worldwide	The Australian market experienced a spike in correlation with the other markets during periods of market distress such as the recent global financial crisis.
Eyraud, Wane, Zhang and Clements (2011)	35 advanced and emerging countries, annual data over 2000-2010.	Panel approach, estimation in real terms using the fixed-effect methodology.	Green investment	GDP growth, GDP per capita, population size, fuel prices (international crude oil, etc, cost variables (wages, unit labour costs, profit tax, etc. Variables measuring the availability and cost of financing (nominal, real, short and long-term real interest rates etc.	Green Investment is boosted by economic growth, a sound financial system that is conducive to low interest rates and high fuel prices.
Petruzelli, Dangelico, Rotolo and Albino (2011)	A sample of firms in the 2004 Dow Jones Sustainability World Index, focusing on four sectors: basic materials, industrials, technology and utilities. Sampled companies were located worldwide	The authors identified a sample of 151 green patents. In particular, 40 firms granted at least one green patent and 83 firms have no patents that could be classified as 'green'.	Inn Value- value of green and non-green innovations	InterOrg, IntraOrg, Complexity; Novelty Controlled Variables: Claims, ScBackCit, USBackCit, ForBackCit & TechCap	Green innovations are characterised by higher levels of both inter and intraorganisational collaborations compared to other innovations developed by the same forms.
Amran, Periasamy and Zulkafli (2014)	Firms in 10 industries across 13 countries in the Asia Pacific Region-under developed & advanced economies: Study time period was 2008.	Regression Analysis; 2 models: 1st model uses the climate change disclosure using an equal weight index 2nd model deploys the climate change disclosure using an unequal weight index	1st model: CCD1— the Climate Change Disclosure Index (equal weighted) 2nd model: CCD2— the Climate Change Disclosure Index (unequal weighted)	Env_cert; Developed; Aut_ret; Duality; Tot_asstUSD; Bsize; industries; gender.	The level of climate change disclosure by firms is still low in the sustainability reports, it is mainly influenced by the firm's country of domicile.

Author(s) (year)	Sample countries and time periods	Methodology and estimators	Dependent variable(s)	Independent variable (s)	Main results and conclusions
Lesser, Lobe and Walkshäusl (2014)	Focused on equities from developed markets. Sampling period ranging from January 2003 through June 2012, yielding 114 monthly observations.	Used three performance measurement models. 1. Four-factor model of Fama & French (1993) and Carhart (1997) 2. Quality-factor model of Asness et al (2013). 3. The q-theory factor model of Chen et al (2010).	Excess return of the green or SRI portfolio	Excess return on the market benchmark MKT, SMB, HML, WMJ, QMJ, DMI and PMU.	Strong evidence that green investments are significantly different from SRI investments in terms of financial performance and underlying firm characteristics models.
Ganda, Ngwakwe and Ambe (2015)	100 South African Carbon Disclosure Project (CDP) on the Johannesburg Stock Exchange (JSE)- and also secondary data from the firms' 2012 sustainability reports or annual integrated reports.	Use of both quantitative (Chi square) and qualitative analysis.	Profitability	Zero carbon schemes, sustainable green business opportunities created, Carbon management investments, Environmental investments, energy management practices, Co-generation projects, Efficient use of energy etc.	Results from the Chi-square tests outline that profitability influences green investment practices in JSE listed firms.
Schaltenbrand, Foerstl, Kach and Maier (2015)	A total of 1052 randomly selected managers working at manufacturing and wholesaling companies Sampling periods were not specifically stated (given that this paper was submitted in 2014—we can assume sampling period to be around (2008-2013).	In addition to survey-based research, vignette-based experiments were also used.	Internal green investments-intGreenINV and supplier-related green investments (supGreenIn)	End consumer pressure (ConsPre) community pressure (ComPre) and resource scarcity (ResSca)	German and US managers respond differently to external pressures in their green investment decisions.
Schaltenbrand, Foerstl, Kach and Maier (2015)	A total of 1052 randomly selected managers working at manufacturing and wholesaling companies. Sampling periods were not specifically stated (given that this paper was submitted in 2014-we can assume sampling period to be around (2008-2013).	In addition to survey-based research, vignette-based experiments were also used.	Internal Green Investments-intGreenINV and Supplier-related green investments (supGreenInv)	End consumer pressure (ConsPre) Community Pressure (ComPre) and Resource scarcity (ResSca)	German and US managers respond differently to external pressures in their green investment decisions.

