

Does Green Bond Issuance Affect Economic Development?

Dr. Swayam Prava Mishra

Assistant Professor (Stage III), Department of Analytical and Applied Economics, Utkal University, Bhubaneswar

Ms Sasmita Pagal

PhD Scholar, Department of Analytical and Applied Economics, Utkal University, Bhubaneswar

ABSTRACT

Green finance is one of the emerging financial investment patterns that prioritizes both the environment and society. The study aims to investigate the relationship between green finance and economic development in BRICS nations, using green bond issuance as a proxy for green finance. Data have been collected from secondary sources, such as the World Bank and the IMF, from 2014 to 2022. The Variables used are GDP per capita, Public-private partnership investment in green projects, FDI, and Green bond issuances. Descriptive statistics, correlation, and econometric analysis are done. From the analysis, green bond issuances and FDI are found to be statistically significant and positively related to the log of GDP per capita. But the log of PPPI is not statistically significant, and the probability of the log of GDP per capita is negatively related to the log of public-private partnership investment in green projects. As a policy recommendation, the Government can provide financial incentives such as tax credits, grants, or subsidies to stimulate investments in green projects and technologies.

Keywords: Green Finance, Green Bond Issuances, Economic Development, Public-Private Partnership, BRICS Nations

Introduction

Rising temperatures and environmental pollution have affected the entire world in recent years. Green finance is one of the emerging financial investment patterns that prioritizes both the environment and society. As a result, it's critical to inform investors about the new financing model, which includes "green finance," and to assess its impact on the country's economic development.

Green finance refers to any financial instrument or investment for those projects that support the environment as well as economic development including equity, debt, grant, purchase and sale of green products which make a combined investment policy from both public and private finance (Charles & Philip, 2020; Yang

et al., 2021; Khan et. al., 2022; Nenavath & Mishra, 2023). The green economy is the result, with "green" acting as a new catalyst for economic growth overall by lowering environmental concerns, launching green technologies, and raising investor awareness of the need to support green investment in the interests of both environmental preservation and economic expansion (Khan et. al., 2022; Nenavath & Mishra, 2023).

According to an Asian Development Bank assessment of the costs incurred by South Asian nations in adapting to climate change, India's acquisition costs in the energy sector alone are expected to reach over USD 7.7 billion by 2030. The reduction initiatives for the low-carbon plan would cost about USD 834 billion by 2030, according to the National Institution for Transforming India

(NITI) Aayog. According to the International Finance Corporation (IFC), a World Bank Group of institution, climate change threatens communities and economies, and it poses risk to agriculture, food, and water supplies. The Reserve Bank of India (RBI) in 2022 announced that for the first time to issue Sovereign Green Bonds worth Rs. 16,000 crore. The government will use the proceeds raised from SGrBs (Sovereign Green Bonds) to finance or refinance expenditure for various green projects, including renewable energy, clean transportation, energy efficiency, climate change adaptation, sustainable water and waste management, pollution and prevention control and green buildings. In renewable energy, investments will be made in solar, wind, biomass and hydropower energy projects. According to the RBI report on currency and finance 2022-23, India needs to invest at least 2.5% of its gross domestic product (GDP) annually in green financing until 2030 to close the infrastructure gap for climate change goals. The report also states that India's total green funding could reach as much as 6% of its GDP.

One of the newest and most effective green financing tools is green bonds. In recent decades, many countries have been developing their green bond markets and using this financing tool to develop green energy consumption and reduce dependence on fossil energy. Historically, the World Bank issued the first green bond in November 2008, following the intentions of Swedish Pension Funds to invest in clean environment projects in 2007. According to World Bank data, the volume of green bonds issued worldwide has increased from 37 billion US dollars in 2014 to more than 500 billion US dollars in 2021. Growing national and international awareness of environmental issues has made it imperative that the finance sector respond to these concerns. So, Green Bonds have emerged as an important financial instrument to deal with the threats of climate change and related challenges. It's critical to connect environmental projects with capital markets and investors, and channel capital towards sustainable development and Green Bonds are a way to make that connection. Green bonds are fixed-income instruments aimed at financing environmental and sustainable development projects, and their proceeds are used exclusively to finance or refinance new and ongoing green projects, in particular, infrastructure investments (Deschryver & De Mariz, 2020). Examples of green projects are Solar and wind installations; Funding for new technologies that permit significant reductions in greenhouse gas (GHG) emissions; Rehabilitation of power plants and transmission facilities to reduce GHG emissions; Greater efficiency in transportation, including fuel switching and mass transport; Waste (methane emissions) management and construction of energy-efficient buildings; Carbon reduction through

reforestation and avoided deforestation (World Bank). As a result, the idea of "green finance" was developed, which is crucial because it meets societal demands and safeguards natural resources, resulting in a morally sound balance between humankind and the environment.

Motivation

The recent budget, the G-20 Summit and the Conference of the Parties (COPs) have all placed a strong emphasis on green finance to lower carbon emissions and greenhouse gas emissions, to create eco-friendly products, and to prioritise renewable resources. With the motto "One Earth, One Family, One Future," India's 2023 G20 chairmanship highlights its commitment to sustainability, even though it is still in its infancy. This is consistent with India's pledge to attain net-zero emissions by 2070 made at the United Nations Climate Change Conference (COP 26).

