

Sustainable finance from foreign actors into renewable energy and economic growth: An Indian perspective

Anita Kohli *

Ritu Wadhwa †

Amity Business School

Amity University

Noida

Uttar Pradesh

India

G. C. Tripathi §

NTPC School of Business

Noida

Uttar Pradesh

India

Abstract

Energy is a basic ingredient to the economic growth story. Given the increased climate change risk, India like all other countries must transit from fossil -based energy to renewable energy. The transition requires large investments from domestic and foreign actors. The major source of sustainable finance from foreign actors is through the Foreign Direct Investment and External Commercial Borrowings routes. This study analyses the causal relationship between ‘Foreign Direct Investment and Economic Growth’ and ‘External Commercial Borrowings and Economic Growth’ in India in Renewable Energy sector, also explores the causal relationship between Foreign Direct Investment and External Commercial Borrowings. The study will help in recommending policy changes to increase Foreign Direct Investment and External Commercial Borrowings into Renewable Energy in India.

Subject Classification: 91G45, 91G99.

Keywords: Sustainable finance, Sustainable investments, Renewable energy, Foreign direct investments, External commercial borrowing.

*E-mail: anita19009@gmail.com (Corresponding Author)

† E-mail: rwadhwal@amity.edu

§ E-mail: gireesh.tripathi@nsb.ac.in

1. Introduction

The climate change risk and environment risk loom large and is impacting all the nations. In countries like India which are growing and dream to be the largest economies by GDP in the decades to come, energy demand is increasing. The oil price shock and Ukraine Russia standoff has further threatened to topple economies across the world. It is, therefore, essential for India to manage its carbon footprint from the increase in demand for energy and to achieve the net-zero goal. To make a quick transition to Renewable or non-conventional sources of energy. To meet the transition and increase in demand investments running into trillions or thousands of crores are required. The Government of India has set an ambitious goal to reach 500 Gigawatt (GW) of renewable/ non-conventional energy capacity by 2030. India currently has about 173 GW of renewable/ non-conventional energy capacity. based on non-fossil fuels, including 62 GW of solar, 42 GW of wind, 10 GW of biomass, 5 GW of small hydro, 47 GW of large hydro, and 7 GW of nuclear power (GOI, MNRE sept 2022). And 80GW capacity is under construction. To reach the goal for 2030 India must add more than 25 GW of renewable/ non-conventional energy capacity every year, starting 2023. This would require an investment of Rupees 1,25,000 crore, or USD 15 to 16 billion. Assuming a requirement of ₹5 crore per MW of capacity addition.

The major sources of funding for Renewable or non-conventional sources of energy are Foreign Direct Investments (FDI) and External Commercial Borrowings (ECB).

The sections of this paper are planned as follows: Section 2 presents a re-view of literature; Section 3 Objectives of the study; Section 4 outlines the empirical model and the research methodology; Section 5 presents the empirical findings; and Section 6 presents the conclusions of our research.

2. Review of Literature

We reviewed all the literature available with the key words, Foreign Direct Investments (FDI) and External Commercial Borrowings in Renewable Energy sector. Following is a summary of the literature reviewed.

Chang, 2010 analyzed the dependency of Taiwan to China for exports, increasing rates of unemployment and issues pertaining to industrial upgradation. They collected response through a survey questionnaire administered to 50 respondents to identify factors that influence firms

to do Foreign Direct investments (Chang, 2010). They found that Foreign Direct Investments were directly related to Taiwan's GDP and Balance of Payments and also concluded that increase in unemployment was more likely to be because of increase in population both in China and Taiwan (Chang, 2010)

Destek & Aslan, 2017 scrutinized 17 emerging economies from 1980 to 2012 for renewable energy consumption and economic growth. They used bootstrap panel causality and they found positive significance for Peru only (Destek & Aslan, 2017). While results were conservatively sustained in case of Colombia and Thailand; and varying results for the balance 14 economies (Destek & Aslan, 2017).

Aydin, 2019 studied twenty six OECD countries during 1980- 2015 to establish relationship between economy's growth and renewable and non-renewable electricity consumption. They used two different panel causality approaches. The results from the two different approaches did not match for most cases. They recommended policies to encourage renewable electricity consumption in turn to positively influence growth (Aydin, 2019).

