



Incorporating Climate Risks into Monetary Policy: Initial Considerations

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1. Introduction

Climate change has been shown to have significant effects on global economic conditions, directly impacting the availability of resources, agricultural production, labour productivity, and even the cost of financial services. According to a report by the Network for Greening the Financial System¹ (NGFS) (2020), climate change is a significant and diverse force, drastically shaping the global economy. The report furthers that climate change and its mitigation will increasingly affect key macroeconomic variables and the conduct of monetary policy across many different time horizons. Considering that climate change and its mitigation could affect several key economic variables in different ways, then policy actions depend on a variety of factors. Accordingly, the NGFS (2020) suggests that the variances in effect from transition risks, extreme weather events, and gradual warming need to be assessed differently from a policy perspective, due to uncertainty and a range of factors.

In light of the complicated nature of climate change and its effect on macroeconomic conditions, many central banks began investigating ways in which climate change risks can be managed, while supporting a green economic transition. This has resulted in many central banks pioneering 'climate-augmented' monetary policy, or 'green monetary policy'. However, concerns have been raised about central banks' engagement in climate change issues without conditions, and the possibility of overburdened policy tools (Chen et al 2020). Nonetheless, including climate risks into monetary policy frameworks may aid in the shift to a more sustainable economy. Monetary authorities can influence how financial institutions and markets behave. Central banks may encourage financial firms to consider climate risks in their decision-making processes and stimulate the funding of sustainable projects and initiatives by including climate risks into their monetary policy frameworks.

On a global scale, central banks have become increasingly cognizant of the necessity of integrating climate concerns into monetary policy frameworks, despite climate change being a relatively new but steadily growing issue. Domestically, the Central Bank of Trinidad and Tobago (CBTT) has made strides in the direction of energy efficiency, but more work has to be done to integrate environmental considerations into the monetary system. While many studies have been conducted on incorporating climate concerns into monetary policy the conversation will be considerably enhanced by examining the effects of climate change on economic injections and leakages as well as how monetary policy might better support risk mitigation.

Taking into account the complex nature of climate change and its impact on economic conditions, this study takes an exploratory approach, examining the impact climate change has on the IS-LM framework, then exploring the governance framework required for the greening of monetary policy followed by an evaluation of the role central banks play in greening the financial system. The next section investigates the role monetary policy can play in shoring up the green bond initiative. Finally, the paper charts the course which the CBTT can engage to eventually include climate change into its monetary policy framework.

¹ The Network for Greening the Financial System (NGFS) was established by eight central banks, in December 2017 to investigate what central banks can do to combat climate change.

2. Climate Related Variables in a Mundell Fleming Framework

The typical Mundell-Fleming framework depicts how a small economy that is exposed to international commerce operates and offers a context for analysing fiscal and monetary policy. The international flows element extends the closed economy IS-LM model to derive external balance from the levels of macroeconomic variables needed to achieve internal balance. The set of trade-offs associated with this model gives rise to the phenomena known as the 'Trilemma', which mutually precludes one of the following: a fixed exchange rate, independent monetary policy, and unfettered financial flows.

The basic tenet of the IS-LM model centres around the IS curve representing the national income identity, whereas the LM curve shows the clearing money market where money supply equals money demand. The introduction of international trade gives the variation in the IS-LM-BP (Balance of Payment) model (Figure 1), which includes a variety of injections and leakages that can shift IS and LM functions. An outward shift of the IS curve, i.e., an increase in equilibrium income levels, occurs when economic injections increase. For example, exchange rate depreciation, fiscal expansion, increased private investment and lower savings will shift the IS curve outward and raise equilibrium income while leaving interest rates unchanged. The converse is also true. An outward shift in the LM curve can occur with an increased money supply or lowered price level (via the real money balance effect), with the converse also applying. As a rule of thumb, the actions of fiscal authorities apply mainly to the IS curve, while the actions of monetary authorities apply mainly to the LM curve.

The BP curve is determined as a function of net exports and capital flows. The export component is determined by foreign incomes and the exchange rate, while capital flows are estimated by the differential between domestic and foreign interest rates, revealing the existence of an international asset market alongside the international goods market. Notably, the slope of the BP is positive (Figure 1) since increasing national income would increase imports. Increased imports result in capital outflows, necessitating increased interest rates due to higher foreign currency demand. Exchange rate depreciation shifts the BP curve outward, as does exogenously increasing export demand via increased real foreign incomes. All points below the BP curve represent a balance of payments deficit, and vice versa.

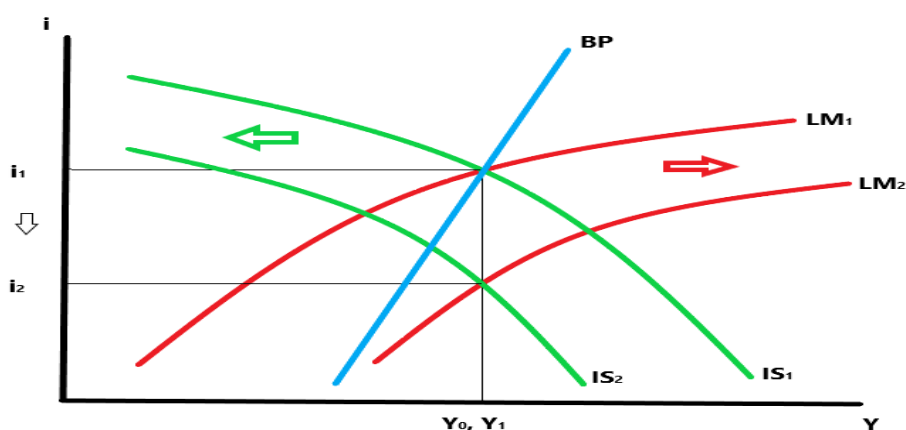
How can the Mundell-Fleming framework help identify the effects of climate change and climate policy? Identifying the impact of injections and leakages in the model becomes paramount. The physical risks of climate change can affect the macro-economy through productivity losses, lowered rates of capital accumulation as well as reduced factor productivity growth resulting in a shift of the IS curve. Extreme events could also deliver permanent negative shocks to the capital base, lowering output potential. Lowered capital stocks can reduce aggregate supply after an extreme event, where a positive output gap emerges, and the central bank may need to act to lower inflation. However, demand shortfalls can also emerge as households and firms reduce consumption, generating a negative output gap. Following an extreme event, these imbalances can distort or even cause a breakdown in financial markets, raise the cost of new investment, and ultimately generate an investment demand deficit. One important channel of climate change on prices is agricultural productivity, i.e., a further negative supply shock. Food and energy prices, and thus headline inflation, may become more volatile as a result of climate change. This may be compounded by the effects on the agricultural production market of a transition to increase reliance on bio-energy, and may further affect the inflation rate (Batten et al 2020).

On the other hand, transition risk in the form of climate policy can burden economic activity through taxes or regulation. Regulation to mitigate climate change is viewed as an intervention to correct a market failure. Ostensibly, intervention to correct a market failure would increase welfare. Regulation generally comes in the form of carbon pricing, carbon taxes, expanding the use of renewables and investment in infrastructure to adapt to a changing climate. These forms of policy manifest as taxes (leakages in the IS-LM-BP sense) and would thus impose a negative shock to aggregate supply through an increase in 'deadweight losses'. However, there may be an efficiency return associated with adopting renewables or expanding infrastructure (injections through investment in the IS-LM-BP framework). Still, the net impact on output remains unclear, and depends on the aggregate effect of regulatory interventions on injections dependent on public finances. Efficiency savings from new technology may thus offset adjustment costs, but it currently remains unclear whether national income will benefit from regulatory interventions associated with climate change (Andersson et al 2020).

Climate policy associated with a monetary authority, however will likely come in the form of asset purchases. A popular prescription is that central banks ought to 'green' their balance sheets in two ways. Firstly, asset purchase and collateral framework programmes could be steered towards low-carbon assets to support the greening of the economy. This entails the switching of portfolios away from supporting 'brown' assets, particularly those of hydrocarbon-producing firms, and replacing them with assets from 'green' companies. In this way, monetary policy becomes climate-neutral (Schoenmaker et al 2018). Secondly, more direct 'green quantitative easing' is often prescribed as an optimal policy, where the central bank commits to buy a significant percentage of available green bonds for an indefinite period. This asset purchase programme thus acts as a 'green industrial policy' rather than a countercyclical intervention. Green quantitative easing can thus reduce climate-related financial instability by bolstering the price of green corporate bonds, moderating transition-related output shocks, and likely imposing a limit on greenhouse gas-related climate change (Dafermos et al 2018).

Several points of departure within the description of climate policy can be related via the Mundell-Fleming framework. Firstly, regulation by the fiscal authority will affect the IS curve. Net increases in taxation will increase leakages, shift the function inward, and lower national income. Central banks' climate change policy will likely take the form of a monetary injection and affect the position of the LM curve. Asset purchases denoted as 'quantitative easing' are not neutral interventions and will likely be expansionary, shifting the LM curve outwards. It is entirely possible that the effects of fiscal leakage and monetary injection balance each other out to leave output unchanged, but even this will ultimately lead to a lower interest rate. The effect of the lowered interest rate matters since it has implications for the balance of payments. Recall that any equilibrium below the BP curve implies balance of payments outflows. If the economy was in equilibrium where the IS, LM, and BP curves intersected at the same output and interest rate, the set of climate policies described would destabilise the economy's external position through outflows generated by an increased interest rate differential. This scenario is demonstrated in **Figure 1**.

Figure 1: The IS-LM-BP framework reflecting the impact of climate change adaptation measures²



In the above scenario, the economy equilibrates at the same income level, but at a lower interest rate. Notably, the possibility exists that the economy can equilibrate at a lower level of national income. In the case of small open economies like Trinidad and Tobago, the most likely scenario is that the IS curve is steep, in that output is not sensitive to interest rates and the LM curve is flatter, i.e., interest rates are not sensitive to expansion in the money supply. It can be demonstrated that negative shocks to steep IS curves combined with positive shocks to flatter LM curves make lower national income levels more likely. Additionally, the BP curve in this scenario is steep to reflect the case of low capital mobility, despite Trinidad and Tobago having an open capital account, capital mobility is somewhat low. The BP curve may shift outward to correct the imbalance via exchange rate depreciation; however, this option is not available in fixed exchange rate economies. Alternatively, an exogenous increase in foreign demand for domestic exports can make up the difference. With respect to Trinidad and Tobago, however, the bulk of exports consists of hydrocarbon products. In the case of a generalised international application of climate adaptation policy, exogenous demand for Trinidad and Tobago's domestic exports would decline, compounding the external imbalance generated by increased interest rate differentials. Concerning central banks in the Mundell-Fleming framework, all monetary expansions under fixed exchange rates lower interest rates and generate a balance of payments outflow. The stabilising policy options are to devalue the exchange rate or to shift the IS curve through expansionary fiscal policy via debt accumulation.