It promotes green growth between the economy and the environment. However, it is a new instrument for sustainability, which inspired us to evaluate the initiative of green finance related to economic growth.

Review of Literature

Determinants of Green Finance

Green finance involves to minimize environmental impacts such as greenhouse gas emissions, carbon emissions and promoting renewable energy, etc., and supporting environmentally orientated businesses while seeking greater financial prosperity (Khan et. al., 2022). Some determinants of green finance help to manage the environmental quality and to achieve economic growth as well. Green finance is classified into some subparts like green bond, carbon finance, green insurance, green credit, green investment, and green securities (Hailiang et al., 2023; Nenavath & Mishra, 2023; Ning et al., 2023; Udeagha & Ngepah, 2023).

Green bonds are debt securities issued specifically to raise funds for projects with environmental benefits. These projects may include renewable energy development, energy efficiency improvements, sustainable waste management and climate adaptation initiatives (Gilchrist et. al., 2021; Phung Thanh, 2022; Shi et.al., 2023; Zhang & Umair, 2023). Some of the findings suggest that green bond issuances are negatively related to carbon emissions (Zhang & Umair, 2023) and positively related to economic development (Gilchrist et. al., 2021; Phung Thanh, 2022; Ning et al., 2023).

Public-private partnership investment in green projects, which are utilised to establish renewable energy infrastructure, green buildings, sustainable transportation systems, waste management facilities

and other environmentally friendly efforts, is another mechanism that is introduced to the context of green projects. Investment in green initiatives through public-private partnerships has a negative correlation with carbon emissions (David & Venkatachalam, 2018) and is positively related to GDP and investment in renewable energy sources (Khan et al., 2022). So, Public-private partnerships involve collaboration between government entities and private sector companies to finance, develop, and operate infrastructure projects, including green projects.

Green Finance and Economic Development

The rising trend in economic progress (GDP) and human activities is responsible for deteriorating environmental quality (Lee et al., 2022). Green finance explains that financial funds flow into sustainable progress and initiatives, environmental products, and policies that encourage the development of a more sustainable economy (Yang et al., 2021). Notably, while making investment and financing decisions, financial institutions take environmental protection into account, which drives cash to green industries. This approach contemplates the adverse environmental impacts and how we should prepare ourselves to strike a balance between excessive natural resource exploitation and economic growth (Song et al., 2011). Green finance bridges the gap in which variables are supposed to be to ensure economic development. It helps in channelling resources more efficiently and efficient environmental protection (Zhou et al., 2020; Zhou et al., 2022).

According to Udeagha & Ngepah (2023), economic growth (GDP) has detrimental effects on environmental quality in BRICS countries. Green finance positively impacts economic growth by improving financial structure, financial efficacy, and environmental protection (Nenavath & Mishra, 2023). Studies suggest that green investment contributes to high-quality economic development by positively impacting the environment, economic progress and GDP per capita (Tawiah et al., 2021; Chen et al., 2023; Kwilinski et al., 2023; Hailiang et al., 2023; Nenavath & Mishra, 2023). Some studies also found that Green investment is negatively related to economic growth (GDP per capita) in the Asian economies (Adeel-Farooq et al., 2018), and an increase in GDP can lead to an increase in CO₂ emissions (Xing, Li & Yu, 2022). The government has given less priority to the less polluting industries, while it could be a priority for green investment (Adeel-Farooq et al., 2018). Also, the transition from traditional industries to green industries can lead to temporary disruptions in economic activities. However, after a certain period, economic development can be gradually increased through green investments (Mansour, 2023).

In China, the role of government priorities, institutional capacity, and regulatory frameworks is strongly associated with green activities (Li et al., 2016; Zhou et al., 2020). Since the Chinese government implemented green finance regulations in 2015, the country's green financial activities have improved (Ren et al., 2020). In the case of green bond issuances, it is seen to be positively related to economic development (Gilchrist et al., 2021; Phung Thanh, 2022). In China, green finance significantly improves the level of green productivity (Lee et al., 2022).

Some studies found that FDI is affecting the environment through CO₂ emissions. They revealed that FDI is positively related to carbon dioxide emissions in developing nations (Acharyya, 2009; Hassaballa, 2013; Shahbaz et al., 2015; Hailiang et al., 2023) and, in the case of high-income countries, FDI has reduced CO₂ emissions and improved the environment (Shahbaz et al., 2015). In contrast, national income and FDI are positively related to the green growth of the BRICS-T economies (Arzova & Sahin, 2024). A study also found that the effect of trade openness and FDI on developing countries is negative and significant; FDI and trade openness are detrimental to green growth (Tawiah et al., 2021). However, FDI can be a major driver of green funding if it invests in renewable energy sectors (Adeel-Farooq et al., 2018; Tawiah et al., 2021; Hailiang et al., 2023).