Wall et. al., 2019 research determined policy measures that have significant impact on FDI in OECD countries (Wall et. al., 2019). Their research established that Fiscal Measures, such as tax incentives, has a significant positive impact on FDI in OECD countries (Wall et. al., 2019).

Weber et. al., 2019 studied the Canadian financial sector landscape and the study revealed that guarantee funds are apparently most favoured followed by other regulatory requirements regarding fiduciary duty, issuance, reporting and incentives (Weber et. al., 2019). Canada has started late in its journey on climate policy and financial stability and the study is important considering that Canadian funds are one of the major investors in the renewable/ non- conventional energy in India (Weber et. al., 2019).

Emre Caglar, 2020 examined the relationship between FDI, renewable energy consumption, economic growth and CO2 emissions for nine countries (i.e., Denmark, Finland, France, India, Italy, Morocco, Norway, Portugal, Sweden) identified as high score countries in the Climate Change Performance Index 2018 using the bootstrap autoregressive distributed lag (ARDL) approach. Their study showed only a few cointegration relationships exist between these variables (Emre Caglar, 2020).

Sarkodie et. al., 2020 research revealed that FDI, income level, and governance worsen climate change. And renewable energy consumption lessened climate change and its impact (Sarkodie et. al., 2020). Their study

demonstrated that dissociating renewable energy from economic growth catalyses the changeover from fossil fuels (Sarkodie et. al., 2020).

A. Khan et. al., 2021 assessed the impact of FDI, technology and finance on renewable energy and CO₂ emissions in the “Belt and Road Initiative (BRI)” countries from 2000 to 2014. They used standard error regression and showed positive impact and highlighted the importance of financial markets in the 69 BRI countries (A. Khan et. al., 2021).

Chishti et. al., 2021 evaluated the linear and non-linear impact of FDI inflows and terrorism on CO₂ emissions in ten global economies impacted by terrorism for the year 1973 to 2016 using the linear and non-linear autoregressive distributed lag methods. They found evidence of non-linearities between these variables. And recommended that these countries promote education, employment, economic stability, and public awareness to eradicate terrorism. And this will have a positive spin off to mitigate CO₂ emissions (Chishti et. al., 2021) Further they recommended regulations to reduce the adverse environmental implication (Chishti et. al., 2021).

Cui et. al., 2021 use vector error correction model and fully modified ordinary least squares to examine relationship amongst renewable energy consumption, GDP and FDI in China (Cui et. al., 2021). The researcher examined and proved there is unilateral causality from GDP and FDI to renewable energy consumption in the long run in China (Cui et. al., 2021).

Dordi et. al., 2022 used network centrality analysis, to link equity owners and non- renewable energy firms and revealed the predominant equity owners. They inferred that governance of the non- renewable energy businesses may be made accountable for their contribution climate instability and to contribute to the energy transitions to renewable energy (Dordi et. al., 2022).

Hamid et. al., 2022 validated statistically that Oman needs to pursue green economic growth policies by restricting inflows of unclean foreign direct investments. They examined data from 1980 to 2019 and evaluated the symmetric and asymmetric effects of FDI, economic growth, and capital investments on carbon dioxide emissions in Oman and found asymmetric environmental impacts associated with these variables (Hamid et. al., 2022).

Jena et. al., 2022 examined the environmental Kuznets curve hypothesis assuming both CO₂ emissions and ecological footprints in India, China and Japan from 1980–2016 using panel estimation and ADL model. They found U-shape Kuznets curve for India and Japan and inverted U-Shape curve for China. For ecological footprint, India and China had

U- shaped relationship and Japan had an inverted U- Shaped relationship and concluded that these three countries need to engage renewable energy (Jena et. al., 2022).

Kamal et. al., 2022 explored the effect that ‘inflation’ and ‘trade openness’ has on Foreign Direct Investments in India from 1980 to 2020. They used Auto Regressive Distributed Lag Bounds test approach and found positive and significant association between trade openness and Foreign Direct Investments and insignificant association with inflation (Kamal et. al., 2022).