Dynamic Impact of Climate Policy

The analysis thus far has relied on a static model. Utilising a standard dynamic IS-LM setup³, the impacts of climate change policy adjustment are simulated⁴ and related through impulse response functions (IRFs). The model produces baseline results and is then calibrated to reflect the effect of climate adaptation policy. Specifically, policy adaptation emerges as a negative technology shock,

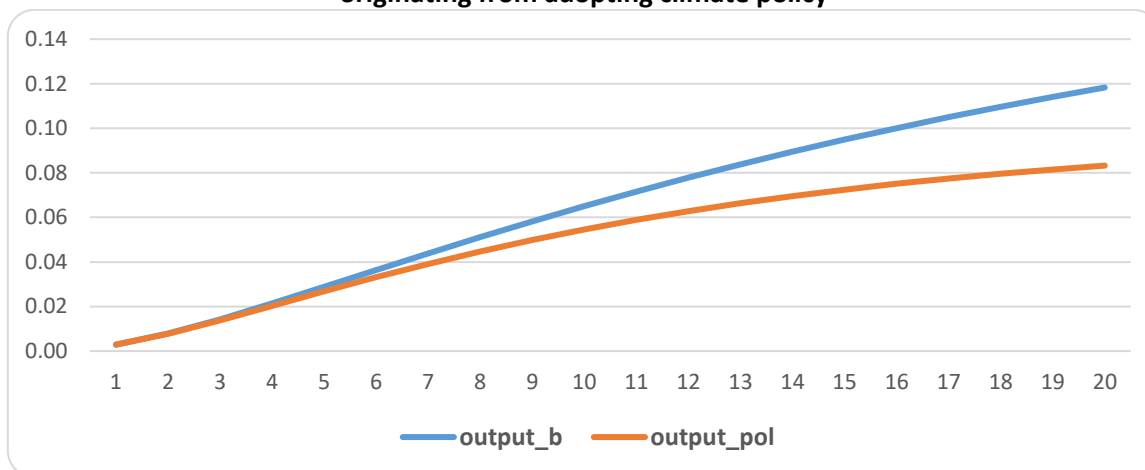
² Note: The IS curve represents the equilibrium path of combinations of national income and the interest rate where savings and investment are equal, and is negatively sloping. This represents equilibrium in the goods market. The LM curve represents the equilibrium path of combinations of national income and interest rates where supply and demand for money are equal, and is positively sloping. The BP curve is the locus of combinations of interest rates and national income where the change in foreign reserves is zero i.e., the BOP is in balance. It is also positively sloping, but preferably has a different gradient and intercept than the LM curve

³ See Appendix A for model.

⁴ Via Dynare in Matlab.

reflecting a net policy-induced drag on productivity. Additionally, the ‘Taylor’ characteristics of the central bank, i.e., reactions to output and inflation volatility, are de-emphasised in the model, providing a behavioural proxy reflecting the prioritisation of green quantitative easing. Furthermore, the Calvo likelihood of the pass-through of price changes is increased to reflect imported inflation, which becomes more probable in this case owing to the weakened reserve buffer. The IRFs are shown below:

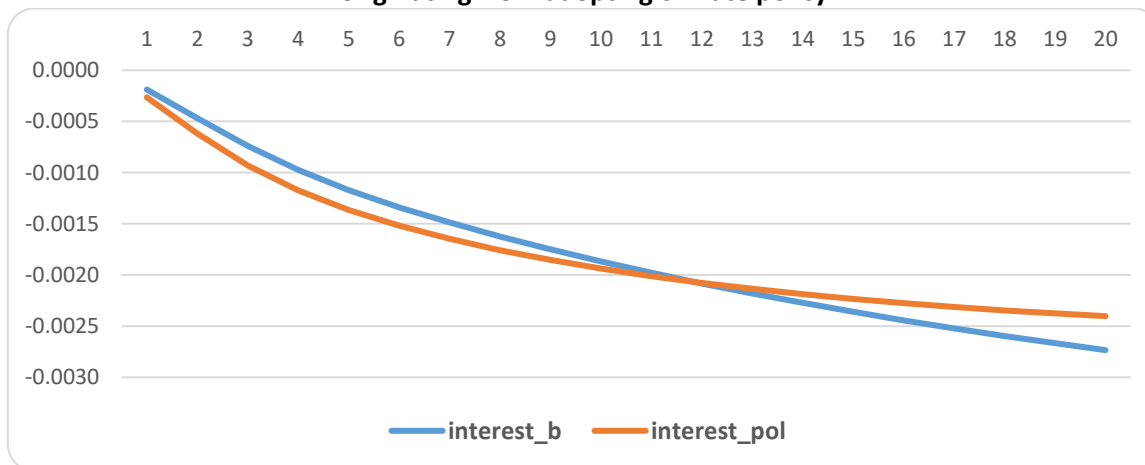
Figure 2: Response of output to a technology shock originating from adopting climate policy



Source: Author’s calculations

Figure 2 shows that the cumulative IRF of baseline national income (output_b) is higher than the output levels adjusted for policy (output_pol), reflecting the net negative impact adopting climate policy exacts on the economy through deadweight losses related to the imposition of fiscal policy measures. Admittedly the assumption is that the net effect of carbon taxes and climate-related investment will drag productivity accumulation, but this is not unrealistic for small hydrocarbon exporting economies. However, in cases where adjustment results in complementary economic activity, e.g., leveraging Trinidad and Tobago’s existing energy production and distribution infrastructure to mainstream green energy sources like hydrogen, could lead to productivity expansion, though this effect would take a much longer time to embed itself than a policy shift. Next, the technology shock is applied to interest rates.

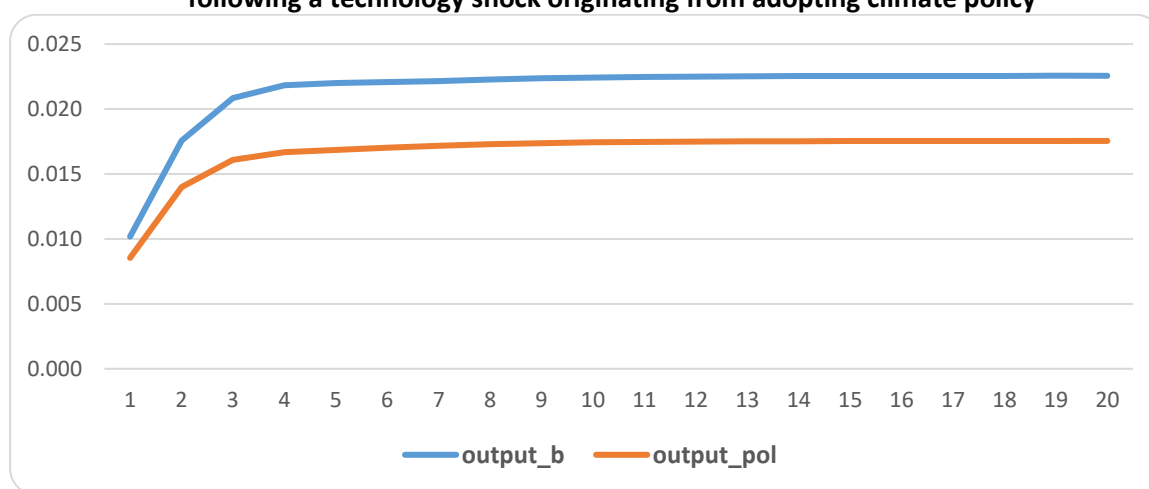
Figure 3: Response of interest rates to a technology shock originating from adopting climate policy



Source: Author’s calculations

Figure 3 shows the response of interest rates to the same technology shocks applied to output. Baseline interest rates (*interest_b*) decrease in response to a technology shock. It can be expected that increased technology-driven productivity increases investment demand and should increase interest rates. However, the technology shock enters the model via a negative coefficient associated with prices and preferences. This can be interpreted to mean technology is deflationary, and that this effect outweighs the investment demand effect, allowing interest rates to decline. It is evident that the lowered technology shock changes the curvature of the decline in interest rates, causing it to settle at a higher rate at the end of the forecast horizon (*interest_pol*). This may mean that the outflow pressure from lowered interest rates is lower than in the alternative scenario. Still, the drag on productivity originating from adopting climate policy lowers output through the IS curve even in the context of lowered interest rates. The implications for output emerging from these interactions will be demonstrated in Figure 4:

Figure 4: Response of output to interest rates following a technology shock originating from adopting climate policy



Source: Author's calculations

Figure 4 shows that accommodative interest rates following a negative shock to technology result in a lower output response (*output_pol*) compared to the baseline (*output_b*). The total effect of adopting climate policy will thus likely manifest as decreased output and decreased ability for a central bank to target output via interest rates. The set of interactions outlined via the static and dynamic IS-LM-BP models suggest that **the interactions generated by adopting climate policy will be economically costly, and emerge through lower output, lower interest rates and result in a BOP deficit if exchange rates remain de facto fixed.**

3. Governance Framework Required for Climate Policy

There has been growing awareness among the world's central banks of the need to include the effects of climate change into their policy decisions. At the helm of the movement toward climate change policy inclusion is the NGFS, which has produced several publications, including one that discusses potential climatic outcomes and research objectives related to the financial system's response to climate change (NGFS, 2020). Although central banks are tasked with monitoring climate-related hazards, they do not hold the reins when shaping climate policy. Governments are the authority concerning climate change policy, and they have the power to implement measures like carbon pricing that address the underlying market failure that is driving climate change (Breitenfellner and Pointner

2021). Notwithstanding, many central banks have made strides in assisting the mitigation of climate risks to the financial system.

Fiscal dominance in climate change policy development remains at the forefront. Krugstrup and Oman, 2019 conducted a review of climate change literature to stimulate debate on potential measures to reduce global warming. The study pointed to the central role of fiscal policy in climate change mitigation and encouraged that fiscal tools be accompanied by financial policy instruments, including financial regulation, financial governance, and measures to improve financial infrastructure and markets, as well as monetary policy. On the fiscal front, carbon taxes, emissions trading schemes, direct regulations and green industrial policies emerging mainly from a fiscal authority can support the transition to a carbon-neutral economy more effectively and efficiently than monetary policy. Nonetheless, monetary authorities have also been charged with facilitating climate change mitigation.

