9

Green Finance Market in India

Trends, Status and Potential for Bank Lending

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9.1. Introduction

Climate change has serious adverse effects on our planet, economy as well as the financial system. Frequent events of natural calamities in various parts of the globe has raised concerns and warnings over the sustainability of our activities. There is growing willingness now to act more responsibly, towards protecting and preserving the planet, by achieving net-zero emissions, for the benefit of future generations. There has been a rising trend in regulatory action towards defining the principles of sustainability and disclosures for organizations to adopt and comply with. There is a strong case for climate –related financial risk management, by Indian banks and FIs. India has been ranked as the seventh worst affected, among one hundred and eighty countries, in the Global Climate Risk Index 2021 (CRI 2021) of Germanwatch (Eckstein et. al. 2021). During Conference of the Parties (COP26), India declared its five-fold strategy to combat climate change risk. It includes a significant reduction of carbon intensity of India's GDP growth by 2030. This gives us a positive direction towards net zero emissions. Recently conducted COP27 edition of the climate change conference has further urged the nations to take immediate actions to limit global warming.

As per the Press Information Bureau (2022), Government of India circular, India has taken proactive role in raising certain critical issues pertaining to climate finance at the United Nations Framework Convention on Climate Change (UNFCCC). However, the concern is that India's emissions can still grow since it is a developing country whose leading priorities are inclusive development and poverty eradication. Otherwise, in its net zero pathway, India may end up compromising some economic growth

India's net zero emissions pledged at COP26 in Glasgow requires huge funding push in the nation's Budget 2022-23 to keep enough momentum to meet the deadline of 2070. Such huge funding is required to reduce dependence on coal and move towards renewable energy sources. India is one of five countries with the most exposure to extreme heat and also the third largest carbon emitter in the world. A recent estimate shows that aggregate investment support requirement to achieve India's 2070 net zero target will be Rs. 105 lakh crore with an average of Rs. 2.1 lakh crore per year. On September 23, 2022, Indian Banks' Association (IBA) set up a large working group comprising representatives of eighteen leading banks in India for handling issues regarding sustainability and green financing.

The banking system in India is, therefore, gearing up to address the requirements for developing climate finance markets. Climate change has been considered as a critical pillar 2 risks by the central banks as well as the Basel Committee on Banking Supervision (BCBS, 2020). Recently, the Reserve Bank of India (RBI)'s Sustainable Finance Group (SFG) has recommended that Indian banks need to adopt proper machinery at top level to review and enhance climate risk management initiatives. Reserve Bank of India (RBI) published its consultation paper

on Climate risk and Sustainable Finance and also one on the preparedness of Indian banks, on July 27, 2022. In the present consultation paper, RBI has proposed six areas and asked for feedback on these points. It includes immediate priorities in shaping policy discourse, way forward for the regulatory policy framework, main challenges in integrating the climate risk framework in Governance and overall timeline for implementation of disclosure/TCFD framework and other important details. It is worthwhile to mention that the task force on climate-related financial disclosures (TCFD) was formed in 2015 by the Financial Stability Board (FSB) to structure consistent and transparent climate-related financial risk disclosures for use by companies, banks, and investors in providing information to important stakeholders. It has now become important part of regulatory framework as part of growing efforts to address global climate change. It is expected that the pressure on businesses to act to the TCFD's recommendations related to governance, business strategy, risk management (process to identify and assess climate risks) and metrics & targets (emissions, climate related risk and opportunities) will scale up in future.

This chapter is an attempt to contextualize the market environment for green finance in India. Section 9.2 discusses the impacts of climate change upon financial performance of firms. Section 9.3 brings out the trends and impacts of green finance market in India highlighting some of the challenges, such as green labeling of new issues. Section 9.4 provides some empirical analysis using data from various levels, such as GDP per capita, carbon emission per capital and default rate in manufacturing sector, financial markets, before linking firm specific ESG scores and carbon emission data to credit rating. Accordingly, it attempts to derive certain key policy recommendations for enhancing green finance by banks. Section 9.5 provides concluding discussions to the chapter.