Author(s) (year)	Sample countries and time periods	Methodology and estimators	Dependent variable(s)	Independent variable (s)	Main results and conclusions
Azhgaliyeva, Kapsaplyyamova and Low (2018)	Multilevel data from 13 countries over the period 2004-2016.	Longitudinal multilevel data, refer to (Laird and Fitzmaurice 2013. Also, four multilevel models: random intercept, fixed intercept, random coefficients, and fixed coefficients.	Private Investment – ratio of private investment in renewable energy sources to the total investment (gross capital formation)	Government investment, real exchange rate, GDP per capita, financial flows, external debt, equity, market capitalization, labour markets, political stability and policies.	Fiscal &financial renewable energy policies can promote renewable energy -costly for Govts. Feed-in tariffs/ premiums & loans are 2 of the most effective fiscal & financial policy instruments.
Chuang and Huang (2018)	Based on 358 companies from the top 1000 Taiwanese manufacturers in 2014.	Electronic questionnaires, also conducted a two-step procedure involving confirmatory factor analysis (CFA) and structural equation modelling (Anderson and Gerbing 1988).	Environmental performance and business competitiveness	Environmental Corporate Social Responsibility proxied by 12 items such as: (1) terms of conditions for suppliers, regarding environmental practices (2) stakeholder involvement in setting corporate environmental policies etc.	Environmental corporate social responsibility (ECSR) has significant positive effects on green IT human capital, green IT structural capital, and green IT relational capital. Green IT
Liao and Shi (2018)	China, 1998 - 2014, using economic & econometric models with a panel dataset for 30 provinces in China.	A 3 three stage game theory model was developed to explain the relationship between public appeal and green investment. Estimators: RE, Pooled OLS and GLS, 2SLS, IV, GMM.	Green Investment	PA; OPEN; EM; TI; CM; FDI; POP; GDP - real GDP per capita; DUST and ER	Public appeal tends to have a positive effect on increasing green investment in China's context.

Author(s) (year)	Sample countries and time periods	Methodology and estimators	Dependent variable(s)	Independent variable (s)	Main results and conclusions
Schaltenbrand, Foerstl, Azadegan and Lindeman (2018)	European firms-survey responses on 750 managers experience, archival data on their employers' performance and answers provided to the vignette-based scenario experiment; 1996-1997, 1999-2001, 2004-2006, 2008-2013.	1. Vignette-based experimental design as the main method 2. Followed by a 2 x2 factorial design experiment.	Corporate Green Investments (GreenInv)	Consumer pressure (ConsPre), Community Pressure (ComPre), Job Tenure (JobTen), employer's business performance (Fin Perf) and market performance (MarPerf).	Managers' yrs. of experience, their employers' financial performance, and their employers' market performance influence investment decisions - under new and different set of circumstances.
Yuan and Gallagher (2018)	Based on development banks operating in Latin America and the Carribean (LAC) region between 2003 and 2016.	An econometric analysis was used via 2 models: 1) Linear probability model and 2) panel approach.	Model 1: Greenfinance if a country receives green commitment from a bank. Model 2: Greenness of development finance that each LAC country receives from a development bank	EPI host, EPI donor, GDP per capita, Population, Inflation, Human Development Index, Political Proximity and Political Orientation of recipients	Private sector and fiscal outlays from Governments will have to increase their contributions in order to blend their efforts towards climate friendly capital formation in the LAC region.
Barua and Chiesa (2019)	Use of Bloomberg global dataset from years 2010-2017 (8 years) on 771 green-labelled bond issuances	Cross Section: OLS and Blinder -Oaxaca decomposition analysis.	Issue size- the amount of funds raised through the supply of the bonds measured in US dollars	Coupon rate, Maturity, Bond rating, Security Risk premium, Denomination currency, Firm size, Business growth, Capital structure, Issuer credit rating, Profitability, Alternative financing cost, Sector of issuer, Market interest rate, Market Type, Market of distribution.	The effects of coupon rates (mostly negative effects) and credit ratings (positive effects) on issue size is more permanent in nature as they consistently persist over the years and across rating grades.