In order for monetary authorities to play a pivotal role in climate change policy development, some important changes must be implemented. According to Volz (2017), a central bank's legal mandate and its ability to correct specific market failures determine the extent to which the monetary authority can engage in climate change policy and greening of the financial system. The author explains that *“the case for assigning an environmental mandate to central banks and financial regulators may be even stronger in developing and emerging economies, where environmental regulation is often not or only weakly implemented or even ignored because weak public institutions lack clout.”* However, one may argue that central banks in developing economies face greater strains in implementing climate change mandates since fiscal authorities carry greater weight, and the ability of monetary authorities to enforce changes may require legal mandates that may be time-consuming and bureaucratic in nature.

Despite the increased monetary policy complexity, central banks are formulating strategies to respond to environmental and sustainability challenges. Volz (2017) discusses the arguments justifying a response by central banks. The first argument highlights the risks to financial and economic systems. Physical risks from a climate crisis can directly affect price stability and economic output, while climate change and transition policies can impact energy prices. Considering climate change may constitute a significant systemic risk, financial regulation and supervision must extend beyond its traditional focus and incorporate these risks when identifying system-wide vulnerabilities. Additionally, the allocation of credit primarily towards environmentally undesirable activities compared to environmentally desirable activities constitutes a type of market failure (Volz 2017). To correct these failures, monetary authorities can play a role in the development of efficient markets that support green-finance segments.

Despite these arguments supporting the role of central banks in environmental and sustainability policies, authorities must consider potential conflicts between macroeconomic goals, risks to credibility if additional goals are unsuccessful, accountability, and institutional independence. Furthermore, it is critical to understand the risks of overstressing the mandate of a central bank.

Volz (2017) discusses three important caveats of a central bank pursuing a sustainable development role. The first and most important is the risk of conflicting objectives. The Tinbergen rule indicates that there must be at least an equal number of tools for monetary objectives; if a central bank included environmental goals and objectives in its mandate, the authority would need to be equipped with additional effective instruments. *“The fact that central banks could do all sorts of things does not imply*

that they should necessarily do so. Important questions arise regarding the mandate and accountability of central banks, potential conflicts between goals, as well as their institutional independence. Central banks' credibility may suffer when they take on and fail to achieve additional goals." In the absence of additional tools, the authority would significantly risk compromising other important goals. Although accounting for financial and macroeconomic risks from climate change can be considered implicitly included in the financial stability mandate of a central bank, the extent to which monetary tools are used to promote green investments should be evaluated. Especially if the promotion of these investments conflicts with other goals of the central bank.

A second warning is the risk of increased power in unaccountable institutions. The author explains that following the financial crisis, many central banks have faced criticism for policy decisions that were considered quasi-fiscal and beyond the central bank's mandate. Consequently, a significant risk to central bank independence would be the repercussion of not being able to deliver on additional objectives, especially given that monetary policy has its limits. As such, the only option for central banks that are including additional environmental and sustainability targets, would be to improve central bank accountability through enhanced reporting and transparency. A final limitation is that central bank frameworks may have little room to include additional objectives other than macroeconomic and financial stability, and it might be counterproductive to overwhelm the tools and instruments of a central bank in targeting these additional objectives.

According to Oman 2019, there are some changes central banks can make that will be less disruptive. The author suggests that a move to include climate-related policy into the monetary framework should see central banks creating their assessments of climate risk and ensuring that these risks are adequately represented in their asset and collateral portfolios. To improve climate risk assessments, corporate governance reforms, and better categorise green assets by creating a standardised taxonomy, tools for financial policy include reserve, liquidity, capital requirements, loan-to-value ratios, limits on credit growth, climate-related stress tests, disclosure requirements, and financial data dissemination.

Careful consideration must be given to the legal framework needed for central banks to implement major adjustments to integrate climate change policy into monetary systems. The legal authority for the Federal Reserve to implement climate change policy is examined by Skinner (2021). Financial institutions may experience losses as a result of owning assets in carbon-intensive industries under the transition risk linked with climate change legislation. The study focuses on the US Federal Reserve's (US FED) legislative capacity to participate in climate change policy, but the larger principle applies to other central banks and their legislative capacities regarding climate change mitigation using monetary policy tools. The paper concludes that *"the Fed currently lacks legal authority to engage its monetary policy tools in pursuit of 'offensive' programs like 'green quantitative easing'. Nor would the use of regulation or supervision to deter certain kinds of "brown lending" sit well within the Fed's existing legal framework."*

4. The Role of Central Banks in 'Greening' Economic Outcomes and the Financial System

The financial sector has a critical role in mitigating climate change challenges. Some of these roles include financing the transition, encouraging sustainable investments, and managing climate risks on

the portfolios of financial institutions. In light of these roles, the central bank would be vital in setting policies and regulations that encourage the transition to a sustainable and low-carbon economy. From a regulatory perspective, central banks would be required to incorporate climate risks into their supervisory and regulatory framework and financial stability assessments. Authorities would also be needed to promote green finance, support green investments through special lending facilities or green monetary policy actions, and encourage transparency and disclosure within these areas. Lastly, central banks would be required to conduct research and analysis on the impact of climate change and climate transition on the financial system and the economy.

The goals of the central banks have historically been linked to economic growth, stable inflation, and high employment. However, financial stability has become an important concern since the Global Financial Crisis (GFC). According to Volz (2017), in its simplest form, monetary policy was designed with one target, inflation, and one instrument, the policy rate. However, this strategy is highly inefficient given the numerous macroeconomic goals of an economy, and instead, there are many targets and many instruments, which creates a complicated problem. According to the Tinbergen (1952) principle, the number of policy goals cannot exceed the number of policy instruments. Therefore, monetary authorities must ensure that in order to achieve various targets, there must be at least an equal number of effective instruments (Volz 2017 and Campiglio 2018).

In current times, central banks have numerous tools, instruments, targets and goals (**Table 1**). However, Volz (2017) explains that if a monetary authority has more targets than instruments, the system can be considered ‘underdetermined’, limiting the attainment of at least one target. On the other hand, if a system contains more instruments than targets, then the system is ‘overdetermined’ with more than one way of achieving the combination of targets. Consequently, with the addition of environmental targets and objectives, economic policy will likely become even more complicated. For a discussion on the potential policy tools a central bank can use in enhancing green investments, see **Box 1**.

Table 1: Tools, Instruments, Targets, and Policy Goals of Central Banks

TOOLS	POLICY INSTRUMENTS	INTERMEDIATE TARGETS	GOALS
Discount Policy	Reserve Aggregates/ Monetary Base	Monetary Aggregates	Low and Stable Inflation
Reserve and Capital Requirements	Interest Rates	Interest Rates	Financial Stability
Open Market Operations	Capital Controls	Inflation Expectations	High Employment
Foreign Exchange Operations	Micro- and Macroeconomic Instruments	Bank Credit	Economic Growth
Capital Account Management	Swap Lines	Inflation	Exchange Rate Stability
Macroprudential Policies		Exchange Rate Stability	Stable Interest Rates
Risk Guidance Policy		Current Account Balance	External Stability
Central Bank Communication		Financial Stability Targets	Financial Market Development
International Corporation		Environmental Targets	Environmental Objectives

Source: Adapted from Volz (2017)

Box 1: Potential Policy Tools of a Central Bank in Enhancing Green Investments

In light of the market failure and financial sector risks argument, a central bank can employ several policy tools to improve the efficiency of credit allocation to environmental projects and green investments. The following summarises some of these tools, as indicated by Volz (2017).

Considering the potential climate-related financial risks from asymmetric information and the mispricing of assets, the TCFD (2016) recommends mandatory disclosure requirements as the basis for green macro-prudential regulation and climate-related stress testing. Disclosure requirements would improve the transparency of climate-related risks and allow more effective risk pricing and capital allocation.

Green macro-prudential regulation and climate-related stress testing would allow authorities to account for externalities caused by environmental imbalances, which can give rise to financial instability. These systemic risks could be addressed by introducing credit ceilings to carbon-intensive or polluting industries while credit can be prioritised towards environmental and sustainable investments. Macroprudential instruments can also include countercyclical capital buffers, higher risk weights for carbon-intensive sectors, and exposure concentration restrictions to these sectors. Furthermore, climate-related stress tests can be used to evaluate the impact of hypothetical climate scenarios and assess the resilience of the financial systems.

Another tool a central bank can employ is a green policy instrument to encourage green credit allocations. For example, if commercial banks provide subsidised loan rates to priority green sectors, then the central bank can offer a differential rediscount rate to these commercial banks. The lower rates will allow commercial banks to be compensated for lending at subsidised rates to borrowers involved in green or sustainable projects.

A central bank can also influence credit allocation via the use of an alternative reserve requirement. Considering that variable asset-based reserve requirements have been used to promote lending to desirable sectors, monetary authorities could allow lower reserve requirements based on commercial banks' green asset portfolio composition. A similar policy was implemented by the Central Bank of Lebanon (Bank of Lebanon 2010), where commercial banks with a higher share of green lending are subject to lower reserve requirements. Central banks can also consider greening their monetary policy rates which will require financial institutions to pledge green collateral.

Similar to differentiated reserve requirements, a central bank can implement alternative capital requirements towards commercial banks that allocate credit to green and sustainable investments. While consideration should be given to asset quality and credit risks, a central bank can adjust the capital adequacy ratio or the risk weights on green assets that satisfy certain requirements. These green assets should satisfy additional requirements such as transparency and disclosure in an effort to limit the risk of greenwashing⁵ assets on a bank portfolio. Providing these conditions are satisfied, lower reserve requirements would allow a commercial bank to create more credit and reduce capital requirement costs.

Another less conventional tool would be implementing green quantitative easing (green QE) and reserve management. In this case, asset purchases could be directed towards purchasing green financial assets or green bonds. Using green QE would reduce the interest cost of green assets and investments and therefore give preference to lending that promotes environmentally responsible development.

⁵ Greenwashing occurs when a company misleads investors on the business's environmentally friendly or sustainable practices. To avoid greenwashing, investors should evaluate environmental claims and use independent certifications and reviews to verify the company's claims.