9.2. Climate Change and Financial Risk

Climate change may lead to economic damage whose amount and exact time of occurrence cannot be known in advance, but could be quite severe for financial institutions. The Basel Committee on Banking Supervision (BCBS, 2022) has highlighted that banks and the banking system are exposed to climate change through macro and microeconomic transmission channels that may arise from physical and transition risks. Natural hazards like flood, heavy rains, heat waves and wildfires can cause physical climate risk which appear in clustered regions and often exacerbate each other. For commercial banks, physical risks can materialize directly through their exposures to climate shocks through housing loans and commercial loans. Such exposures manifest themselves through increased default risk or clustered defaults in loan portfolios. Credit risk will increase if climate risk drivers reduce borrower's ability to repay and service debt. An abrupt and unexpected implied escalation of climate regulation (such as the carbon tax, restriction in greenhouse gas emissions, environmental fines or transition to low carbon economy etc.) can act as a strong exogenous shock that can influence borrower creditworthiness due to rising cost. Further, companies receiving huge environmental penalties from regulatory due to waste pollution, carbon emissions, and plastic and car producers losing significant amounts of market share due to change in legislation may adversely affect their cash-flows and dent their creditworthiness. Loans not being repaid due to crop failure and business closures due to pandemic situations may lead to simultaneous defaults. Such climate shocks can trigger fire sales at distressed price which may lead to manifold increase in loss given default (LGD).

Transition risks arise from the adjustment towards a net zero economy that requires drastic changes in policy, technology as well as shift in consumer preferences. Transition risks may hardly hit banks' loan book if there is a surge in carbon prices which may lead to rise in default probability of companies together. The sudden requirement for technology adjustment may also lead to erosion of market values of companies leading to rise in credit risk for lenders. The effect may be more prominent in high carbon intensive companies than its less carbon intensive counterparts. Many studies have recommended that economies must decarbonize their energy sectors to fulfil their climate policy

objectives. It requires huge financial resources to make investment in low carbon energy infrastructure. According to a study published in the journal Nature by Welsby, Price, Pye and Ekins (2022) almost 60 per cent of oil and gas reserves and 90 per cent of known coal reserves to remain unused to contain global warming to 1.5 degree Celsius (the Paris Agreement target). With this transition, the fossil fuel resources that will have to be abandoned (such as pipelines, power plants etc.) will end up as liability before its anticipated economic life and will be termed as "Stranded Assets". Accordingly, companies extracting oil, gas and coal will be severely affected by stranded assets due to transition to lower carbon usage. The other sectors using fossil fuels as inputs for production (such as Aviation sector) will also be adversely affected. Zhang, Mohsin and Hesary (2022) through a panel quantile regression model estimated the impact of green finance on environmental protection. They find CO2 emissions are increased due to factors like economic growth, energy consumption, trade and exchange as well as foreign direct investment. These economies or sectors will also be more vulnerable to environmental crisis. Therefore, solvency of the companies will also be dependent on performance of financial parameters. The study finds that carbon emissions will be reduced by green finance and for this promoting digital finance and carbon trading market would foster sustainable development. Climate finance supports the activities of climate change adaptation and mitigation to achieve low carbon economy and thereby give financial stability.

Research on the relationship between ESG parameters and financial performance of the companies have been conducted for decades. These studies discovered positive relationships between ESG performance and financial parameters. Corporate investments in environmental sustainability had no immediate impact on financial performance, but they had positive long-term impacts (Hang, Klingeberg and Rathbeger, 2020). Research conducted by Dorfleitner, et al. (2018) on the cross-sectional data of the companies with high ESG ratings found that returns were 3.8% higher per standard deviation of ESG score in the mid and long term. The ESG integration strategic benefits actually outperforms negative screening in a firm's risk analysis (Khan, Serafeim and Yoon (2016). Whelan, et.al. (2021) studied the relationship between ESG and financial performance of firms. They find companies experience better performance in terms of Return on Assets or Return on Equity or improvement in stock price relative to conventional investment approaches. German green mutual funds outperformed their peers in terms of risk-adjusted returns, during the financial crisis in 2007-09 and performed equal during non-crisis situation (Fernandez, et. al., 2019). After the 2008 financial meltdown, the FTSE4Good stock market indices performed better and quickly regained their value compared to non-ESG stock market indices (Wu, et. al., 2017).[1] About 24 out of 26 ESG index funds outperformed their traditional equivalents during the COVID-19 pandemic (Hale, 2020).