Author(s) (year)	Sample countries and time periods	Methodology and estimators	Dependent variable(s)	Independent variable (s)	Main results and conclusions
Lyeonov and Pimonenko (2019)	Annual data for European and developing countries in the period 2015-2017.	Stata 14.0., Cluster analysis and regression analysis.	Global Sustainable Competitive Index (GSCI)	Volume of Climate Finance (GFI) Climate related expending (CM)	The results of the analysis showed that emerging and developed countries influence on climate with different power.
Mejia, Baccianti, Mrkaic, Novta, Pugacheva and Topalova (2019)	Usage of data from around 1,460 provinces and states across 79 countries with annual temperature and precipitation data. Sample period was from 1965 to 1995	B/line specification, Acevedo Mejia et al. (2018), Jordã's (2005) local projection method, within-country & across-country yr.-to-yr. fluc. in temp & precip. Finally, regression analysis.	Cumulative growth of real GDP per capita	Average annual temperature and average annual precipitation	Policies do help mitigate the negative effects of weather shocks

Appendix 2: Vector error correction estimates

Vector Error Correction Estimates

Sample (adjusted): 1993 2020
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LGF(-1)	1.000000
LGDP(-1)	-0.451668
	(0.70893)
	[-0.63711]
LCAPT(-1)	-2.035408
	(0.61467)
	[-3.31140]
IR(-1)	-0.036498
	(0.14700)
	[-0.24829]
LFP(-1)	1.285944
	(0.19442)
	[6.61423]
C	10.11127

Long-run Equation

Error Correction:	D(LGF)	D(LGDP)	D(LCAPT)	D(IR)	D(LFP)
CointEq1	0.184895	0.080106	0.036458	0.246394	-0.389608
	(0.27977)	(0.07178)	(0.09347)	(0.27779)	(0.09805)
	[0.66088]	[1.11592]	[0.39004]	[0.88698]	[-3.97344]

Error Correction Terms

Appendix 3: Vector error correction estimates (extended version)

Vector Error Correction Estimates- extended version of Appendix 2

Sample (adjusted): 1993 2020
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1				
LGF(-1)	1.000000				
LGDP(-1)	-0.451668 (0.70893) [-0.63711]				
LCAPT(-1)	-2.035408 (0.61467) [-3.31140]				
IR(-1)	-0.036498 (0.14700) [-0.24829]				
LFP(-1)	1.285944 (0.19442) [6.61423]				
C	10.11127				
Error Correction:	**D(LGF)**	**D(LGDP)**	**D(LCAPT)**	**D(IR)**	**D(LFP)**
CointEq1	0.184895 (0.27977) [0.66088]	0.080106 (0.07178) [1.11592]	0.036458 (0.09347) [0.39004]	0.246394 (0.27779) [0.88698]	-0.389608 (0.09805) [-3.97344]
D(LGF(-1))	-0.366735 (0.28223) [-1.29941]	-0.067474 (0.07242) [-0.93176]	0.081785 (0.09430) [0.86733]	-0.213960 (0.28023) [-0.76350]	0.242603 (0.09892) [2.45262]
D(LGF(-2))	-0.126635 (0.25297) [-0.50059]	-0.011266 (0.06491) [-0.17357]	-0.039285 (0.08452) [-0.46480]	-0.025185 (0.25118) [-0.10027]	0.212545 (0.08866) [2.39729]
D(LGDP(-1))	-1.115247 (0.99457) [-1.12133]	-0.256576 (0.25519) [-1.00542]	-0.054222 (0.33229) [-0.16317]	1.164064 (0.98754) [1.17875]	-0.621895 (0.34858) [-1.78410]
D(LGDP(-2))	0.883518 (1.42937) [0.61812]	0.268754 (0.36675) [0.73279]	0.738297 (0.47756) [1.54597]	2.923752 (1.41925) [2.06006]	0.633902 (0.50096) [1.26537]
D(LCAPT(-1))	1.137635 (0.84320) [1.34919]	0.027494 (0.21635) [0.12708]	-0.472952 (0.28172) [-1.67880]	0.386058 (0.83724) [0.46111]	-1.075638 (0.29552) [-3.63978]