Green Finance and Environmental Quality

Apart from economic development, Green finance plays a crucial role in environmental quality. Carbon emissions contribute to greenhouse gas emissions and environmental damage (Xing, Li & Yu, 2022; Hailiang et al., 2023). Nowadays, economies have shifted their energy pattern from non-renewable to renewable energy (REU), but the cost is too high. So, the financial sector should perform well in facilitating such green activities (Hailiang et al., 2023).

As a bridge connecting the economy and the environment, Green finance is an example of financial breakthroughs in the field of achieving sustainable development. Its primary objective is to limit resource supply to polluting businesses and allocate financial resources to environmentally favourable enterprises (Udeagha & Ngepah, 2023). Some studies found that CO₂ emissions have a significant and negative correlation with renewable energy consumption, public spending (carbon tax) (Xing, Li & Yu, 2022) and R&D expenditure for eco-friendly projects (Khan et al., 2022; Hailiang et al., 2023; Ning et al., 2023). Some studies also reported that energy consumption has adverse effects on the environment through the increase in carbon dioxide emissions (Akhmat et al., 2014; Haseeb, Hassan & Azam, 2017). However, if economic growth is achieved through

renewable energy production, it has a lasting positive impact on the environment and economy (Tawiah et al., 2021).

In summary, this review of literature has highlighted the multifaceted relationship among green finance, economic development, and environmental quality. While the determinants of green finance, such as green bonds, public-private partnerships, and carbon finance, have been explored, and all these determinants of green finance aim to promote environmental sustainability through financing, they differ in their structure, funding sources, and modes of operation. The findings suggest that green finance can play a crucial role in promoting sustainable development by reducing carbon emissions, increasing renewable energy consumption, and improving environmental quality. However, the relationship between green finance and economic development is complex, with both positive and negative impacts observed in different contexts.

Overall, the above studies provided insights into the relationship among green finance, economic development and environmental quality, and the impact of green finance on the BRICS nations remains an area that requires further research and attention.

Research Gap

Although there are several studies which had attempted to examine the determinants of green finance and how it

leads to economic development, yet these are regionally and institutionally specific. Moreover, the role of FDI in green finance is unclear, which presents conflicting evidence regarding whether FDI promotes the green transition or environmental degradation. Again most studies focus on high-income countries and there is lack of country-specific analysis; few studies are related to developing countries such as BRICS nations, where policy is crucial.

Objective

To find out if Green Bond Issuances affect economic development in the BRICS nations.

Data and Methods

Sources of Data: Data has been collected from secondary sources like the World Bank WDI data and the IMF from 2014 to 2022.

Variables used to find out the relationship between green finance and economic development, such as GDP per capita, Public-private partnership investment in green projects (Khan et. al., 2022), Foreign Direct Investment and Green bond issuances (Gilchrist et. al., 2021; Phung Thanh, 2022; Shi et.al., 2023; Zhang & Umair, 2023).GDP per capita is used as a proxy of economic development, and PPPI and GBI are proxies of green finance, and FDI is a control variable.

Table 1: Specification of Variables

Variables	Definitions	Authors
GDP per capita	Based on endogenous growth theory (Romer, 1986; Lucas, 1988), GDP per capita shows how much an economy can produce in the long run, taking into account investment, innovation, and regulatory frameworks. It is frequently employed as the dependent variable in empirical studies examining the relationship between green finance and growth.	Khan et al., 2022; Li et al., 2022; Nenavath & Mishra, 2023
Green bond issuances	Green bond issuances are financial instruments that improve capital allocation efficiency for environmentally responsible initiatives. Green bonds are a direct indicator of green finance, reflecting investor confidence in long-term growth.	Gilchrist et al., 2021; Li et al., 2022; Phung Thanh, 2022; Shi et al., 2023; Zhang & Umair, 2023
Public-private partnership investment in green projects	PPPI promotes collaborative financing strategies for supporting green initiatives (such as renewable energy and sustainable transportation). It indicates institutions’ ability to mobilise resources for sustainable development.	Khan et al., 2022
Foreign Direct Investment	Foreign direct investment is measured by the net inflow of foreign direct investment as a percentage of GDP. It serves as a channel for external financial resources and technological advances. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital, as shown in the balance of payments.	Adeel-Farooq et. al., 2018; Tawiah et al., 2021; Hailiang et al., 2023; Arzova & Sahin, 2024; IMF

Source: Author’s compilation

Statistical tools: For the data analysis, Descriptive statistics, correlation, bar diagram, line graph and panel data analysis have been used. The sample comprises five diverse cross-sections across nine years, from 2014 to 2022. The data are evaluated as a balanced panel dataset. Panel data analysis takes individual heterogeneity into account and can be done using three methods: pooled regression, fixed effect, and random effect models. The study considers all panels to be heterogeneous due to their geographical and demographic diversity. This model was chosen for two reasons: the study is conducted on heterogeneous panels, and the model is validated using the Hausman test. As a result, this analysis uses the panel data fixed effect model (Khan et al., 2022). Further, DW statistics for autocorrelation, variance inflation factor for multicollinearity and Breush Pagan test for heteroscedasticity are used to check the robustness of the data.