RBI (2020) paper highlights the risks arising from climate change to the macroeconomic outlook and provides a review of available risk mitigating policy options. Eight high frequency indicators like tourist arrivals, automobile sales, electricity demand, total trade, index of industrial production, purchasing managers' index, IIP manufacturing food products and tractor sales were used to assess the impact of climate change. The study finds that rainfall has greater impact on the economy relative to temperature change. Ghosh, Kundu and Dilip (2021) in their research paper have demonstrated that extreme weather events can increase inflation in India. Using panel data of selected coastal states of India, their regression results provide empirical evidence that natural disasters adversely impact output growth, dampen tourist arrivals and raise inflation. The study recommends that is essential to strengthen disaster management capabilities, develop scenario analysis, incentivize green projects and promote green finance to enhance resilience to climate disasters. Last year, RBI (2022a) estimated the exposure of Indian commercial banks to green transition. The research report highlighted the increase in direct exposure risk to three fossil fuel based sectors-electric chemicals and automobiles.

1. The series FTSE4Good Index is considered as a good representative indicator for ESG (Environmental, Social and Governance) investors.

It also urged the importance of monitoring the fossil fuel value chain and its linkage with sectoral default risk. Accordingly the recent RBI (2022b) discussion paper emphasizes the importance of understanding the degree of physical and transition risks for our banking sector. It broadly covers the issue of climate risk and sustainable finance. It seeks to understand desired approaches to detection and disclosure of exposure of assets to climate related risks, frameworks for management of such risks and capacity building within the banking sector. Our study attempts to throw light on imminent impact of climate change on financing pattern, firm solvency and credit risk. It tries to examine the extent to which our banking sector will be impacted through such risks and reviews scope for alternative financing options available to effectively manage climate risk.

Risk can be thought as a random event that causes a negative impact on an organization's goals. It has three major elements: scenario, probability of occurrence and severity of its impact. The climate risk can be defined as known unknown and it requires lot of investigations to understand its damaging impact. Thus, the climate risk equation will look like:

Climate Risk=f (Climate Hazard, Exposure, Vulnerability) Equation 9.1

Thus,

Climate Risk=Prob. of Climate Hazard × Vulnerability Equation 9.2

The climate hazard is referring to the peril or event that has the capacity to damage or destroy a financial asset. The peril could be through cyclone, earthquake, and flood or due to rapid technology change.

9.3. Green Financing Trends and Impacts

Financing of green initiatives and projects have received immense boost through the instrument Green Bonds. Green bonds are fixed income securities used to finance projects that are favorable to environment and provide climate benefits. These issues need to fulfill certain requirements as per the Green Bond Principles, most prominently in their use of proceeds for certain projects labelled as green or those that have positive environmental and climate benefits. Green bonds are limited to those projects for which at least 95 per cent proceeds are designated for green projects aligned with climate bonds taxonomy. Though the income earned from these bonds are allocated for environmental friendly projects but are actually supported by the issuing entity's balance sheet.

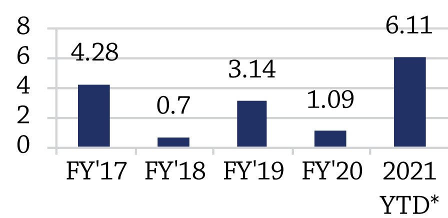
Green labeling requires certification of products and project activities in line with specific environmental standards. Such labelling acts as a positive information that distinctly separates a particular product or service as less harmful to the environment. It is an important initiative to address the problem of environmental deterioration and provides positive guidance towards sustainable development. However, green labeling may be unreliable without proper independent validation by third parties.

Due to such challenges, the various other products for sustainable finance, broadly defined as any form of financial product or service that sponsors environmental, social and governance (ESG) purposes while contributing to the achievement of environmental targets have emerged. These issues are more similar to general purpose finance but may include certain penalties for non-performance on targeted key result indicators.

Green bonds were first dispensed during 2007 from European Investment Bank (EIB) and World Bank. The market started picking up from 2014 and over time it has seen an exponential growth path with crossing USD 1 trillion in cumulative issuance in 2020. India has issued USD 6.11 billion in green bonds by end of 2021. This is quite evident in the accompanying Figure 9.1.

FIGURE 9.1

Amount of Green Bonds Issued in Billion USD



Note: * Represents data compiled up to November 30, 2021

Source: Climate Bonds Initiative

FIGURE 9.2

Green Bond Issuance by US, China and India

Display Currency U.S. Dollar X-Axis: Issue Date Y-Axis: Domicile

Green Universe

Domicile:
China, United States, India

CHART China United States India Issued

Source: EIKON Database.