Mujtaba et. al., 2022 examined the linear impact of capital formation, economic growth, renewable energy consumption on the ecological footprint of 17 OECD states for the year 1970 to 2016. And provided evidence on the positive impact of interaction of these variables (Mujtaba et. al., 2022).

Samour et. al., 2022 provide empirical proof in case of UAE that FDI, financial development, economy’s growth have a positive impact on renewable energy consumption. The study suggested promotion of green finance and investments in energy in UAE (Samour et. al., 2022).

Shahbaz et. al., 2022 established that the demand and consumption of renewable energy increases with increase in economic growth. The study was done on 39 counties over the period 2000 to 2019 (Shahbaz et. al., 2022).

Xie et. al., 2022 studied the effect of economic growth and financial development (consisting of institutions and markets) on energy consumption from 1998 to 2019 in emerging economies (Xie et. al., 2022). They suggested ways to reduce energy deficits by optimization of financial markets and financial institutions. Their study also provided some policy implications for reducing energy poverty through optimizing economic and financial advancement (Xie et. al., 2022).

Zain Al-Thalabi et. al., 2022 attempted to forecast the foreign direct investment of the State of Qatar. They used artificial neural networks, and explained economic and financial chains, revealing the non-linear and stochastic individualities. (Zain et. al., 2022)

Chandra Voumik & Ridwan, 2023 explored the key ingredients of a green economy in Argentina. They used the Stochastic Implications of Regression on Population, Affluence, and Technology (STIRPAT) methodology for the year 1972 and 2021 (Chandra Voumik & Ridwan, 2023). And identified the key variables to be FDI, education, renewable energy and sustainable industrialization (Chandra Voumik & Ridwan, 2023).

M. T. I. Khan et. al., 2023 established that natural disasters disproportionately impact economic growth in developing countries. In their research paper they incorporated an infrastructure index, foreign direct investment (FDI) index, human capital index (M. T. I. Khan et. al., 2023).

Most studies available till date focus on impact of FDI on renewable energy consumption and not on establishing causal relationship between the FDI, ECB and economic growth. Further, there is no research available covering External Commercial Borrowings (ECB) or debt in general as an important source of finance for renewable/ non- conventional energy sector and its relationship with FDI. In view of these observations from the review of literature available till date our paper's contribution to the current literature will be highly significant.

3. Objective of the Study

This research aims to provide novel empirical evidence whether the three study variables are related, to define the equation for predicting the dependent variable if linearly related and if the independent variables have significant impact on the dependent variable.

The three variables under study are considered from the **year 2004 to 2022**:

- a. Incremental Foreign Direct Investments into Renewable/ Non-conventional Energy sector in India (referred to as FDI in the paper).
- b. External Commercial Borrowings into Renewable/ Non-conventional Energy sector in India (referred to as ECB in this paper).
- c. GDP growth(%) of the Indian economy (referred to as GDP in the paper).

4. Research Methodology and Data Sources

The research methodology used is applying statistical tools on the three variables FDI, ECB and GDP to determine the correlation and impact of dependent variable on independent variable. The paper uses secondary data sources. The GDP data for India from the year 2004 to 2021 has been taken from World bank site. The GDP data for India 2022 is an estimate number extracted from past press releases of World Bank on the expected GDP growth rate for India for 2022.

The FDI data is taken from the DPIIT, Ministry of finance, Government of India for Foreign Direct Investment into non- conventional energy from

the year 2004 to 2022. While the ECB data is taken from Reserve Bank of India website and had to be consolidated and curated as the sector names changed over the years 2004 to 2022. However, the data was available with the borrower's name making the selection flawless.

5. Results and Discussion

The three variables under study are plotted on 'line chart' and 'bar chart'.

Figure 1 depicts the GDP as a line chart. Figure 2 depicts ECB and FDI as a bar chart. While Figure 3, is a combo chart to show the three variables FDI, ECB and GDP in one frame.