With respect to guidelines and frameworks, a central bank can implement green credit guidelines comprising frameworks for environmental risk assessments and green investment incentives. A similar guideline, the Green Credit Guideline, was undertaken by the China Banking Regulatory Commission in 2012, encouraging the banking sector to focus on green credit and the reduction of environmental and social risks. This was complemented by the Green Credit Monitoring and Evaluation mechanism and a key Performance Indicators Checklist in 2014, evolving the initial guideline into a metrics-driven performance assessment. Additionally, given a central bank's ability to influence economic and financial outcomes through non-coercive means, such as persuasion, reputation, and credibility, then the bank can use its soft power to promote the development of green market segments and practices. Through this influence, a central bank can include climate and environmental policies on the agenda, signalling its importance to the objectives to the economy.

5. Incorporating Green Instruments in Monetary Operations

Numerous financial instruments can be used to finance green projects, however, green bonds are considered the most popular and effective financial instrument for funding environmental and sustainability projects (Appendix B). Green bonds generally provide a dedicated and transparent mechanism for raising capital for environmental and sustainability projects, while providing opportunities for financial returns. Issuers frequently follow internationally recognised principles, which provides transparency and accountability through reporting on the environmental impact of funded projects. Furthermore, the popularity of green bonds has increased notably given a growing market of socially responsible investors who seek to align their investments with environmental and sustainability principles. By facilitating the flow of capital towards these projects, financial markets can drive significant positive change, contribute to a more sustainable future, and support the transition to a low-carbon economy.

Given that green bonds can play a significant role in transitioning to a low-carbon economy and promoting sustainable development, monetary authorities in emerging economies need to consider plausible avenues to support the development of a green bond market. One option is to allow the short-term money market to be sufficiently liquid to support green bond issuances. While this can conflict with primary monetary objectives, effective market liquidity management can provide support to green bond issuances. An example of liquidity support was instituted by the Bangladesh Bank offering a low-cost refinancing window to provide liquidity support to lenders for green financing (UNEP 2016). The Bangladesh Bank also uses incentives and moral suasion to motivate banks and financial institutions to increase financing for green businesses, in addition to instituting macroprudential support measures such as lower equity margin requirements to favour socially and environmentally beneficial initiatives.

Considering that central banks influence the cost of funding through interest rates, then the current bias towards high-carbon assets cements existing financial market misalignments (Campiglio 2018). A potential solution would be to incorporate eligible green bonds into asset purchases and open market operations. This will increase the demand for green bonds and help to lower the borrowing costs for green bond issuers. Alternatively, direct lending towards eligible green bond issuers at lower costs or subsidised rates can reduce the borrowing costs for issuers and support the development of the green bond market. Additionally, this can drive the mobilisation of private capital towards environmental and sustainability investments.

Another avenue would be for a monetary authority to include eligible green bonds in asset and collateral frameworks. By including green bonds as collateral, or enabling the purchase of green bonds in quantitative easing asset purchases, the central bank would increase the demand for these asset types, lower borrowing costs and encourage market development. Furthermore, this provides a source of liquidity for green bond issuers and increases the attractiveness of green bonds for investors.

Schoenmaker (2021) examined an approach for adjusting the European Central Bank's (ECB) asset and collateral framework towards low-carbon assets. The author determined that the ECB's portfolio was overweight in high-carbon companies, which improved liquidity and lowered the cost of capital for these companies, resulting in higher carbon emissions. The study examined the possibility of altering the ECB's portfolio towards eligible low-carbon assets while avoiding any disruptions to the monetary policy transmission. Disruptions were avoided via three conditions. The first was to avoid major changes to the asset mix, currency denomination and maturity, which are chosen to smooth monetary policy and manage reserves. The second was to keep the eligible list of green assets as broad as possible to minimise the impact on the market and price formation. Lastly, the adjustment should be undertaken gradually to ensure no significant shock to the transmission mechanism and permit smooth portfolio rebalancing.

Overall, the study determined that a tilting approach minimises distortions in the asset and collateral base by gradually over-weighting low-carbon and under-weighting high-carbon assets. This approach is somewhat confirmed given the practical limitations in correcting brown biases in central banks' operations (Campiglio 2018). In a European Money and Finance Forum conference report, Campiglio (2018) recounted that there is not enough volume of green bonds available to satisfy central banks' required volumes. Consequently, excluding high-carbon assets into a portfolio mix would unduly limit a central banks' abilities, and instead, a gradual portfolio shift would be best suited.

While the inclusion of green bonds in monetary policy actions can support the transition to a low-carbon economy and promote sustainable development, this should only occur if green bonds can satisfy specific requirements. This includes having a transparent and credible framework for verifying the environmental sustainability of the projects, in addition to criteria such as the use of proceeds, reporting requirements, and third-party certification. Green bonds would also need to meet standard credit risk criteria and have sufficient liquidity to be included in central bank operations. Finally, the use of green bonds in monetary policy would need to be consistent with monetary policy objectives and the central bank's mandate, which may include considerations such as financial stability, inflation, and economic growth.

6. The Central Bank of Trinidad and Tobago's Road Map to a Green Monetary Policy Agenda

Financial Institutions

Global central banks continue to place a high priority on climate change issues, and the Central Bank of Trinidad and Tobago (CBTT) has undertaken a number of steps to advance the local agenda. But, the CBTT may go even further to guarantee that a foundation is built to support the pursuit of a green monetary policy. First, it is necessary to include a research agenda on climate change and some of its effects on the economy and the financial system. In particular, research aimed at enlarging and enhancing the analytical tools at the disposal of central banks in order to better understand how

climate change may influence the economy in the long-run. Examining the potential economic and financial market disruption brought on by climate-related shocks, as well as the physical and transitional risks will aid the adjustment of monetary policy frameworks to address climate risks.

Financial market monitoring is essential for greening monetary policy. One technique for assessing the financial markets' capacity to withstand climate change threats is stress testing. In addition to encouraging market participants to stress test their portfolios, the CBTT may use a climate stress test scenario which trace the dynamic interactions between the macroeconomy and the financial system on account of climate-related developments. In addition, the bank may need to promote transparency by publishing climate risk stress testing, analysing the effects on the financial system, and encouraging the financial sector to reveal their particular findings.

The CBTT may also assess its current monetary policy critically and deliberate on implementing innovative initiatives that may support the economy in the aftermath of a climate related event. According to Fratzscher et al. (2020), the inflation targeting monetary regime often performs best after a natural disaster. To determine which monetary policy goals will be most effective in the wake of a climate-related shock, the CBTT may wish to consider a range of options. The option of greening the Bank's Repo rate can be considered. This will require the Bank to ensure that commercial banks only use green collateral to enter the repurchase market warranting that commercial banks green their balance sheets.

Notwithstanding the further steps that must be taken to advance green monetary policy, the CBTT has made significant progress in addressing climate change. The CBTT altered its internal procedures, examining the bank's energy effectiveness and calculating the bank's carbon footprint. Moreover, the bank has collaborated with several international organisations and other central banks to advance the climate change agenda, actively joining the NGFS with representation in two work streams (Supervision and Scenario and Design Analysis). In terms of investments, the Bank authorised the placement of around 2 per cent of the nation's reserves in Environment, Social, and Governance (ESG) instruments. World Bank Sustainability Bonds received a US\$30 million investment from CBTT in September 2022.

Industrial Policy

The development and dispersion of 'green' technology may be subject to the traditional market failures used to justify industrial policy (IP). However, economists and policymakers alike tend to be sceptical of IP as an effective intervention against market failures generated by the inability of innovating firms to internalize the associated benefits. For as many historically successful cases of applying IP, there are also examples of major and lasting failures. Nevertheless, the case for green IP is identifiable.

The hypothetical gold standard for monetary support of green IP however remains green quantitative easing (QE). Green QE would entail a central bank committing to purchase a fixed proportion of its balance sheet in green bonds, or to purchase in entirety the assets of a 'green investment fund' mandated to finance the green economic sector, and managed by an independent government agency (Bailey, 2019). Ideally, green QE would act to mitigate positive externalities associated with investing in green, low-carbon technology, with the commitment of the monetary authority to purchase green bonds providing a ready source of finance. This readily available finance should then boost investment in renewables, energy efficiency, and bolster overall output levels. Additionally, a desirable effect of

green QE would be the long run reduction of global temperatures. There is little empirical work concerning greening QE programmes, in either advanced or emerging economies. Nevertheless, some simulations show that while green QE can result in modest long run temperature reductions, it achieves this at the expense of crowding out private capital in the green sector. In fact, moderate carbon taxation is shown to significantly outperform green QE in achieving goals related to the reduction of temperatures, emissions, the carbon stock and environmental damage (Abiry, et al., 2022). With respect to green IP therefore, it is evident that monetary policy will likely play a secondary role to fiscal and regulatory approaches. Current evidence suggests that green bond issuance will be supported by fiscal incentives and capital market development efforts. Nevertheless, as a matter of supporting competitiveness in the green sector, the subsidizing effect of green QE, as well as the supportive regime for green bonds would still have positive effects, and can be used in a complementary role to other green industrial policies.

Capital Market

Within the domestic sphere, the financing of environmental and sustainability projects via green bonds can be achieved via domestic or international sources. However, this depends on the specific characteristics of the project being financed. Such features include project complexity and funding requirements, currency resources, domestic capital market ability to finance the project, project sponsors, length of project, and others. Given that some environmental and sustainability projects would require large amounts of financing; the international route would be the only feasible option. However, this would require the satisfaction of a variety of conditions prior to being classified as a green bond. Alternatively, for smaller financing needs, the domestic bond market could be a potential solution.

In many cases, the scale and complexity of environmental and sustainability projects require substantial amounts of funding and resources, which can be challenging to obtain on the domestic market through traditional means. Consequently, these projects would require financing via a US dollar green bond issued on the international financial markets. In such a case, the green bond would have to satisfy various internationally accepted green bond guidelines and principles, and would require the establishment of a domestic green bond framework and the satisfaction of the core components. Furthermore, following the successful issuance of the US dollar green bond, the domestic issuer would have to engage in external review requirements.

Alternatively, smaller environmental and sustainability projects can potentially access financing from the local market. While the domestic appetite for TT dollar investments can be significantly high, domestic commercial investors, such as mutual funds and investment firms, may have the appetite and ability to finance domestic foreign currency investments. Considering that the domestic primary bond market primarily issues bonds via private placements, then this option would likely be the easiest to access financing. However, while it is common practice to engaging potential investors privately, the development of the primary bond market could be encouraged by offering green bond investments publicly to retail investors. Additionally, a domestic green bond issuer and sponsor should attempt to satisfy similar conditions and requirements as international bond issues in an effort to develop the expertise and capacity to issue larger US dollar green bonds on external markets. Furthermore, following international standards and conditions would help to promote transparency and accountability, paving the way for future domestic and international green bond issues.