In the year 2021, Reserve Bank of India has joined the network of central banks for Greening Financial System in promoting the exchange of best practices on green finance. Figure 9.2 compares Green Bonds issued by US, China and India. One Standard & Poor projection shows that the issuance of sustainable bonds will cross USD 1.5 trillion mark in 2022. India has also seen a record increase in Green Bond issuance in 2022. Corporate and bank issuers in India are tapping the climate related debt market more actively to reduce the carbon intensity and move towards carbon neutrality over time Green Bond issuance has several advantages like lower borrowing cost, better market reputation etc. More financial incentives in the form of tax concession (tax deduction for issuance cost or tax relief to the investors holding the bond), subsidy (to partially cover the cost) etc. from the Government will be crucial to accelerate the growth of India's green bond market.

Several studies (Krüger, 2015; Flammer, 2021) indicate that market news like issuance of Green Bonds act as a positive signal in the product market as well as better firm financial performance. The benefits come from lower cost of capital. Using a matching methodology, Flammer (2021) study results reveal that firms issuing Green Bond Issuers experiencing improvement in their environmental performance (e.g. an increase in environmental rating measured by Thomson Reuter's ASSET4 score). Green bonds provides positive environmental externality. Study by Tang and Zhang (2020) provides robust empirical evidence that stock markets react positively when firms announce issuance. One can argue that issuance of Green Bonds might therefore lead to better corporate performance and improve their solvency rating. This financing mode needs to be incentivized along with green loans.

9.4. Carbon Credits and Scope for Carbon Trading

It is now evident that emission of greenhouse gases (GHGs) from variety of human activities including production of goods and services cause global warming. In order to mitigate the same UNFCCC has reached a deal with 196 nations to reduce the emission of GHGs and the signatories (countries) have been made to submit their targets for reducing their GHG

emissions through various means and methods. The national targets are called Nationally Determined Contributions (NDCs). In order to achieve the national targets individual nations have to set the emission reduction target for various sectors and companies in the country. To ensure the attainment of the targets by individual entities the government will incentivize those entities who exceed the targets and will penalize those who do not attain the targets. The excess emission reductions are measured and certified by a designated authority and the same are referred to as carbon credits. Reducing or avoiding the emission of one ton of carbon dioxide will get one carbon credit. Reducing the emission of other GHGs like methane and HFCs will be converted into carbon dioxide equivalents. The carbon credits can be traded in the market wherein those who could not achieve the emission targets will be the buyers. The efficiency of carbon emissions and mitigation can be optimized through carbon trading.

Carbon markets offer many advantages:

- Environment friendly projects like renewable energy projects get financial incentive by way of carbon credits
- Emitters are penalized by making them to pay for carbon credits
- Carbon credits can also be exported to earn foreign exchange.
- Cross border trading in carbon credits will create competition among nations and will lead to development of most efficient technologies and processes that will lead to making a greener world

The awareness to climate change has opened up tremendous opportunities for banks and financial institutions to participate in carbon trading (Bello, 2022; Debkarma and Sengupta, 2022). The Paris Climate Agreement (often referred to as the Paris Agreement) reached in 2015 at the COP 21 held in Paris in 2015 is a legally binding accord. It has been signed by 196 countries in the world including India. The agreement demands the signatories to submit their nationally determined contributions (NDCs) to reduce carbon emissions. India in its updated NDC submitted in August 2022 (GOI 2022b) has set the following targets for 2030, among others:

- Targeted reduction of carbon emissions intensity of India's GDP by 45 per cent from 2015 level
- Achieving 50% cumulative electric power generated from non-fossil fuel energy sources
- Creation of 2.5 to 3.0 billion tonnes of Carbon dioxide equivalent (CO_{2e}) through added forest and tree cover
- To mobilize funds from domestic and developed markets to implement mitigation and adaptation actions

India has spelt out its long-term goal of becoming net-zero by 2070. Article 6 of the Paris Agreement (UNFCCC, 2022) which was adopted during COP 26 held at Glasgow in 2021 is paving the way for voluntary carbon markets for trading in GHGs, instead of Cap-and-Trade mechanism. One major requirement for implementing this is creating domestic voluntary carbon markets. South Korea has started its market called Korea Emissions Trading System (K-ETS) in 2014 and China has launched its national emissions trading system – Shanghai Environment and Energy Exchange (SEEE) in 2021. India has started the process for setting its national carbon trading market by making necessary provisions in the Energy Conservation (Amendment) Bill 2022. The draft blueprint for the same has been prepared by the Bureau of Energy Efficiency. It is argued that the introduction of carbon trading increases the cost of materials with a high environmental impact and hence businesses will be motivated to use less carbon intensive materials. Banks and financial institutions need to participate in the carbon trading market in order to broaden and deepen the markets.