We tested the following four Hypothesis for the three variables under study:

H_{1-0} : There is no linear relationship between FDI and GDP

H_{1-1} : There is a significant linear relationship between FDI and GDP

H_{2-0} : There is no linear relationship between ECB and GDP



Figure 1

GDP growth (%) of India from 2004 to 2022

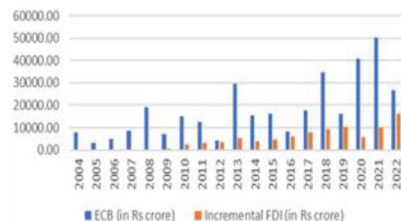


Figure 2

ECB and FDI in Renewable Energy Sector in India

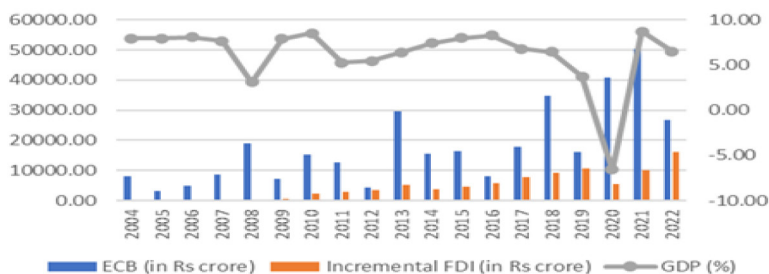


Figure 3

ECB, FDI and GDP (%) in India in Renewable Energy Sector

H_{2-1} : There is a significant linear relationship between ECB and GDP

H_{3-0} : There is no linear relationship between FDI and ECB

H_{3-1} : There is a significant linear relationship between FDI and ECB

H_{4-0} : Intercept or slope is zero for the regression equation y (ECB, dependent variable) on x (FDI dependent variable).

H_{4-1} : Intercept or slope is not zero for the regression equation y (ECB, dependent variable) on x (FDI dependent variable).

We used the Pearson's correlation coefficient to evaluate the linear correlation between the variables ECB, FDI and GDP.

Table 1
Correlation between

	ECB	FDI	GDP
ECB	1		
FDI	0.613451	1	
GDP	-0.39068	-0.11179	1

Table 2
Regression Statistics

Multiple R	0.6134514
R Square	0.3763226
Adjusted R Square	0.3396357
Standard Error	10668.628
Observations	19

ECB, FDI and GDP

The correlation coefficient between 'ECB and GDP' and 'FDI and GDP', is less than 0.5 (refer Table 1) therefore we fail to reject the Null Hypothesis H_{1-0} and Null hypothesis H_{2-0} . We conclude that there is no significant linear correlation between the variables 'ECB and GDP' and 'FDI and GDP'.

The correlation coefficient between 'ECB and FDI' is 0.6134 (refer Table 1) which is greater than 0.50. We therefore reject the Null Hypothesis H_{3-0} and infer that there is a significant linear correlation between the variables 'ECB and FDI'.

In view of the above result of the correlation statistic we further performed Regression Analysis (Table 2) on the variables FDI and ECB as only these two variables have significant linear correlation. We performed Regression Analysis with FDI as the Independent variable and ECB as the dependent variable. The coefficient of determination R Square is 0.3763 for the two variables being studied. We deduce that 37.63% of ECB, the dependent variable can be explained by FDI, the independent variable.

Standard Error is high as the amount of investment through ECB and FDI route has been taken and not percentage of growth. And the value of these variables run into thousands of crores.

We now determine the equation for predicting the dependent variable ECB. And test our fourth hypothesis. We find from Table 3: ANOVA analysis done using excel that both the P- value 0.016 and 0.00522 are less than 0.05. Hence, we reject the null hypothesis and conclude that the FDI, the independent variable has significant impact on ECB, the dependent variable. For determining the equation for predicting the dependent variable ECB we use the data from Table 3: ANOVA analysis.

$$Y = m \cdot X + b$$

Wherein, Y is the dependent variable ECB; X is the independent variable FDI; m is the coefficient = 1.7892; b is the intercept = 9531.1399

The equation for predicting ECB = 1.7892*(value of independent variable FDI) + 9531.1399

We plot the residual values on Y axis and the independent variable FDI on x axis as shown in Figure 4. It is noted that the values have a random pattern with roughly half the value above and below the x axis. As can be seen from Figure 4 the data points are vertically spread along the x axis and therefore data passes the homogeneity of data test assumed for regression test.