The central bank can play a pivotal role in supporting the issuance of green bonds and developing the domestic capital market. Through collaborative partnerships with stakeholders such as other regulatory agencies, government enterprises, and financial institutions, a central bank can assist in accelerating the adoption of sustainable finance practices and creating a supportive ecosystem for green bond activities. This includes developing the necessary regulatory frameworks and market infrastructure, providing incentives, building capacity, and promoting information transparency. These developmental initiatives will encourage the issuance of green bonds and establish a vibrant green bond market.

Regulatory Support of a Green Bond Market

The underdevelopment of the domestic bond market, and the dominance of the domestic commercial banking sector in credit supply limits the ability of the local bond market in facilitating bond issuances. However, given that financing environmental and sustainability projects would require large financing resources combined with higher risk appetites, then the domestic bond market would be essential. In small open economies with underdeveloped bond markets, regulators would therefore be required to enact appropriate policies and guidelines to support the development of a green bond market.

First, regulators would need to promote a sound and legal bond market framework to support the development of the market. This would ensure that green bonds issued on the domestic market would be guided by a structure that supports the issuance of the bond and builds investor confidence and ensuring that all market participants are protected. Secondly, regulators would be required to develop market infrastructure such as trading platforms, clearing and settlement systems, and custody services. Given that the domestic financial system already has these infrastructural characteristics, regulators would be needed to support and promote the ease of usage of these services. This can be done by encouraging a green bond issuer to list the bond via a public offer or auction, utilising the trading platforms and other infrastructural systems. Furthermore, to ensure that the bonds are fully financed, regulators could encourage the participation of financial intermediaries such as investment firms, mutual funds, and brokers.

Lastly, regulators would be required to encourage transparency and promote investor protection. Transparency and investor protection are crucial for building investor confidence and minimising market manipulation. However, in small underdeveloped financial markets, often with illiquid market structures, investors may be hesitant to invest. Additionally, in small markets, investors may be limited in number and in bond market experience. Regulators can address these concerns by requiring issuers to provide investors with accurate and timely information on the terms of the bonds, the financial condition of the issuer, associated investment risks, and disclosure on investment positions. Furthermore, regulators can ensure that issuers maintain adequate levels of disclosure and transparency, and adhere to accounting and reporting standards.

Other areas where regulators can support the development of a green bond market is by developing rules for credit rating agencies that incentivise the development of green rating methodologies and require issuers to disclose environmental, social and governance (ESG) factors related to the bond. Additionally, regulators and stakeholders such as governments, multilateral organizations, and the private sector can collaborate and leverage their expertise, resources and networks to promote the growth of the green bond market and accelerate the transition to a low-carbon economy.

7. Conclusion

Climate change has been shown to have far-reaching impacts on the global economy, directly affecting resources, agriculture, labour, and financial services. The report by the NGFS 2020 highlights the diverse and significant influence of climate change on the global economy, highlighting that climate change and its mitigation will increasingly affect macroeconomic conditions and the conduct of monetary policy. Consequently, policy actions should consider the various effects of transition risks, extreme weather events, and gradual warming, while taking into account uncertainties, which require varying assessments.

In light of the complicated nature of climate change and its effect on macroeconomic conditions, central banks have been exploring ways to manage climate change risks while promoting a green economic transition through "green monetary policy." By incorporating climate risks into monetary policy frameworks, central banks' can encourage financial institutions and markets to consider climate risks in their decision-making processes and encourage funding for sustainable projects. Furthermore, given the vast amount of investments needed to bring about a green transition, Volz (2017) explains that the financial sector and Central Bank will be required to play a central role in allocating resources towards a sustainable and green economy while reducing the financing of carbon-intensive and environmentally harmful activities.

However, Volz (2017) acknowledges that environmental factors and policy actions can impinge on the conventional goals of a central bank, while concerns have been raised about overburdening policy tools and engaging in climate change issues without conditions. Despite this, including climate risks in monetary policy frameworks may aid in the shift towards a more sustainable economy. Consequently, a calculated and cautious approach would be required by central banks, given the changing roles of these institutions. Thus several caveats ought to be engaged when considering how central banks ought to support the adoption of climate related policy. Small open commodity exporting in particular economies were demonstrated to be likely to suffer significantly negative impacts to production possibilities. Adopting climate policies in the first instance may result in weakening external conditions in small commodity exporters, which would be compounded if the exchange rate was inflexible. Furthermore, global application of climate policy may derogate foreign demand, resulting in further economic destabilisation. In the long run, small commodity exporters with fixed exchange rates can expect a much lower output path resulting from adopting climate policy. Monetary policy may act as industrial policy by engaging green QE in a bid to raise alternative sources of productivity, but while the effects on actual climate change are positive, it is unclear whether monetary policy can obtain a role that is anything but complementary to other climate policies.

Nevertheless, central banks globally have made progress in integrating climate concerns into monetary policy frameworks, although it remains a relatively new issue. The Central Bank of Trinidad and Tobago has taken steps towards energy efficiency, but more work is needed to incorporate environmental considerations into the monetary system. A critical area of research is needed on the implications of integrating climate concerns into monetary policy and the effects of climate change on economic injections and leakages and how monetary policy can better support risk mitigation. As such, this study explores the impact of climate change on the IS-LM framework and the governance framework required for green monetary policy. It evaluates the role of central banks in promoting a greener financial system and discusses the financing of green projects through green bonds. The paper

also examines the role of monetary policy in supporting the green bond initiative and charts a course for the Central Bank of Trinidad and Tobago to integrate climate change into its monetary policy framework.

Appendix

Appendix A - Dynamic IS-LM model

Dynamic IS-LM model:

$$\text{IS Curve: } y_{t+1}/(1-b) - (1+b/1-b) * y_t + (b/1-b) * y_{t-1} + \pi_{t+1} = R_t + v_{t+1} - v_t$$

$$\text{Prices: } \pi_t = [(1-\gamma) * (1+\beta\gamma) / (1-\gamma) * (1+\beta\zeta)] x_t + (\beta/1+\beta\zeta) * \pi_{t+1} + (\zeta/1+\beta\zeta) * \pi_{t-1}$$

$$\text{Taylor Rule: } R_t = \rho_r R_{t-1} + (1-\rho_r) * (\alpha_\pi \pi_t + \alpha_y y_t) + \epsilon_t^r$$

$$\text{Markup: } x_t = [1 + \sigma_h(1-b)/(1-b)] * y_t - (b/1-b) * y_{t-1} - (1 + \sigma_h) a_t$$

$$\text{Technology shock: } a_t = \rho_a a_{t-1} + \epsilon_t^a$$

$$\text{Preferences: } v_t = \rho_v v_{t-1} + \epsilon_t^v$$

Baseline Model Calibration:

$b = 0.8$; (Habit preferences)

$\beta = 0.99$; (Discount factor)

$\sigma_h = 1$; (Inverse of labor supply elasticity)

$\gamma = 0.75$; (Probability of keeping price)

$\zeta = 1$; (Indexation)

$\rho_r = 0.75$; (Interest rate smoothing)

$\alpha_\pi = 1.5$; (Reaction to Inflation)

$\alpha_y = 0.15$; (Reaction to output)

$\rho_a = 0.95$; (Persistence of Technology Shock)

$\rho_v = 0.95$; (Persistence of preference shock)

For the climate policy shock, the persistence on the technology shock was reduced to 0.90, the reaction to inflation reduced to 1.2, the reaction to output reduced to 0.1 and the Calvo probability of keeping prices reduced to 0.5. Standard deviations need to be applied in the estimation of the monetary policy, technology and persistence shocks (taken as 0.01 in all cases here).

Appendix B - Financing Projects via Green Bonds in Financial Markets

The global pursuit of environmental sustainability has become an increasingly pressing concern, with countries seeking ways to reduce their environmental impact and promote sustainability. However, the scale and complexity of many environmental and sustainability projects require substantial amounts of funding and resources, which can be challenging to obtain through traditional means.

Financial markets can therefore play a crucial role, providing a platform for investors to fund and support these projects while providing opportunities for financial returns. By enabling the flow of capital towards environmentally beneficial projects, financial markets have the potential to drive significant positive change, supporting the transition towards a more sustainable future. Furthermore, considering that the future of humanity may depend on the attainment of sustainable development, the promotion of 'green growth'⁶, and the reduction of greenhouse gas (GHG) emissions (Mo et al. 2022), then green investments and financial institutions can play an essential role in this regard.

However, financing these projects can be challenging, given the long-term nature and associated risks of environmental and sustainability projects. Various financial instruments can be used to fund these projects, such as bonds, equity, and venture capital; however, Green Bonds are considered the most popular financial instrument used for environmental projects. Green bonds are fixed-income securities used to raise capital for, or re-finance, environmental and sustainability projects via debt capital markets. Governments, corporations, or other organisations typically issue these bonds, and the proceeds are often earmarked for specific projects. The key difference between green bonds and regular bonds is that the issuer of a green bond explicitly states that capital is being raised to finance or re-finance green (climate-sensitive) projects, assets, or businesses, with an environmental or social benefit (KPMB 2015 and Velloso 2017).

The benefits of green bonds are numerous and far-reaching, making them an attractive financing option for investors and issuers. Green bonds provide a mechanism to mobilise capital for a wide range of environmental and sustainability projects which can promote sustainable economic growth and development, reduce negative environmental impacts, promote resource efficiency, and support the transition to a low-carbon economy. Green bonds can also provide a way for issuers to access a growing market of socially responsible investors and portfolios. As more investors seek to align their investments with environmental and sustainability principles, green bonds offer an attractive option. Furthermore, this can help issuers expand their investor base and access new funding sources. Additionally, green bonds provide a mechanism for measuring and reporting on the environmental impact of projects. By requiring issuers to report on the use of proceeds and the environmental benefits of funded projects, green bonds create transparency and accountability, helping to ensure that investors are able to track the progress and impact of their investments.