9.5. Financing for Decarbonising Economies –Opportunity for Banks

India is the third largest emitter of GHGs in the world and its emissions from manufacturing industries has doubled from 1585.51 mtCO2e in 2005 to 2952.87 mtCO2e in 2018.

During the same period India's per capita emissions has increased from 1.45 tonnes to 2.24 tonnes. (GHG Platform India, 2022). As India is the fastest growing large economy and has set tall targets its contribution to GHG emissions will grow substantially in the future. All these open up the need for funding and other opportunities for banks and financial institutions. Government of India has taken several steps to reduce its carbon emissions. One major step in this regard was "National Action Plan on Climate Change released (NAPCC) encourages developments in the specific areas of solar energy, enhanced energy efficiency, sustainable habitat, water, sustaining the Himalayan Ecosystem, strategic knowledge for climate change, Green India and sustainable agriculture (PIB, 2022)". The share of coal in the energy basket is still going to remain significant in years ahead, while there is thrust for renewable or non-fossil based energy.

Government of India's another priority is to develop Safe, Smart, and Sustainable Transportation Network through dedicated freight corridors by Indian Railways, Jal Marg Vikas-National Waterways project, Sagarmala project for enhancing logistics using waterways and Bharatmala project for road and highways (GOI 2022a). Further, emphasis is given on emission reduction from mass rapid transit system (MRTS) projects, green highways through plantation and maintenance, adoption of hybrid and electric vehicles and launching vehicle fuel efficiency programmes. The Indian government has made a National Mission on Waste to Wealth which demands lot more work and investment for achieving its intended goals. The three different actions under this mission are: Waste to Energy; Solid Waste Management and Swachh Bharat Mission. Few other initiatives of the Government of India are: a) National Policy on Biofuels (blending 20% of biofuels with fossil fuels); b) Green India Mission (afforestation); c) National Agroforestry Policy; d) Fly Ash Utilization Policy (to make blended cement, bricks, tiles, etc.); e) Zero Liquid Discharge (ZLD) (for treating liquid wastes from industrial units and reusing water);

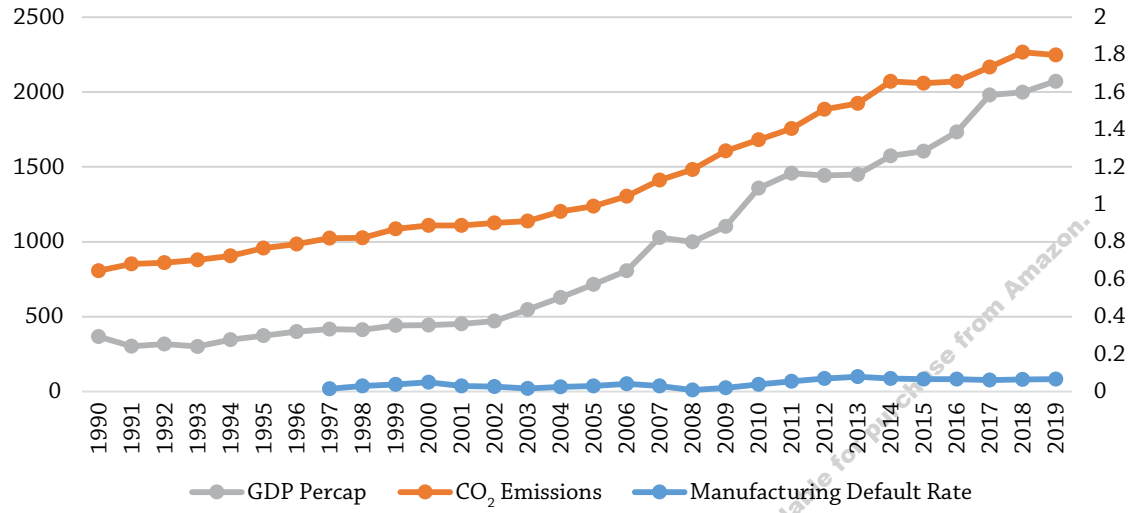
Recently, Government of India has approved Rs. 20,000 crore National Green Hydrogen Mission to enhance its renewable energy production capacity and facilitative its effective usage and reduce dependence on imported fossil fuels. The aim is to meet its climate targets and enhance non fossil fuel based capacity. The target under this scheme is to bring in over Rs. 8 lakh crore investments and over 6 lakh job creation. It is also aimed to facilitate Research and Development (R&D) towards alternative energy and avert nearly 50 million metric ton per annum of CO2 emissions by 2030. Green hydrogen uses will bring greater stability in cash flows of creditworthy companies who will be using the hydrogen products. Banks expected to extend loans to renewable energy-powered electrolysers that will be used to produce green hydrogen at ammonia plants and refineries, since demand for the gas is growing globally. The recent RBI report on Currency and Finance (RBI 2023) is focused on Climate Change and Sustainable Finance. It stresses the importance of substantial improvement in energy mix to achieve net zero goal by the year 2070. In this direction, it projects that India's green financing requirements would be around 2.5 per cent of GDP annually till 2030.