In Figure 5 we draw the ECB along y axis. The actual data and FDI along x- axis and draw the line of best fit is determined as $y = 1.7892x + 9531.1$

Table 3
ANOVA Analysis

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	1167525484	1167525484	10.25768	0.0052165
Residual	17	1934933432	113819614		
Total	18	3102458916			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	9531.14	3563.37	2.67	0.02	2013.08	17049.20	2013.08	17049.20
FDI (in Rs crore)	1.79	0.56	3.20	0.01	0.61	2.97	0.61	2.97

Table 4
Residual Output

<i>Observation</i>	<i>Predicted ECB (in Rs crore)</i>	<i>Residuals</i>	<i>Standard Residuals</i>
1	9531.14	-1555.57	-0.15003
2	9531.14	-6312.77	-0.60887
3	9531.14	-4727.21	-0.45594
4	9652.56	-1002.24	-0.09667
5	10028.86	9046.055	0.872494
6	10586.22	-3467.95	-0.33448
7	13443.05	1743.47	0.168158
8	14845.78	-2232.29	-0.2153
9	15552.03	-11286.7	-1.08861
10	18769.89	10709.25	1.032909
11	16163.18	-720.467	-0.06949
12	17586.98	-1348.51	-0.13006
13	19994.34	-11965.1	-1.15404
14	23429.28	-5725.31	-0.55221
15	26144.66	8634.977	0.832845
16	28325.61	-12224.9	-1.17909
17	19342.35	21594.79	2.082823
18	27693.48	22711.41	2.19052
19	38536.23	-11870.9	-1.14495

The predicted value for the dependent variable ECB for all the FDI values is given in Table 4: Residual Output. We further find the Residuals that the distance between the actual ECB data as shown in Table 4. We also calculated the standard residuals to evaluate the homogeneity of the variables. All the values of the standard residuals are less than plus minus three. Hence, we conclude there are no outliers.

5. Conclusions and Policy Implications

We conclude that there is no significant linear correlation between the variables 'ECB and GDP' and 'FDI and GDP'. Whereas there is a significant correlation between the variables 'FDI and ECB'.

We further, conclude that the independent variable FDI has a significant impact on the dependent variable ECB.

A mix of debt and equity is necessary to enable the renewable energy / non-conventional energy sector to get funds from the foreign actors. These foreign actors can be global banks, multilateral development banks/ institutions, green banks, climate change funds, private equity funds, sovereign wealth funds and pension funds. Whereas a mix is essential and therefore conducive policies regarding both debt and equity are essential, equity investments have to precede borrowings or other debt or hybrid investments. Though as a general principal borrowings or debt can be 3 to 4 times equity investments. Further the role of retained earnings and retail investments like crowd funding and general awareness will also play an important role as significant sources of funding for the sector in the future.

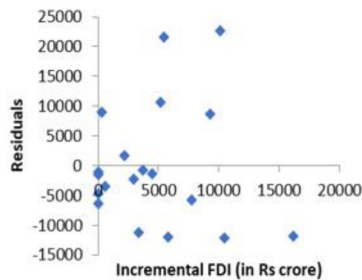


Figure 4
Incremental FDI (in Rs crore)
Residual Plot

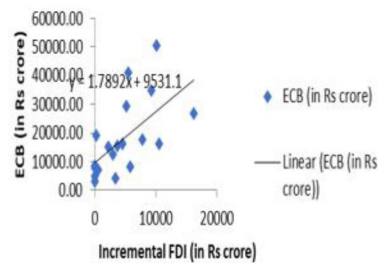


Figure 5
Incremental FDI (in RS crore) Line
Fit Plot

We suggest that “reasonable policy for ease of doing business” and “incentives to attract FDI into Renewable/ Non- Conventional Energy” will go a long way to help bridge the gap between the funds required and funds currently available for renewable energy sector in India from investors outside India. Investments via the debt route namely External Commercial Borrowings framework as applicable in India will follow as a corollary to Foreign Direct Investments into the sector from both the foreign equity investors and other eligible investors outside India.

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