Despite the potential benefits of green bonds, there are numerous drawbacks. For example, the issuance and ongoing costs associated with a green bond could be greater due to expenses related to additional tracking, monitoring and reporting processes, as well as up-front investment to define the criteria and sustainability objectives of the bond (KPMG 2015). Additionally, investors may also seek

⁶ According to the OECD (n.d.), 'Green Growth' refers to fostering economic growth and development that is sustainable and environmentally friendly, while ensuring that natural resources are sustained. The concept of green growth recognizes that traditional economic growth models are not sustainable in the long run and that environmental and natural resource degradation can have significant negative impacts on economic and social well-being.

to obtain a premium for investing in green bonds due to the risky nature of some environmental projects with minimal financial returns.

Another critical drawback is the increased potential of 'greenwashing', which can leave issuers of genuine green projects open to criticism and accusation. Beschloss and Mashayekhi (2019) explain that instances of dubious market players entering the market have blurred the lines between sustainable and non-sustainable projects, igniting the need for more robust guidelines and verification systems. As a result of limited standardisation criteria or requirements for tracking and reporting, issuers of green projects must ensure that they minimise the reputational risks associated with green projects. Greenwashing erodes public trust in environmental claims, creates market distortions that disadvantage genuine projects, and diverts attention and resources from real solutions. Consequently, greenwashing can increase the investment cost of environmental and sustainability projects, delaying many beneficial projects due to higher financing costs.

Lastly, a major limitation to the use of green bonds in resource mobilisation is that this instrument may only be available in regions and economies with access to well-developed capital markets or international bond markets (Velloso 2017). According to the United Nations Environment Programme (UNEP) (2016), developing countries with underdeveloped financial systems often face particular challenges in financing development priorities, including environmental and sustainability objectives. Within smaller economies with less developed capital markets, the ability to issue and finance these instruments may be limited by a combination of regulatory hurdles, financial sector capabilities, insufficient investor base, and even the presence of other dominant lending facilities.

Types of Green Bonds and Green Bond Principles (GBP)

Although there are no universal formally accepted guidelines that govern the issuance and designations of green bonds, the International Capital Market Association (ICMA) has established various principles, guidelines, and designations to promote transparency and integrity in the market (Velloso 2017). Furthermore, according to Beschloss and Mashayekhi (2019), despite competing standards and the absence of solid compliance mechanisms, the ICMA and Climate Bonds Initiative (CBI) have tailored green bond issues to clear metrics and ensured that projects deliver relevant benefits. Generally, issuers of green bonds adhere to the principles' core components, which dictate the best practices related to bond issuance, assessments, transparency, reporting, and characteristics.

The ICMA (2021) mentions four main types of green bonds. The first is a standard use of proceeds green bond issued with the explicit purpose of financing earmarked environmental projects. Generally, these bonds will typically include detailed information about the use of proceeds⁷, including the type of projects, the expected environmental benefits, and the estimated timeframe. The bond issuer may also be required to routinely report on the use of proceeds and the environmental benefits of funded projects. Another type of green bond is the green revenue bond, where the credit exposure is tied to cash flows from the revenue streams, fees, and taxes. The third green bond is the green project bond which can be linked to financing a single or multiple green projects. Investors in green project bonds typically have direct exposure to the risk of the financed project, with or without

⁷ Eligible green bond projects could include investments into renewable energy and energy efficiency; pollution prevention and control; environmentally sustainable management of living natural resources and land use; terrestrial and aquatic biodiversity; clean transportation; sustainable water and wastewater management; climate change adaptation; circular economy adapted products, production technologies and processes; green buildings (ICMA 2021).

recourse to the bond issuer. Lastly, green securitised bonds are collateralised by a single or multiple green projects where the source of repayment can be tied to the cash flows of the underlying assets.



Eligible green bond projects could include investments into renewable energy and energy efficiency; pollution prevention and control; environmentally sustainable management of living natural resources and land use; Terrestrial and aquatic biodiversity; Clean transportation; Sustainable water and wastewater management; Climate change adaptation; Circular economy adapted products, production technologies and processes; Green buildings.

Additionally, to be classified as a green bond, the security must be aligned to a set of internationally acknowledged and accepted principles⁸ and guidelines, such as the Green Bond Principles (GBP), Social Bond Principles (SBP), the Sustainability Bond Guidelines (SBG) and the Sustainability-Linked Bond Principles (SLBP). The principles are a collection of voluntary frameworks designed to promote debt capital markets' role in financing progress towards environmental and social sustainability (ICMA 2021). Given the similarities between the various principles, this report focuses on the GBP. The International Capital Market Association (ICMA 2021) explains that the GBP are a collection of voluntary frameworks designed to promote the role of debt capital markets in issuing green bonds and therefore financing progress towards environmental and social sustainability. The principles are important as they help ensure transparency, integrity, and credibility in the green bond market by providing guidance on aspects such as the use of proceeds, project evaluation and selection, reporting, and verification. Furthermore, the principles ensure that green bonds are aligned with international best practices and standards.

The GBP provide issuers with guidance on the key components involved in issuing a credible green bond, while providing investors with the information necessary to evaluate the environmental project being financed. Generally, the GBP recommends a clear process and disclosure requirements for issuers, which investors, banks, underwriters, arrangers, placement agents and others may use to understand the characteristics of the bond (ICMA 2021). Overall, the transparency, integrity and disclosure requirements recommended by the GBP can be summarised through four core components. A comparison of the various principles and associated financial instrument guidance is shown in **Figure B1**.

⁸ According to the ICMA (2021), the Principles outline best practices when issuing bonds serving social and/or environmental purposes through global guidelines and recommendations that promote transparency and disclosure, thereby underpinning the integrity of the market. The Principles also raise awareness of the importance of environmental and social impact among financial market participants, which ultimately aims to attract more capital to support sustainable development.

Figure B1: Principles and Guidelines for Environmental and Sustainability Bonds

		Financial Instrument Guidelines
<p>Use of Proceeds:</p> <p>Green, Social, Sustainability Bonds</p> <p>Core Components:</p> <ol style="list-style-type: none"> 1. Use of Proceeds 2. Process for Project Evaluation and Selection 3. Management of Proceeds 4. Reporting <p>Key Recommendations:</p> <ol style="list-style-type: none"> 1. Green Bond Frameworks 2. External Reviews 	<p>General Purpose:</p> <p>Sustainability-Linked Bonds</p> <p>Core Components:</p> <ol style="list-style-type: none"> 1. Selection of Key Performance Indicators 2. Calibration of Sustainability Performance Targets 3. Bond characteristics 4. Reporting 5. Verification 	

Source: Adapted from ICMA (2021)

The first component is based on the use of proceeds, which is a cornerstone of a green bond. For eligible green bonds, the use of proceeds is required to be suitably described in the legal documentation. The issuer must disclose the amount of funds raised and where the funds will be allocated, in addition to details and assessments on the environmental project. The second component refers to information on the project evaluation and selection process. The green bond issuer must communicate the environmental project objectives, ensuring that the project is aligned to an eligible category, and provide information on the potential social and environmental risks. In assessing the risks, the GBP also encourages issuers to have a process in place to identify the risks and undertake monitoring and trade-off analysis when the risks are considered meaningful.

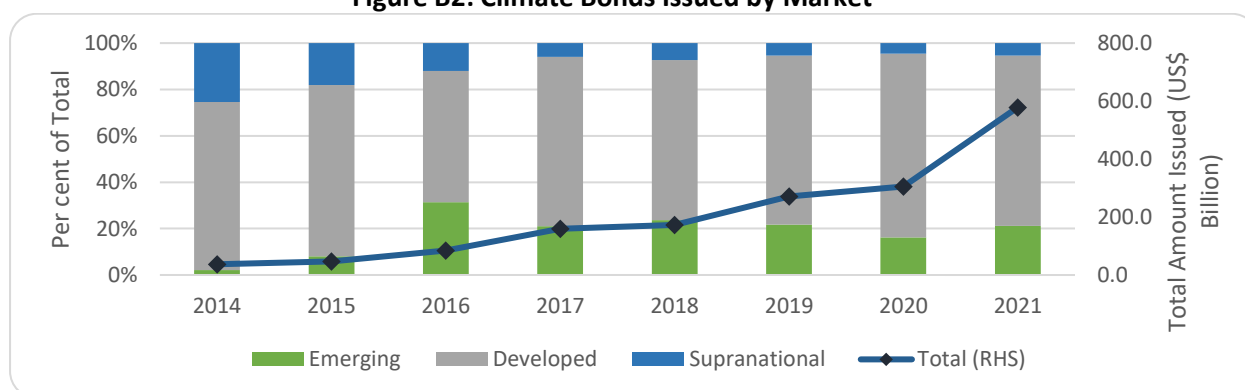
This third component covers the management of proceeds where the issuer, via a formal internal process, credits a specific account with the proceeds and tracks the usage of the funds. The balance of proceeds should be periodically adjusted to match allocations for eligible projects and disclosed to investors. Additionally, the proceeds from different green bonds by one issuer can be managed per bond or on an aggregate basis via a portfolio approach. However, the GBP encourages transparency and recommends that the management of proceeds is supplemented by external auditors. Independent reviews of an issuer ensure that the green bond framework is consistent with established principles and that the use of proceeds and reporting are in line with the principles. The final component refers to reporting, where green bond issuers provide information on the use and management of proceeds on a timely basis. Reports on project updates, allocation amounts, expected impacts, and potential risks should also be available. Additionally, given that transparency is key in communicating the expected impact of the green project, the GBP recommends that issuers employ qualitative performance indicators and measures, and disclose any underlying methodologies and assumptions.

Global Trends in Green Bonds

According to the International Finance Corporation (2016), the first green bond was issued in 2007 by the European Investment Bank, under the label Climate Awareness Bond, while the World Bank issued its first green bond in 2008. The initial challenge to develop an investment class tied to an environmental impact was considered overwhelming. However, the efforts by these supranational institutions to create a new class of securities that would be credible, replicable, and attractive to institutional investors and environmental organisations set a trend for investments in climate-related projects (Beschloss and Mashayekhi 2019). Since then, the international market for green bonds has experienced tremendous growth surpassing US\$500 billion issued in 2021 and reaching over US\$1 trillion in cumulative issuances since market inception (Climate Bonds Initiative n.d.).

Data from the CBI (**Figure B2 and B3**) shows the total amount of green bonds issued by market and region over 2014 to 2021. Justifiably, developed markets continue to be the driver in environmental project financing via green bond issues, accounting for an average of 71.0 per cent of all issues over the period. However, although emerging markets (EM) have seen some volatility with respect to their issuances, the EMs have increased their share, ending 2021 at roughly 21.1 per cent or just over US\$122.2 billion. On the other hand, while the amount issued by Supranational entities has increased, the share of total issuances has generally declined, ending 2021 at just 5.3 per cent of US\$30.9 billion.