The above mentioned initiatives of the government as also the United Nations Framework Convention on Climate Change (UNFCCC) unveil many opportunities for banks. To be more specific, banks and financial institutions can contribute to the mitigation of climate change by participating in the following:

- Financing renewable energy that includes alternative solar power, wind power, hydro power, biomass energy, hydrogen fuel, and so on.
- Financing energy efficient industrial projects, buildings, etc.
- Financing emission reduction projects of industry
- Financing projects and businesses that are eligible and registered with the relevant regulator for carbon credits
- Many corporates would pursue net-zero targets and they can be provided funding support

FIGURE 9.3

Per capita GDP and CO_2 Emissions and Default Risk of Firms in India



Source: World Bank Data, CMIE Database.

Note: CO_2 emissions in unit of metric tons per capita; GDP per capita is at current USD unit.

- Accessing and channeling Green Climate Fund of UNFCCC to eligible projects in India
- Accessing funds of The World Bank, Asian Development Bank, and funds of other multilateral agencies that are meant for climate friendly projects and investing the same in India
- Enabling corporates to raise fund by issue of green bonds abroad
- Incorporation of ESG framework in credit appraisal framework and providing loans to companies and projects which comply with ESG standards
- Subscription to government of India's green bonds

It is utmost essentials for banks and financial institutions in India to establish a direct linkage between financial parameters and climate change factors for sustainable finance.

9.6. Empirical Linkage of Climate and Financial Risk

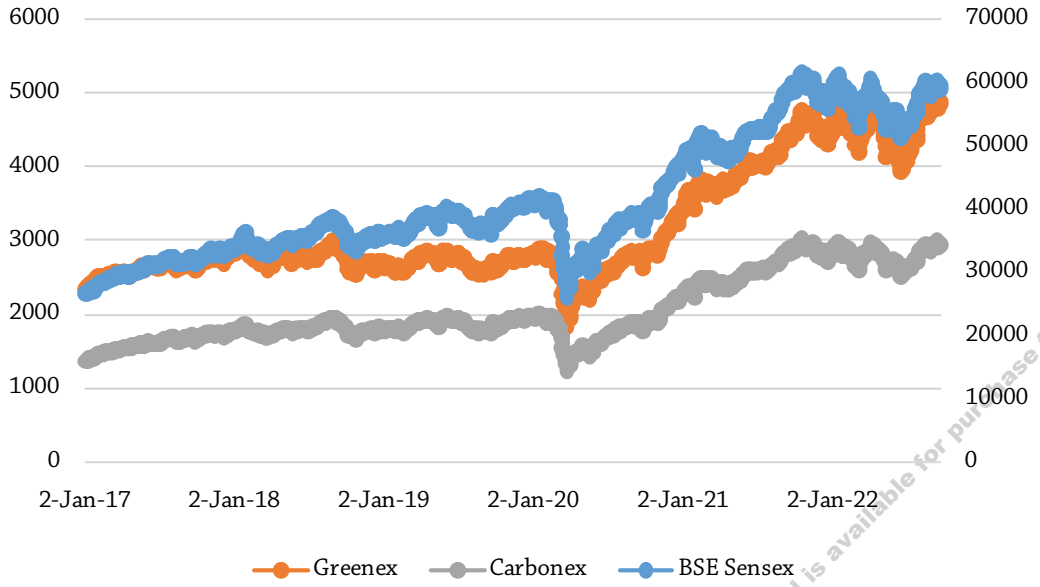
Macro level analysis

In Figure 9.3, with data from World Bank database and CMIE, India's economic growth in terms of annual GDP growth rate in relation to its carbon dioxide emissions and manufacturing default rates are plotted. There is a strong correlation between these factors. Correlation between GPD per capita and CO_2 emission is estimated as 0.989. The correlation coefficient between corporate default rate in manufacturing sector and CO_2 emissions is estimated as 0.791 and is statistically significant. In a recent study by Carbon Brief, it has been projected that a 1.5 degree Celsius to 2 degree Celsius temperature hike may reduce almost 8 to 13 per cent of Global GDP by 2100.[2] It can be argued that green finance or carbon pricing can be suggested to break the link for sustainable growth.