The model is

$$LnGDP_{it} = \alpha + \beta_1 GBI_{it} + \beta_2 LnPPPI_{it} + \beta_3 FDI_{it} + u_{it}$$

Table 2: Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
GDP per capita (in dollars)	7164.37	3069.86	1490.03	11560.24
PPPI (in dollars)	2404749367	2860396819	9710000	14598300000
FDI (% of GDP)	2.0801	1.5329	0.4387	9.6779
GBI (in billion dollars)	7.8582	19.6726	0	99.4288

Source: Authors' calculation

Table 2 shows that the mean value of GDP per capita is 7164.37 dollars, and the fluctuation among the countries over the years is reflected by the standard deviation of 3069.86. Coming to the independent variables, the mean value of FDI is 2.08% of GDP, and the standard deviation is 1.53. Similarly, the mean value of public-private partnership investment in green projects (PPPI), i.e., 2404749367 dollars and the standard deviation is 2860396819. But in the case of Green bond issuances mean value is 7.85 billion dollars, and the standard deviation is 19.67, which shows that there is a huge fluctuation between the countries over the years.

Where,

i= cross-section unit

t= time

Ln GDP =Log of GDP per capita

GBI= Green Bond Issuances

Ln PPPI= Log of Public-Private Partnership Investment in green projects

FDI= Foreign Direct Investment

Data Analysis

Green finance is the innovative financial pattern adopted by countries to integrate environmental protection with economic growth and development. Here, the public-private partnership investment in green projects and the green bond issuances are taken as the proxy of green finance (Khan et. al., 2022; Ning et al., 2023; Shi et.al., 2023).

Table 3: Correlation Analysis

Variables	GDP	PPPI	GBI	FDI
GDP	1			
PPPI	0.01211	1		
GBI	0.38578	-0.20793	1	
FDI	0.02186	0.40248	-0.15585	1

Source: Authors' calculation

From the correlation analysis in Table 3, the study has

found that the GDP per capita is positively correlated with Public-private partnership investment in green projects (PPPI), Foreign direct investment (FDI) and Green bond issuances (GBI). Green bond issuances are negatively correlated to Public-private partnership investment in green projects and Foreign direct investments. For higher reliability, the Variance Inflation Factor (VIF) test is also carried out to detect the multicollinearity problems in Table 4.

Table 4 : VIF (Variance Inflation Factors) Test Result

Variables	VIF Test
FDI	1.17
Ln PPPI	1.22
GBI	1.09

Source: Authors' calculation

Table 4 shows that all the VIF values are less than 3, which demonstrates the absence of multicollinearity between the independent variables (Udeagha & Ngepah, 2023).

For panel data analysis, the study has used three types of analysis: pooled regression analysis, fixed effect model and random effect model.

Table5 : Pooled Regression Analysis

Variables	Coefficient	Probability
Constant	4.5212	0.0000
GBI	0.0361*	0.0056
FDI	0.0339**	0.0438
Ln PPPI	-0.0924	0.1592
R-squared=0.5342	Durbin-Watson stat=0.1361	

Note: * indicates significance at 1% level and ** indicates significance at 5% level

Source: Authors' calculation

The above table shows that 53.42% of the dependent variable is explained by the independent variable, and the green bond issuances and FDI are statistically significant at 1% and 5% levels of significance, respectively, and positively related to the dependent variable. However, the log of PPPI is adversely related to the dependent

variable and not statistically significant, as the p-value is more than a 10% level of significance. As the p-value of the Breush Pagan Test for cross-section and time element is less than 0.05, the null hypothesis is rejected, which means that pooled OLS is not the efficient one.

Now, the proper estimation has been calculated through the random effect model or the fixed effect model. Between the random effect model and fixed effect model, the Hausman test is used to check which model is more appropriate for the study. From this analysis, we have to accept the null hypothesis that to select the random effect model as the probability value is more than 0.05 and to select the fixed effect model as an alternative hypothesis is less than 0.05 (Khan et.al., 2022). Here, the Hausman test result shows that the p-value is 0.03 means the fixed effect model is a more appropriate method for this dataset.

Table 6 : Fixed Effect Model

Variables	Coefficient	Probability
Constant	3.8607	0.0000
GBI	0.0172*	0.0000
FDI	0.0149**	0.0299
Ln PPPI	-0.0922	0.2790
R-squared=0.6923	Durbin-Watson stat=0.78	