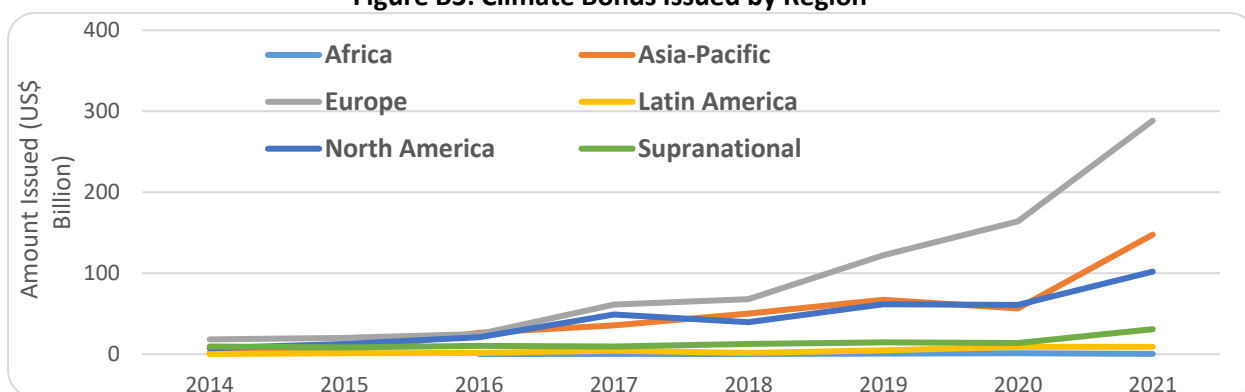
Figure B2: Climate Bonds Issued by Market



Source: Climate Bonds Initiative

In terms of regions, Europe has been the most high-volume issuer, accounting for almost 50.0 per cent of total issues in 2021 (US\$288.5 billion). This is followed by the Asia-Pacific region recording US\$147.7 billion in issues (25.5 per cent), and North America with US\$102.0 billion (17.6 per cent). While North America has generally observed consistent growth in green bonds issued, the Asia-Pacific and Europe regions have experienced stronger growth in issuances. On the other hand, Latin America and Africa has been consistently low, cumulatively averaging just 2.0 per cent of total issues over 2014 to 2021, and reaching its highest in 2020 at US\$10.3 billion issued.

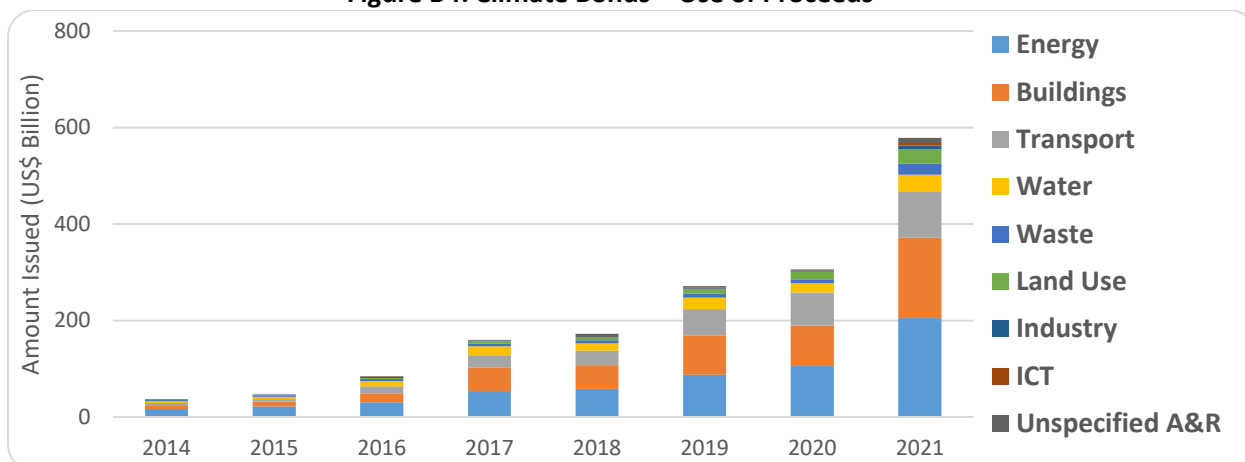
Figure B3: Climate Bonds Issued by Region



Source: Climate Bonds Initiative

In terms of issuer type, private sector (financial and non-financial corporate) issuers have become the dominant green bond originator, moving from 37.7 per cent (US\$14.0 billion) in 2014 to 51.7 per cent (US\$299.1 billion) in 2021. Government issuers, which includes sovereign, local government, and government-backed entities, also observed an increase from 15.4 per cent (US\$5.7 billion) to 32.3 per cent (US\$187.1 billion). On the other hand, development banks, which were the dominant issuer in 2014 (40.4 per cent at US\$15.0 billion), declined to just 7.4 per cent (US\$43.0 billion) by 2021. In terms of the use of proceeds, green bonds are issued for a variety of projects (Figure B4).

Figure B4: Climate Bonds – Use of Proceeds

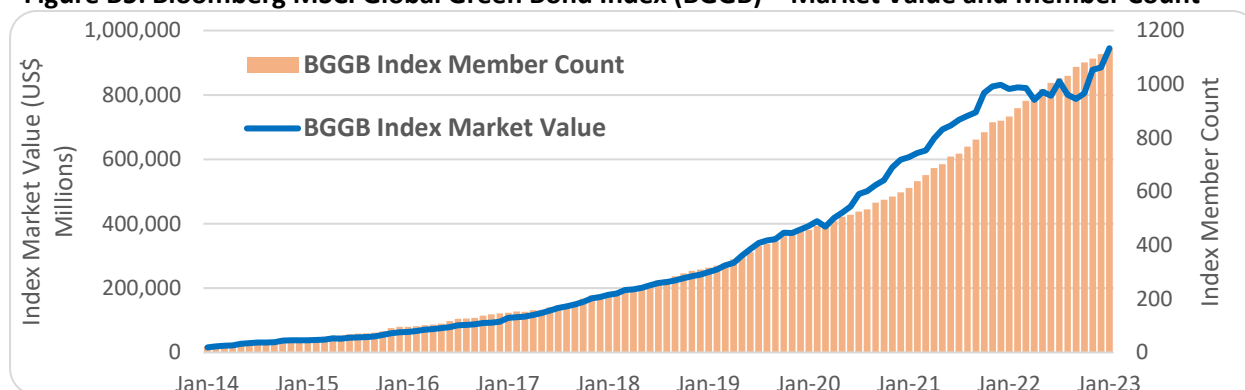


Source: Climate Bonds Initiative

Energy related projects accounts for the largest volume of green bonds, capturing an average of 37.2 per cent of the market over 2014 to 2021. This is closely followed by building projects (26.3 per cent) and transportation projects (16.7 per cent) over the same period. These three areas tend to remain the largest use of proceed categories, collectively making up just over 80.0 per cent of the green bond issues in 2021.

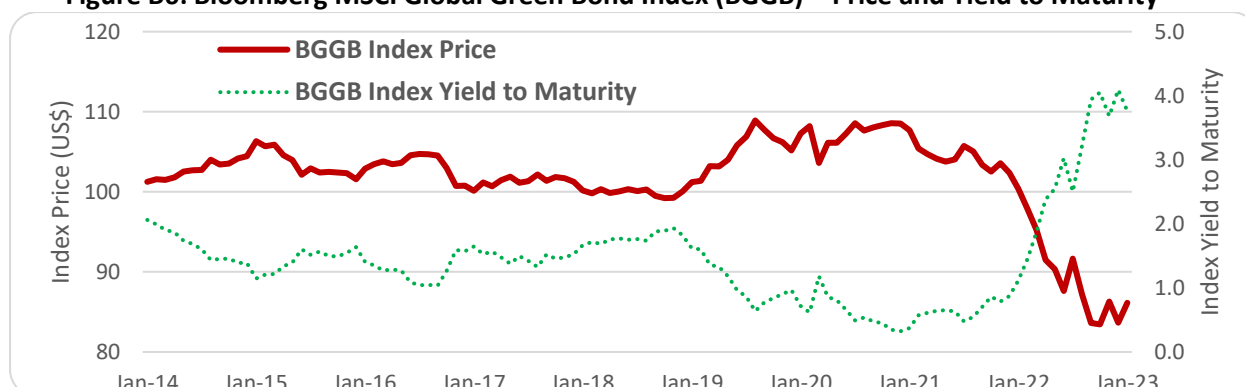
Another important metric that can shed light on the performance and growth of the global green bond market is the Bloomberg MSCI Global Green Bond index (BGGB)^{9,10}. The BGGB is a market-capitalisation-weighted index that tracks the performance of global fixed-rate green bonds issued by corporations, governments, and other entities. **Figure B5** shows the BGGB index market value and member count, providing an indication of the growth of the index and global green bond market. While **Figure B6** shows the BGGB index price and yield, which provides an indication of the index returns and price volatility.

Figure B5: Bloomberg MSCI Global Green Bond Index (BGGB) – Market Value and Member Count



Source: Bloomberg

Figure B6: Bloomberg MSCI Global Green Bond Index (BGGB) – Price and Yield to Maturity



Source: Bloomberg

Similar to data on total green bond issuances, from January 2014 to January 2023 the BGGB index has displayed notable growth in terms of member count and market value. Over the 9-year period, member count increased from 24 to 1135, while the index market value jumped from US\$15.8 billion to US\$945.0 billion. Despite the growth, the index has observed some instances of declines and volatility. Recent declines were driven primarily by volatility in financial markets, for example during the impact of the COVID-19 shock on financial markets in 2020, and followed by the impact of monetary policy tightening in many advanced and emerging market economies in 2022. Monetary

⁹ The index provides a measure of the market's perception of the overall creditworthiness and sustainability of these issuers and is designed to reflect the total return performance of the green bond market, including both price changes and interest income. The BGGB Index includes only green bonds, which are specifically designated to finance environmentally sustainable projects and activities, and excludes conventional bonds that do not meet the green bond criteria. This focus on green bonds allows the index to provide investors with exposure to issuers that are committed to sustainability, while also promoting the growth and development of the green bond market.