Many countries (like Germany, France, and Sweden) are in the process of decoupling economic growth from CO_2 emissions for sustainable growth path. Recent reports and research papers (Hannah Ritchie, 2021; Nate Aden, 2016; Wu, Zhu and Zhu, 2018) suggest that several countries are shifting to a low carbon path to address global climate challenges while prevailing economic security. It is therefore

2. The information is available at: https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/?utm_source=web&utm_campaign=Redirect

FIGURE 9.4
Comparison of Performance of Various Market Indices



Source: BSE India.

necessary to identify the time horizon for phasing down fossil fuel across sectors in a planned manner. The risk implications for such shift as well as disinvestment from fossil fuel based assets need due consideration. Thus, there are systemic benefits of reducing credit risk through de-carbonization or encouragement in green financing.

Market-based Analysis

In the Indian equity market, it has been empirically observed that stock of Indian companies which are sincerely dedicated to reduce climate change risks have performed moderately well. A comparison of BSE Carbonex index with the benchmark Sensex return reveals such facts. Based on sustainability investments, S&P BSE indices provides BSE Greenex index. It comprises of top 25 stocks in the S&P BSE 100 that adopt relatively better energy efficient practices. In Figure 9.4, we have plotted the historical closing price of BSE Sensex, BSE Greenex and BSE Carbonex. Over the five years, if Sensex has given average annual return of 17.35 percent, BSE Greenex has gained by 14.33 percent and Carbonex by 14.48 percent. This indicates that financial markets for green finance are yet to culminate into better returns compared to the markets for traditional instruments and securities for finance.

An analysis of equity return performance in terms of Sharpe ratio further reveals that both Carbonex (0.39) and Greenex (0.31) have underperformed compared to Sensex (0.43). Sharpe ratio actually gives us information about their risk adjusted performance.

Firm Level Analysis

Here, we present a firm level panel data analysis to link ESG ratings, CO2 emissions with default risk and solvency position of selected companies. The balance sheet information for selected top 200 BSE companies was extracted from the company's annual reports and carbon emission data was obtained from India CDP reports. The ESG scores and emissions are obtained from Refinitiv EIKON database. ESG score of EIKON Refinitiv to reflect environmental, social and governance relative score in terms of ESG factors which also discounts ESG controversies. Many academic literature show that portfolios with ESG profile outperform non ESG finance.

TABLE 9.1

Detailed Summary Statistics

Variable	*Observations*	*Mean*	*Std. Dev.*	*Minimum*	*Maximum*
Rating_Scale	205	2.385	2.143	1	20
FSIZE	197	5.472	0.785	0.696	7.597
ROA	197	0.089	0.234	-0.116	1.811
DER	197	1.031	4.943	0	68.789
SALESTA	206	0.610	0.494	0.0007	3.294
ESG_Score	184	5.451	1.521	2	11
CDP_Score	200	4.25	1.829	1	8
CO2_Emissions	182	10.05461	25.21726	0.00284	250.9939

Source: Authors' own calculation based on Audited data of listed firms and CDP data and EIKON database.

Note: CO_2 emission is scaled to million tonnes unit.

The data and variables used in setting multivariate framework have been summarized in Table 9.1.

It is important to mention that both ESG, CDP as well as Credit Ratings scales are in order of their riskiness. We have used categorical variables to represent risk ratings. So a lower rating which get a higher risk scale. Similarly, better rating will receive higher ranking in risk scale and its values will be lower (scale 1, 2, 3).

We perform various univariate and multivariate analysis on selected top 200 BSE companies that are having disclosures in CDP reports over five years (2017 to 2021). We have performed multivariate probit regression analysis to link ESG scores and CO2 emissions with firm's credit rating.