Note: * indicates significance at 1% level, ** significance at 5% level

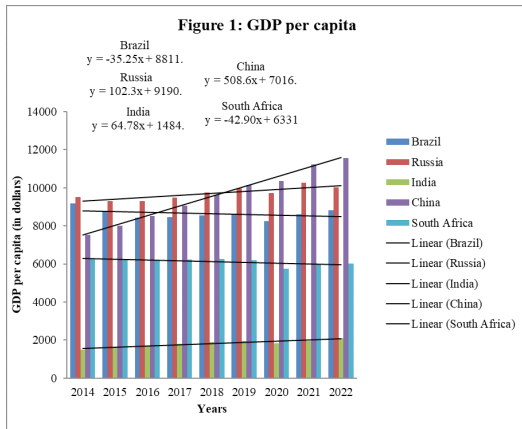
Source: Authors' calculation

The fixed effect model estimation shows that the study is statistically significant, and 69.23% of the dependent variable is explained by the independent variables. This study shows that green bond issuances are statistically significant at a 1% level of significance and positively related to the log of GDP per capita. So, green bond issuances are positively related to economic development (Gilchrist et. al., 2021; Phung Thanh, 2022). Similarly, the foreign direct investment is statistically significant at a 5% level of significance, i.e., 0.0299 and positively related to the dependent variable. But the log of PPPI is not statistically significant, i.e., 0.2790 and the probability of the log of GDP per capita is negatively related to the log of public-private partnership investment in green projects.

Country-wise Analysis

In the country-wise analysis, four key variables, such as GDP per capita, Green Bond Issuances, Public-Private Partnership Investment and Foreign Direct Investment (FDI), are analyzed across the BRICS (Brazil, Russia, India, China, and South Africa) nations from 2014 to 2022.

Figure 1: GDP per capita (in US dollars)

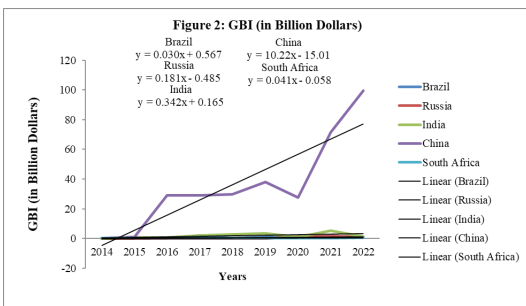


Source: Author's compilation using World Development Indicator (WDI) data

Figure 1 depicts the GDP per capita trends from 2014 to 2022 in the BRICS nations, where the Y-axis shows the GDP per capita value in terms of dollars, and the X-axis represents the number of years from 2014 to 2022. The trend line shows the increasing or decreasing trend of GDP per capita over the years, whereas the equations display the positive or negative trend for each country.

China's trend line shows a significant positive tendency, with GDP per capita rising annually from roughly \$7,500 in 2014 to nearly \$13,000 by 2022. As a result, China has the highest and most constant rise in GDP per capita among the BRICS countries. Russia's trend line indicates a positive but small increase in GDP per capita each year. It stays continuously high throughout the period. As a result, it demonstrates stable but slower growth when compared to China. India's economy is gradually improving, rising from \$1500 in 2014 to \$2000 in 2022. So, GDP per capita is low yet improving, reflecting India's status as a developing country. However, in Brazil and South Africa, this line shows a negative trend in GDP per capita, with decreases of \$35.25 and \$42.90 per year, respectively. Yet, the economy is stagnant or declining in terms of per capita income.

Figure 2: Green Bond Issuances (in Billion Dollars)



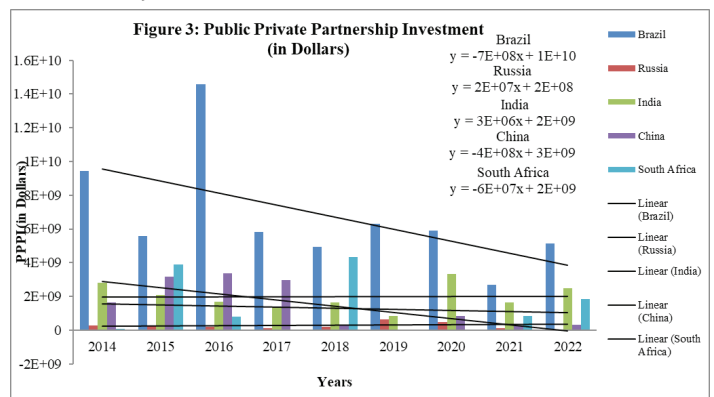
Source: Author's compilation using International Monetary Fund (IMF) data

Figure 2 depicts the Green Bond Issuance in US billion dollars in the BRICS countries, with the X-axis representing years from 2014 to 2022 and the Y-axis representing Green Bond Issuances (GBI) in US billion dollars. The trend lines or equations represent the positive or negative trend of green bond issuances in each country.

In this analysis, China dominates green bond issuances (GBI), with values rising drastically, especially since 2016. This country issued more than \$99 billion GBI by 2022 and is the only one with a double-digit growth rate, with a rate of change or slope of 10.22 US billion dollars. China, on the other hand, is the global leader in green financial infrastructure, which is in line with national sustainability goals. A similar result is found by Ren et al. (2020).

After China, India has a consistent and upward trend, with green bond issuance gradually increasing, peaking in 2021. So, India has the second-highest trend slope, at 0.342 US billion dollars. Then Russia exhibits a little upward trend, but total GBI remains below \$5 billion across the years. As a result, improved green financing requires regulatory frameworks or policies. South Africa shows negligible GBI growth, with a slope of \$ 0.041 billion. This suggests an irregular issuance of green bonds. Finally, Brazil's trend line is nearly flat, with green bond activity remaining quite modest. It reveals a low growth of GBI, with the equation indicating a rate of change of \$0.030 billion annually.