D(LCAPT(-2))	1.397674	0.203623	-0.092173	-0.232069	-0.432469
	(0.70084)	(0.17982)	(0.23415)	(0.69588)	(0.24563)
	[1.99429]	[1.13235]	[-0.39364]	[-0.33349]	[-1.76067]
D(IR(-1))	-0.397056	-0.061343	-0.012906	-0.170375	-0.126704
	(0.22660)	(0.05814)	(0.07571)	(0.22499)	(0.07942)
	[-1.75227]	[-1.05507]	[-0.17047]	[-0.75725]	[-1.59543]
D(IR(-2))	-0.050605	0.061699	0.215668	-0.291515	0.034402
	(0.22252)	(0.05710)	(0.07435)	(0.22095)	(0.07799)
	[-0.22742]	[1.08062]	[2.90088]	[-1.31939]	[0.44112]
D(LFP(-1))	0.111464	0.066241	0.022573	0.444455	-0.295927
	(0.54883)	(0.14082)	(0.18337)	(0.54495)	(0.19235)
	[0.20309]	[0.47039]	[0.12310]	[0.81559]	[-1.53846]
D(LFP(-2))	1.217651	0.042656	0.016093	0.074582	-0.288958
	(0.57084)	(0.14647)	(0.19072)	(0.56680)	(0.20007)
	[2.13308]	[0.29123]	[0.08438]	[0.13158]	[-1.44431]
C	-0.264107	0.030288	0.090235	-0.362238	0.181672
	(0.19314)	(0.04956)	(0.06453)	(0.19177)	(0.06769)
	[-1.36746]	[0.61119]	[1.39838]	[-1.88891]	[2.68388]
R-squared	0.466153	0.202876	0.559104	0.519943	0.656334
Adj. R-squared	0.099133	-0.345147	0.255989	0.189904	0.420063
Sum sq. resids	5.386800	0.354644	0.601317	5.310857	0.661686
S.E. equation	0.580237	0.148880	0.193862	0.576132	0.203360
F-statistic	1.270103	0.370196	1.844525	1.575398	2.777889
Log likelihood	-16.65474	21.43354	14.04145	-16.45596	12.70208
Akaike AIC	2.046767	-0.673824	-0.145818	2.032569	-0.050149
Schwarz SC	2.617712	-0.102879	0.425127	2.603513	0.520796
Mean dependent	0.000184	0.047274	0.067431	-0.077143	0.053708
S.D. dependent	0.611329	0.128366	0.224751	0.640109	0.267040

Determinant resid covariance (dof adj.)	2.19E-06
Determinant resid covariance	1.33E-07
Log likelihood	22.98623
Akaike information criterion	3.000984
Schwarz criterion	6.093601

Appendix 4: Vector error correction estimates without logs of the variables

Vector Error Correction Estimates without logs of the variables

Sample (adjusted): 1993 2020
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
GF(-1)	1.000000
GDP(-1)	0.019770 (0.09781) [0.20214]
CAPT(-1)	-0.001595 (0.00040) [-4.00510]
IR(-1)	238571.5 (119247.) [2.00065]
FP(-1)	0.001321 (0.00026) [5.00555]
C	-1965696.