Following regression framework was used:

$$RiskRating_{it}=\alpha+\beta_1 ESG_{it}+\beta_2 ROA_{it}+\beta_3 DER_{it}+\beta_4 CO2Em_{it}+\beta_5 SALESTA_{it}+\varepsilon_{it} \quad \text{.... Equation 9.3}$$

Where symbols I represent firms and t years in the panel structure. Risk rating is in ordinal form in order of risk categories (lower values mean lower risk and higher values imply greater credit risk due to lower rating). The regressors are ESG rating, Return on Assets (ROA), Debt Equity Ratio (DER), CO2 emissions level, and turnover ratio (SALESTA). Ordered probit model is more suitable in this panel structure.

The multivariate results are presented in the following Table 9.2. Probit regression is more suitable for ordinal rank based dependent variable.

TABLE 9.2

Ordered Probit Model to Link Climate Risk Factors with Credit Rating

Dependent Variable: Credit Rating (Rating_Scale)	*Model 1*	*Model 2*
FSIZE	-1.74***	-0.652***
	(-7.30)	(-4.42)
ESG_Score	---	0.129**
		(1.93)
ROA	-5.95***	-4.76***
	(-3.48)	(-2.93)
DER	0.998***	0.442***
	(4.99)	(3.16)
CO2_Emissions	0.0013**	---
	(2.02)	
SALESTA	-0.348	-0.635**
	(-0.98)	(-2.18)
LR Chi2 (d.f)	105.25 (5)***	59.50 (5)***
Pseudo R-square	0.34	0.19
Number of Observations	120	140

Source: Authors' own calculation based on Audited data of listed firms and CDP data and EIKON database

Note: CO_2 emission is scaled to 'million tonnes unit

Values in the parenthesis are the estimated z values by dividing the coefficients by its respective standard errors. *** denotes significance at 1 percent or better & *** denotes significance at 1 percent to 5 percent level.

It is quite evident from Table 9.2 regression results that key financial ratios like return on assets (ROA), turnover ratios (SALESTA) have significant negative effect on credit ratings. That means better the profitability and sales to assets, there is a higher probability that a company will achieve better credit rating (i.e. lower values in risk rating scale). On the other hand, if debt equity ratio is higher (DER), a firm will most likely will obtain lower credit rating (i.e. greater values in risk rating scale) due to higher leverage. Normally, bank's credit rating model will factor this relationship. What is interesting is that we find ESG score by companies have significantly positive influence on borrower credit rating (captured in Model 2). It means, if companies receive lower rating (that means higher in the order of risk scale), the likelihood that it will receive lower rating (or bottom rank in the risk scale) is also significantly higher. Hence, lower ESG performance causes greater credit risk in terms higher default risk.

Our findings will enable banks to establish linkage between credit risk and climate change risk. Similarly, higher CO_2 emissions by firms increases the likelihood of obtaining lower credit ratings by agencies and hence increases the risk of default. This will assist them to adjust their borrower level ratings and factor the impact of climate change on their capital as well as business decisions.

9.7. Concluding Observations

Banks would have many opportunities to grow their business as a result of the transition to a greener future given their disproportionate influence in the country's credit system. The traditional lending and investment approach would need to undergo structural changes to enable green financing. It is anticipated that breaking the link between emissions and GDP will be crucial to achieve climate goals.

Translating climate risk to economic and financial risks for banking sector would need new data and variables, such as emission levels, carbon footprint, dependence on fossil fuels, etc. These indicators need to be linked to ESG rating and integrate with credit rating and assessment of default risk. The banking system needs to take the lead to transition the economy to become more sustainable and resilient. This requires framing a clear ESG policy statement that will entail how the bank will support clients/borrowers taking an active role in the orderly transition (reducing dependence to fossil fuel, reduce emissions or servicing the segments having transition plans consistent with the banks 2030 emission targets) and helping to finance related technologies and infrastructure.

The regulator needs to incentivize the commercial banks to reduce fossil fuel based financing and move towards renewable energy financing. The Reserve Bank of India (RBI) has categorized renewable energy sector under priority sector lending. A further increase in loan limit for renewable energy under priority sector lending, risk weight concessions for lending to borrowers with good ESG scores will encourage banks to lend more. This way central bank can guide the flow of credit to climate saving sectors. Proper risk assessment and disclosure frameworks are essential to understand measure and understand risks from climate change. Further, the scenario of climate change can be an added attention for monetary policy to ensure overall macroeconomic stability. The government may explore innovative financing mechanisms through Green bonds, alternative investment funds for renewable energy sector. In the long run, a climate-oriented economy is going to be more efficient and therefore more productive.

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