Figure 3: Public-Private Partnership Investment in Green Projects (in Dollars)



Source: Author's compilation using World Development Indicator (WDI) data

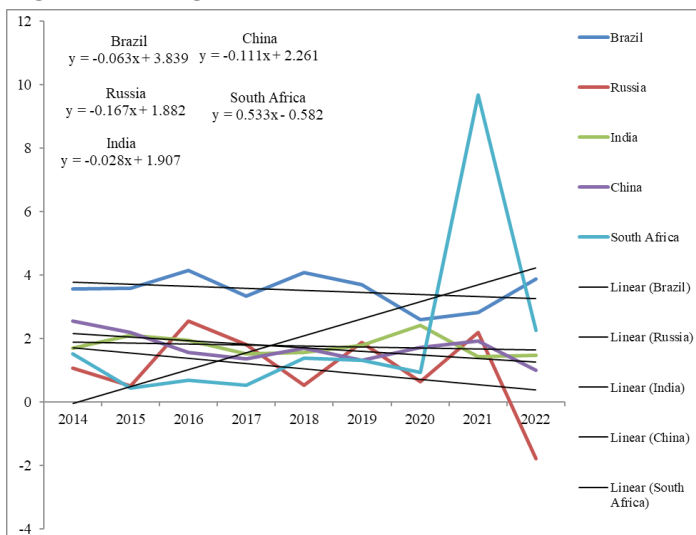
The above Figure 3 depicts trends in Public-Private Partnership Investment (PPPI) from 2014 to 2022 in five BRICS countries (Brazil, Russia, India, China, and South Africa). The Y-axis in the above picture depicts PPPI in dollars, while the X-axis represents years (2014 to 2022). Trend lines depict the direction of investment over time

for each country, whereas linear trend line equations are displayed for each country.

In Brazil, the trend line indicates a strong negative trend, meaning that investment is declining over time; the highest investment was recorded in 2016 (14.5B USD), and it then declined. In Russia, the trend line indicates a slight positive trend, with PPPI very low and almost constant over time, never exceeding 0.5B USD; in India, the trend line indicates a positive trend, with investment fluctuating but staying between 1.5B and 3.5B USD, with a spike in 2020. In contrast, the trend line for China and South Africa indicates a downward trajectory, with an early increase in 2015–2016, a fall in China, and a peak in 2015 and 2018 (4B USD), followed by a decline.

However, Brazil had the greatest PPPI values, but over time, they have significantly decreased. Despite their low to moderate absolute investment levels, Russia and India exhibit somewhat rising tendencies. After 2016, China’s PPPI decreased, which might be a sign of changing priorities or sector saturation. Investments from South Africa are generally volatile, with a negative trend.

Figure 4: Foreign Direct Investment (% of GDP)



Source: Author’s compilation using World Development Indicator (WDI) data

Figure 4 depicts Foreign Direct Investment (FDI) as the percentage of GDP in five BRICS countries from 2014 to 2022, with the Y-axis showing FDI (% of GDP) and the X-axis showing years from 2014 to 2022.

India stands out for stable, improving trends, as evidenced by its trend line, which is nearly flat with a very slight negative slope where FDI remains stable between 1.5% and 2%, demonstrating consistency; Brazil’s trend line shows a mildly declining trend, with FDI hovering around 3.5–4.0% of GDP. In Russia, there is the sharpest negative trend of all years, with FDI falling drastically

after 2020 and going negative in 2022, indicating capital outflows or disinvestment. The trend line depicts a mild decline in China, where FDI as a percentage of GDP steadily drops over time. However, there is a general upward tendency in South Africa, with a notable increase in 2021 (almost 10% of GDP), most likely as a result of a few big agreements or a post-COVID rebound, then declines once again in 2022.

Results and Discussions

This study, Table 6, shows that green bond issuances are statistically significant at a 1% level of significance and positively related to the log of GDP per capita. Gilchrist et. al. (2021) and Phung Thanh (2022) also found a similar result. Similarly, the foreign direct investment is statistically significant at a 5% level of significance, i.e., 0.0299 and positively related to the dependent variable. According to Arzova & Sahin (2024), national income and FDI are positively associated with the green growth of the BRICS-T economies. However, if FDI makes investments in renewable energy sectors, it can be a significant source of green funding (Adeel-Farooq et. al., 2018; Tawiah et al., 2021; Hailiang et al., 2023).

But the log of PPPI is not statistically significant, i.e., 0.2790 and the probability of the log of GDP per capita is negatively related to the log of public-private partnership investment in green projects. A similar result was found by Khan et. al. (2022). So, public-private partnership investment should promote the collaborative financing frameworks related to supporting green activities such as renewable energy and sustainable transportation, which indicates institutions’ ability to mobilize resources for sustainable development. The government has given less priority to the less polluting industries, while it could be a priority for green investment (Adeel-Farooq et. al., 2018).