Error Correction:	D(GF)	D(GDP)	D(CAPT)	D(IR)	D(FP)
CointEq1	-0.109693 (0.28278) [-0.38792]	1.024219 (0.81983) [1.24931]	-29.98559 (172.981) [-0.17335]	1.57E-07 (5.5E-07) [0.28590]	-526.5515 (152.274) [-3.45793]
D(GF(-1))	0.468417 (0.25871) [1.81056]	-1.193665 (0.75007) [-1.59141]	330.9587 (158.262) [2.09120]	-4.54E-07 (5.0E-07) [-0.90142]	304.8641 (139.316) [2.18828]
D(GF(-2))	-0.012554 (0.27490) [-0.04567]	-0.493222 (0.79699) [-0.61886]	-151.8983 (168.163) [-0.90328]	2.23E-07 (5.4E-07) [0.41680]	179.7187 (148.032) [1.21405]
D(GDP(-1))	-0.186286 (0.08626) [-2.15953]	-0.609039 (0.25009) [-2.43526]	-28.27248 (52.7688) [-0.53578]	1.25E-07 (1.7E-07) [0.74726]	-153.9615 (46.4518) [-3.31444]
D(GDP(-2))	0.224550 (0.21334) [1.05253]	-0.013357 (0.61853) [-0.02160]	193.6612 (130.508) [1.48391]	8.83E-07 (4.2E-07) [2.12742]	43.43212 (114.884) [0.37805]
D(CAPT(-1))	0.000307 (0.00047) [0.65659]	0.000981 (0.00135) [0.72469]	-0.835370 (0.28574) [-2.92356]	-1.33E-10 (9.1E-10) [-0.14651]	-0.692356 (0.25153) [-2.75257]

D(CAPT(-2))	0.000589	0.000647	-0.154542	-3.76E-10	-0.298408
	(0.00033)	(0.00097)	(0.20417)	(6.5E-10)	(0.17973)
	[1.76609]	[0.66868]	[-0.75694]	[-0.57945]	[-1.66036]
D(IR(-1))	-162537.5	-467986.5	-30717469	-0.252616	64336560
	(125918.)	(365062.)	(7.7E+07)	(0.24507)	(6.8E+07)
	[-1.29082]	[-1.28194]	[-0.39879]	[-1.03080]	[0.94883]
D(IR(-2))	71190.33	-176367.2	2.28E+08	-0.353462	84682919
	(128423.)	(372325.)	(7.9E+07)	(0.24994)	(6.9E+07)
	[0.55434]	[-0.47369]	[2.89881]	[-1.41416]	[1.22453]
D(FP(-1))	0.000296	0.000689	0.093230	7.82E-10	-0.269547
	(0.00034)	(0.00098)	(0.20773)	(6.6E-10)	(0.18286)
	[0.87156]	[0.70015]	[0.44880]	[1.18251]	[-1.47404]
D(FP(-2))	0.000733	0.001027	-0.097025	6.64E-11	-0.301549
	(0.00036)	(0.00103)	(0.21778)	(6.9E-10)	(0.19171)
	[2.06002]	[0.99499]	[-0.44552]	[0.09579]	[-1.57296]
C	-93577.99	264849.0	1.10E+08	-0.330226	1.33E+08
	(85919.4)	(249099.)	(5.3E+07)	(0.16722)	(4.6E+07)
	[-1.08914]	[1.06323]	[2.08579]	[-1.97478]	[2.88064]
R-squared	0.641972	0.379585	0.705121	0.489170	0.649592
Adj. R-squared	0.395827	-0.046951	0.502391	0.137974	0.408687
Sum sq. resids	1.49E+12	1.25E+13	5.58E+17	5.651300	4.33E+17
S.E. equation	305360.7	885306.6	1.87E+08	0.594312	1.64E+08
F-statistic	2.608108	0.889925	3.478135	1.392869	2.696463
Log likelihood	-385.5146	-415.3190	-565.1707	-17.32581	-561.6005
Akaike AIC	28.39390	30.52278	41.22648	2.094701	40.97147
Schwarz SC	28.96485	31.09373	41.79742	2.665646	41.54241
Mean dependent	89.67140	226710.7	58848702	-0.077143	16973429
S.D. dependent	392855.3	865227.9	2.65E+08	0.640109	2.14E+08

Determinant resid covariance (dof adj.)	1.45E+55
Determinant resid covariance	8.86E+53
Log likelihood	-1937.708
Akaike information criterion	143.0505
Schwarz criterion	146.1432

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