¹⁰ Other similar indices that tracks the performance of green bonds are the S&P Green Bond Index and FTSE Green Bond Index Series, among others.

policy accommodation and quantitative easing in response to the pandemic shock in 2020 would have placed upward pressures on bond prices and hence lowered yields. However, a reversal of monetary policy and generally strong tightening in 2022, largely in response to inflationary pressures, resulted in a large opposite effect, reducing bond prices and increasing yields.

Despite the initial challenges establishing green bonds as a viable class of securities, the market for green bonds has proved to be robust, durable, and scalable, ensuring that crucial environmental and sustainability objectives are achieved. Beschloss and Mashayekhi (2019) indicate that earmarking bonds proceeds for specific climate and environment-related projects was a major change that attracted new, impact-oriented investors and boosted incentives focusing on key public goods. Furthermore, the rigorous and transparent model for verifying green bonds developed by the World Bank, and the various frameworks and protocols established to guide investors and issuers has supported market growth.

However, despite the notable expansion in the global green bond market, the Latin America and Caribbean (LAC) region represents a very small fraction of the market, while the Caribbean region accounts for an even smaller share. According to Kravatzky (2022), one Caricom-based company¹¹ from Barbados has bonds issued on the Inter-American Development Bank (IDB) Green Bond Transparency Platform, while the Jamaica Office of the Prime Minister (2019) has reported on one windfarm¹² listed on the Jamaican Stock Exchange (JSE). Additionally, in 2021 the JSE launched its Green Bond Project to facilitate Caribbean green bond listings and to strengthen Jamaica's commitment to climate action. McIntosh (2021) explains that the Jamaica Green Bond Project is intended to raise funds on the domestic and regional debt capital markets to finance the implementation of climate-related or environmentally sustainable activities locally. However, considering that the local investor base may not have the capacity to supply the large sums required for these projects, the majority of the funding must come from international markets. On the aggregate, while the region remains a minor participant on the global green bond market, there is growing interest in alternative sustainable financing (Velloso 2017). Despite this, numerous challenges still exist, related mainly to the underdeveloped financial markets in the region.

Capital Market Development: Challenges and Requirements in Emerging Markets

Challenges

The development of a bond (debt) market is crucial to the foundation of an effective capital market, while a well-functioning money-market is essential for developing the debt market. The interbank or money-market is the key source of liquidity and dictates the level of short-term rates, while the long-term debt market allows investors to match maturity liabilities and reduce credit concentration risks. An indispensable benefit of long-term debt markets is that they help finance infrastructural development, which generally requires a long-term investment commitment (Saxena 2007). However, the author furthers that in Africa, the banking sector plays an important role in the development of debt markets as they are a major source of demand for debt instruments, provide arranging and underwriting services, and can improve investment or hedging opportunities.

¹¹ Williams Caribbean Capital of Barbados is listed as the only Caricom-based company to have issued US\$18.8 million through seven published bonds on the IDB's Green Bond Transparency Platform (Kravatzky 2022).

¹² According to the Jamaica Office of the Prime Minister (2019), the Wigton Windfarm was able to achieve 17% of domestic renewable energy generation, was listed on the JSE in 2019.

Despite the important role of the banking sector in the development of the debt market, Saxena (2007) explains that banking systems in African economies are generally highly concentrated. Consequently, this often results in the sector being imperfectly competitive, weakening the drive for financial innovation and leading to market inefficiencies such as volatile interest rates and heightened liquidity risks. High concentrations and reduced competition can also contribute to higher overhead costs and increasing net interest margins. Furthermore, these characteristics often restrict the development of debt markets due to collusion in the auctioning of government securities, and illiquidity in secondary markets due to the frequent holding to maturity (Saxena 2007). While the author discusses these traits in African economies, they are similar to other emerging market economies and generally reflect the conditions in the Trinidad and Tobago financial market.

The need for sustainable and environmentally-friendly investment has never been greater in small-open developing states, such as Caribbean economies. However, despite the global push towards sustainable finance, the financial markets in many of these economies remain underdeveloped, limiting investors' ability to support green bond financing. As discussed previously, while a dominant banking sector can restrict the development of an effective debt market, other factors often compound the challenges. These include inadequate market regulation, limited investor interest, and a lack of awareness and understanding of green bonds. As a result, the potential for sustainable investment in small developing economies remains largely untapped, leaving a significant financing gap for environmentally beneficial projects.

According to the United Nations Environment Programme (UNEP) (2016), developing countries with underdeveloped financial systems face particular challenges in financing national development priorities. Furthermore, these economies tend to be characterised by a dominant banking sector, and large areas of the economy remain unserved by the formal financial sector. Consequently, public finance and foreign direct investment are often important funding sources in these economies. Within the Caribbean, Kravatzky (2022) mentions that one of the biggest challenges will be to attract large investments across projects that involve many small players. Compounding this is the relatively low liquidity of Caribbean capital markets would create a deterrent for larger investors. Furthermore, Kravatzky (2022) states that small investments require the same amount of due diligence as large investments, increasing the transaction costs for big institutional investors, further discouraging investment.

The UNEP (2016) furthers that a lack of clear and comparable definitions for green bonds could undermine confidence, while uncertainty and high verification costs could prevent issuance. Market and institutional deficiencies, such as lack of disclosure requirements and weak environmental impact assessment capacity, can limit the ability to conduct comprehensive investment decision-making, which could result in inadequate risk management and potentially excess caution over allocations to green investments. Furthermore, the UNEP (2016) discusses that low GDP and weak fiscal positions in developing economies can encourage reliance on international financial flows, particularly for longer-term investments. This can result in further challenges and pressures on the external health of developing economies, further restricting funding opportunities.

Within the LAC region, public financing often falls short of what is needed for green and infrastructure projects, while bond financing is only available to a small sub-set of countries. In the case of small economies with less developed domestic capital markets and limited access to international capital

markets, the role of regional and multilateral banks is vital in providing direct funding (Velloso 2017). Furthermore, the author explains that to finance these developmental objectives, bonds placed in local and international capital markets could be an important part of the region's funding mixture to address its infrastructure gap and green development challenges.

Although the Latin America and Caribbean region remains a small participant in the global climate-aligned bond market, Velloso (2017) discusses that the region has placed several green bonds in local and international markets, culminating in a few important takeaways. The first is that a well-developed capital market and access to international capital markets have been critical factors in supporting green bond issuances in the region. Additionally, the strength and willingness of domestic pension funds to invest in these projects has been a vital factor in their success. Often, some level of guarantees from the government and/or regional/multilateral banks has resulted in significant market participation. However, green bond issuances in the local markets tends to show size and maturity limitations compared to those issued on international financial markets. Lastly, the most active LAC economies in local and international capital markets have launched targeted green investment initiatives such as investment funds, promotion agencies and project models.

Requirements

Given the importance of environmental and sustainability objectives in emerging economies, a green bond market can present a significant investment opportunity towards sustainable development. However, several conditions are required to ensure the development of a climate-aligned bond market. Velloso (2017) recommends first developing the local capital market, focusing on promoting green bonds and establishing practical guidelines. The author offers the example of the Mexican Stock Exchange, in collaboration with private, institutional and national market actors, in increasing green finance awareness. Within the Caribbean, the JSE Green Bond Project can be used to achieve similar awareness and market development. Velloso (2017) also recommends a supportive regulatory environment which reduces barriers to green bond investments, offers incentives to investors, and enhances credit channels towards climate-related projects. Lastly, given that the public sector may have insufficient capital to fund climate-sensitive activities, authorities should support the role of non-traditional institutional investors, such as pension funds, to help cover the financing gaps.

In light of the recommendations discussed, developing an effective and efficient capital market would be central to success of green bonds. The first step, however, would be the development of a government bond market. According to the Central Bank of Trinidad and Tobago (CBTT) (2009), an efficient government bond market is central to the development of the capital market as it provides a benchmark for the pricing of securities offered by market issuers. The rate of return on government securities is considered the 'risk-free' rate, which is used as the foundation for pricing other assets. Furthermore, Treasury Bills and Notes, which are classified as short and medium-term government securities, are used by the central bank to influence banking sector liquidity and the level of interest rates, the primary instruments and targets of monetary policy. Despite the importance of the Treasury market in debt market development and monetary policy, medium to long-term debt markets in emerging economies are often underdeveloped.

However, the government can play an important role in promoting the development of the longer-term bond market. Firstly, the government can strengthen the development of the debt market by providing timely and relevant information on its finances, debt portfolio, borrowing strategy and market activity (Saxena 2007). The government can also phase out borrowing from commercial banks

and commit to deficit financing via debt markets at market-determined rates. This will support market activity and participation by investors who previously had limited access. The government can also issue standard debt securities across the maturity spectrum at various benchmark tenors, allowing the establishment of an effective yield curve for pricing. These improvements to a government bond market would help establish a foundation for green bond asset classes.

Within the domestic environment, and despite a developed short-term money market, the medium to long-term government bond market is characterised by private placements¹³ and a small number of market participants, most of which are commercial banks. While private placements enable quicker access to funding, and are thought to be less costly than public auctions, they generally restrict participation to a small group of investors and limit an effective market-pricing mechanism. However, the phasing out of private placements and increased use of public auctions would promote the development of an efficient primary and secondary bond market, which is required for the foundation of a green bond market.

The central bank can also play an important role in developing the debt market. Specifically, given the role of the central bank in the Treasury market and open market operations, the central bank can further develop the distribution channel and auction system for government securities. While the auction of certain Treasury securities is sometimes limited to the primary dealers, effectively developing a government bond market along the maturity spectrum would require full market participation. However, a critical counterview is that allowing too many participants would increase costs and undermine the market-making role of primary dealers (Saxena 2007). Despite this drawback, an effective pricing mechanism and active secondary market can only be achieved if full market participation is allowed. Furthermore, while a bank-dominant financial system will provide some financing support, Velloso (2017) indicates that this will not suffice, and a broader range of investors would be needed to support the development of a green bond market.

Green bonds and capital markets can be essential to the funding mixture for climate and sustainability-related projects. Given that the public and private sectors alone could not guarantee the mobilisation of capital, corporation between public and private entities, in addition to national and international sources of funding, will be crucial. Furthermore, national, regional, and global multilateral development banks can play an important role through the provision of guarantees, mobilising capital, and assisting with technical cooperation, advisory services, co-financing, and innovative financing mechanisms (Velloso 2017).

¹³ Private placements refer to the sale of government securities to a small number of pre-selected institutions. Often, private placements require fewer regulatory criteria and are less costly when compared to market auctions.

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