Also, the transition from traditional industries to green industries can lead to a temporary slowdown in economic activities. However, after a certain period, economic development can be gradually increased through green investments (Mansour, 2023).

From the country-specific analysis, it is found that China has the highest and most consistent growth in GDP per capita along with green bond issuances among the BRICS countries throughout the years. But in the case of PPPI (in US dollar) and FDI (% of GDP) are not performing well compared to the other BRICS countries. India demonstrates the highest contribution of public-private partnership investment in green field projects and the second highest position in case of green bond issuances among the BRICS nations. According to the trend line, the GDP per capita is gradually improving over the years, but the foreign direct investment as a percentage

of GDP is showing a very negligible decline in India. The growth rate of GDP per capita in Russia has risen over the years, after China. Brazil and South Africa show a slight negative trend, which highlights the economic stagnation, while others accelerate the GDP per capita. In case of green bond issuances, Russia, Brazil, and South Africa indicate a very low rate of growth, which requires more green financial activities. However, the results show notable differences in economic paths, with Brazil, Russia, and South Africa trailing behind China and India, which exhibit robust upward trends in green finance.

Conclusion and Policy Suggestions

The nation's creative approach to finance, known as "green finance," combines environmental preservation with economic expansion and advancement. The aforementioned analysis indicates that additional government actions are needed, such as increasing funding for green projects that will progressively lower CO₂ emissions and boost economic activity in a nation without endangering the environment. However, through the investment initiative for environmentally friendly projects, the green transformation of the economy can play a significant role.

According to a recent study, China dominates green bond issuance and GDP per capita with a strong upward trend. Once again, China leads with major infrastructure projects, while India is gradually expanding PPPs in areas such as renewable energy and urban development. Furthermore, FDI inflows are highest in China and India due to favourable investment climates and reform programs and policies. So, India and China are pioneering the green transformation, while others confront structural and institutional hurdles. However, the BRICS countries have mixed economic and green investment prospects, where strategic changes, foreign finance, and strong policy frameworks are crucial for achieving equitable and sustainable growth.

There are some policy suggestions from the findings of the study. Firstly, the Governments should offer financial incentives such as tax credits, grants, or subsidies to encourage investments in green projects and technologies. Secondly, the government should encourage investment linked to climate change and focus on sector-specific green bond regulations, particularly in the manufacturing, transportation, and energy sectors. They should improve the green financing system, prioritise green operations in approval processes, and streamline the application process for green or low-carbon companies. Lastly, the government should provide some policies to support the green financial development in the underdeveloped regions and give priority to the

IPO (initial public offerings) of green companies. So that these incentives can help the traditional industries as well as the less polluting industries, which can be more attractive towards green investments.

Limitations

This study has certain limitations. The study has focused on only five countries with four variables over nine years due to the unavailability of data on green bond issuances. It can be extended by including more countries with more variables like green insurance, green credit, green loans, etc. This study is also related to the macro-level studies. Future studies can be undertaken for the sector-level analysis of green finance determinants and their impacts, especially regarding how specific sectors benefit from green bonds or PPP investment, such as the power, manufacturing, finance, transportation sectors, etc.

References

- Acharyya, J. (2009). FDI, growth and the environment: Evidence from India on CO₂ emission during the last two decades. *Journal of economic development*, 34(1), 43-58.
- Adeel-Farooq, R. M., Abu Bakar, N. A., & Olajide-Raji, J. (2018). Green field investment and environmental performance: A case of selected nine developing countries of Asia. *Environmental Progress & Sustainable Energy*, 37(3), 1085-1092.
- Akhmat, G., Zaman, K., Shukui, T., Irfan, D., & Khan, M. M. (2014). Does energy consumption contribute to environmental pollutants? Evidence from SAARC countries. *Environmental Science and Pollution Research*, 21, 5940-5951.
- Arzova, S. B., & Sahin, B. S. (2024). Macroeconomic and financial determinants of green growth: an empirical investigation on BRICS-T countries. *Management of Environmental Quality: An International Journal*, 35(3), 506-524.
- Chakraborty, D., & Mukherjee, S. (2013). How do trade and investment flows affect environmental sustainability? Evidence from panel data. *Environmental Development*, 6, 34-47.
- Charles, G., & Philip, B. (2020). Green Finance: Recent Drifts, Confrontation and Prospect Opportunities for Sustainable Development in India. *Mukt Shabd Journal*, 9(4), 1854-1865.
- Chen, M., Chen, R., Zheng, S., & Li, B. (2023). Green investment, technological progress, and green industrial development: implications for sustainable development. *Sustainability*, 15(4), 1-12.
- David, D., & Venkatachalam, A. (2018). *A comparative study on the role of public-private partnerships and green investment banks in boosting low-carbon investments* (No. 870). ADBI Working Paper.
- Deschryver, P., & De Mariz, F. (2020). What future for the green bond market? How can policymakers, companies, and investors unlock the potential of the green bond market?. *Journal of risk and Financial Management*, 13(3), 61.

- Gilchrist, D., Yu, J., & Zhong, R. (2021). The limits of green finance: A survey of literature in the context of green bonds and green loans. *Sustainability*, 13(2), 1-12.
- Hailiang, Z., Iqbal, W., Yin Chau, K., Raza Shah, S. A., Ahmad, W., & Hua, H. (2023). Green finance, renewable energy investment, and environmental protection: empirical evidence from BRICS countries. *Economic research-Ekonomiska istrazivanja*, 36(2), 1-23.
- Haseeb, M., Hassan, S., & Azam, M. (2017). Rural-urban transformation, energy consumption, economic growth, and CO₂ emissions using STRIPAT model for BRICS countries. *Environmental Progress & Sustainable Energy*, 36(2), 523-531.
- Hassaballa, H. (2013). Environment and foreign direct investment: policy implications for developing countries. *Journal of Emerging Issues in Economics, Finance and Banking*, 1(2), 75-106.
- Khan, S., Akbar, A., Nasim, I., Hedvicakova, M., & Bashir, F. (2022). Green finance development and environmental sustainability: A panel data analysis. *Frontiers in Environmental Science*, 10, 1039705.
- Kwilinski, A., Lyulyov, O., & Pimonenko, T. (2023). Greenfield Investment as a Catalyst of Green Economic Growth. *Energies*, 16(5), 23-72.
- Lee, C. C., & Lee, C. C. (2022). How does green finance affect green total factor productivity? Evidence from China. *Energy economics*, 107, 105863.
- Li, T., Wang, Y., & Zhao, D. (2016). Environmental Kuznets curve in China: new evidence from dynamic panel analysis. *Energy policy*, 91, 138-147.
- Mansour, N. (2023). Green technology innovation and financial services system: Evidence from China. *Businesses*, 3(1), 98-113.
- Muganyi, T., Yan, L., & Sun, H. P. (2021). Green finance, fintech and environmental protection: Evidence from China. *Environmental Science and Ecotechnology*, 7, 100-107.
- Nenavath, S., & Mishra, S. (2023). Impact of green finance and fintech on sustainable economic growth: Empirical evidence from India. *Heliyon*, 9(5).
- Ning, Y., Cherian, J., Sial, M. S., Alvarez-Otero, S., Comite, U., & Zia-Ud-Din, M. (2023). Green bond as a new determinant of sustainable green financing, energy efficiency investment, and economic growth: a global perspective. *Environmental Science and Pollution Research*, 30(22), 61324-61339.
- Phung Thanh, Q. (2022). Economic effects of green bond market development in Asian economies. *The Journal of Risk Finance*, 23(5), 480-497.
- Ren, X., Shao, Q., & Zhong, R. (2020). Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model. *Journal of Cleaner Production*, 277, 122844.
- Salari, M., Javid, R. J., & Noghanibehambari, H. (2021). The nexus between CO₂ emissions, energy consumption, and economic growth in the US. *Economic Analysis and Policy*, 69, 182-194.
- Shahbaz, M., Nasreen, S., Abbas, F., & Anis, O. (2015). Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries?. *Energy Economics*, 51, 275-287.
- Shi, X., Ma, J., Jiang, A., Wei, S., & Yue, L. (2023). Green bonds: Green investments or greenwashing? *International Review of Financial Analysis*, 90.
- Song, Z., Storesletten, K., & Zilibotti, F. (2011). Growing like china. *American economic review*, 101(1), 196-233.
- Tawiah, V., Zakari, A., & Adedoyin, F. F. (2021). Determinants of green growth in developed and developing countries. *Environmental Science and Pollution Research*, 28, 39227-39242.
- Udeagha, M. C., & Ngepah, N. (2023). The drivers of environmental sustainability in BRICS economies: do green finance and fintech matter?. *World Development Sustainability*, 3, 100096.
- Xing, L., Li, J., & Yu, Z. (2022). Green Finance Strategies for the Zero-Carbon Mechanism: Public Spending as New Determinants of Sustainable Development. *Frontiers in Environmental Science*, 10, 925678. <https://doi.org/10.3389/fenvs.2022.925678>
- Xing, Y., & Kolstad, C. D. (2002). Do lax environmental regulations attract foreign investment?. *Environmental and Resource Economics*, 21, 1-22.
- Yang, X., Zhang, J., Ren, S., & Ran, Q. (2021). Can the new energy demonstration city policy reduce environmental pollution? Evidence from a quasi-natural experiment in China. *Journal of Cleaner Production*, 287, 125-135.
- Zhang, Y., & Umair, M. (2023). Examining the interconnectedness of green finance: an analysis of dynamic spillover effects among green bonds, renewable energy, and carbon markets. *Environmental Science and Pollution Research*, 30(31), 77605-77621.
- Zhou, G., Zhu, J., & Luo, S. (2022). The impact of fintech innovation on green growth in China: Mediating effect of green finance. *Ecological Economics*, 193, 1073-1093.
- Zhou, X., Tang, X., & Zhang, R. (2020). Impact of green finance on economic development and environmental quality: a study based on provincial panel data from China. *Environmental Science and Pollution Research*, 27, 19915-19932.