Green Growth & Environmental Degradation In India: Role Of FDI

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Abstract - *Since the implementation of new economic policy (1991) India is growing quite satisfactory despite of several ups and downs and abnormal years. During this period the country as well as the globe has witnessed recession and pandemic which posed the growth rate but, the country is recovering from the shocks. However, it is not only sufficient to recover form shocks and attain a satisfactory growth rate; checking sustainability of the growth rate is also important. In this context UN has stated 17 sustainable development goals (SDGs) to be achieved by 2030 (United Nations, 2015). FDI can act as a stimulus to attain faster growth in the developing economies. There are a few literatures on this issue but there has not been a common consensus between the researches.*

Rising CO2 emissions have a detrimental impact on the environment and are a major source of FDI concern. Industrialization has a massive environmental impact. This paper addresses the need for empirical analyses of the environmental impacts of FDI inflows into India, given the formation of a far-reaching national green growth strategy. Green efficiency is increased by FDI in emission-intensive industries, mostly through better economic efficiency. The environment, the economy, and the environment all gain from foreign direct investment in low-emissions industries. Given this background, the present study aims to estimate environmental Kuznets curve in India for the time period 1990 - 2020. We also attempt to look at the impact of foreign direct investment on the economy's green growth.

Index Terms - Green GDP, CO2 emissions, FDI, SDG, Unit Root, ARDL, India.

I. INTRODUCTION

Green growth is regarded as a positive indicator for any country in the world, but with rising pollution and other health concerns, it is now regarded as a pressing issue, necessitating either the conservation of natural resources or the payment of a cost in the event of excessive or unrealistic resource consumption. Although natural resources have been striving to conserve for a better environment for the benefit of humans living at home in the long term, green growth is described as the fastest economic growth and development. Green growth allows the earth to remain in balance by preserving economic growth while simultaneously conserving the environment in accordance with the demands of living beings. (Mahwish, Shazia; 2019)

Despite the fact that it established various programmes such as Sashakt Bharat, Swachh Bharat, Sanatan Bharat, and many more, India was rated last in the Environmental Performance Index (EPI) 2022. According to the report, India has the lowest environmental sustainability standards among the 180 nations examined (). Gross Domestic Product (GDP) appears to be a poor statistic in terms of sustainable development. FDI plays a vital role in the growth of any nation, such as the generation of money, the creation of new employment, and the development of new technologies, all of which contribute to the overall expansion of the economy.

Considering technology and environmental regulation, a specific region's environmental regulation can govern the relationships between local green credit, green technological innovation, and economic growth. Simultaneously, environmental regulations will inevitably necessitate the government's adjustment of some existing policies and regulations, as well as the formulation of corresponding incentive measures, such as green subsidies and preferential funding, which will undoubtedly stimulate technological innovation.

By enabling the movement of capital, talent, and knowledge, foreign direct investment (FDI) has aided rising economies in engaging in global trade. Securities and other financial assets held by foreign investors are known as overseas portfolio investment (FPI). Investors are not given direct ownership of a company's assets, which are partially liquid subject to market volatility. FPI is one of the most popular ways to invest in a foreign economy, alongside foreign direct investment (FDI). To fund themselves, most economies rely on FDI and FPI. The act of creating and sustaining a hands-off—or passive—asset investment with the purpose of profit is known as portfolio investing. Stocks, American depositary receipts (ADRs), and global depositary receipts of companies headquartered outside the investor's nation are all examples of securities that can be included in a foreign portfolio investment.

Bonds or other debt issued by these firms or foreign governments, as well as mutual funds and exchange traded funds (ETFs) that invest in assets abroad or overseas, are included in the holdings. Individual investors who want to participate in possibilities outside of their own nation are more likely to use an FPI. Foreign portfolio investment is reported on a country's balance of payments and is included in its capital account (BOP). The BOP examines the amount of money going from one country to another over the course of a fiscal year.

International trade can be leveraged by the governments to expand markets for goods and services that would otherwise have been inaccessible. Because of international trade, the market has more competition and hence more competitive pricing, which results in a reduced price for the client at home. The trade-to-GDP ratio measures the proportionate importance of foreign trade in an economy. It can be seen as a measure of an economy's level of globalisation. Apart from other factors, countries with large economies and populations have a low trade-to-GDP ratio.

When we look at sustainability and SDGs, environmental degradation is a global issue that has gained significance as carbon dioxide emissions are the principal factor influencing the natural environment on a global scale (MK, 2020; Villanthenkodath, 2021). Nevertheless, growing economies like India have seen a huge increase in carbon dioxide emissions.

The United Nations issued the first definition of "sustainable development" in 1987, and it may be differentiated into three components: economic, social, and environmental sustainability are all significant factors. The Sustainable Development Goals (SDGs) in 2015, provide worldwide guidance for addressing the global challenges of the international community. It's about preserving the natural underpinnings of life and our environment for everyone, everywhere, as well as people's capacity to live in dignity and affluence for future generations. The goal of affordable and clean energy, industry, innovation and infrastructure and climate actions can be achieved through this study.

Not only UNO, the Government of India also has unveiled the National Action Plan on Climate Change (NAPCC) in 2008, which included eight National Missions on climate change. India has sought to do its part by launching various efforts to preserve its natural resources and reduce carbon emissions. Because, in the end, it is up to us, and there is no turning back. India is reducing its carbon footprint mainly due to five initiatives, namely; NRDC's India Initiative on Climate Change and Clean Energy, PepsiCo India's Waste to Wealth initiative, Save Himalaya Campaign, National Action Plan on Climate Change, National Wetland Conservation Program.

II. LITERATURE SURVEY

Increased foreign direct investment reduces CO2 emissions; yet, increased trade openness has a net positive effect on CO2. A Kuznets curve depicts the link between trade and CO2 emissions, whereas a U-curve depicts the relationship between FDI inflows and CO2 emissions. FDI may be effectively handled to decrease CO2 emissions. (Asongu and Odhiambo, 2020). The dynamic relationships between CO2 emissions and their potential causes (as indicated by current research), including per capita GDP, squared term of per capita GDP, coal consumption, financial development, and trade openness for India from 1971 to 2017. The ARDL limits the findings in the long-run cointegrating relationship between these variables. Coal consumption is greatly increasing CO2 emission and economic expansion (Sanu, Sahnewaz, 2019)

To begin with, increasing trade openness has a net positive impact on CO2 emissions, but increasing FDI has a net negative impact. Second, whereas CO2 emissions and trade are linked by a Kuznets curve, CO2 emissions and FDI inflows are linked by a U curve. Third, in order to create a green economy, a minimum trade openness (imports plus exports) criterion of 100 (percentage of GDP) and 200 (percentage of GDP) is beneficial correspondingly, for the first and second samples. Fourth, below critical masses of 28.571 net FDI inflows (percent of GDP) and 33.333 net FDI inflows (percent of GDP) for the first and second samples, respectively, FDI is advantageous to the green economy. While FDI may be successfully restricted to decrease CO2 emissions, trade openness may not be, according to the research, since equivalent trade openness criteria are closer to the upper limit.

The literature on the relationship between economic growth and environmental quality is rather vast. In their book "The Limits to Expansion," (Meadows, 1972) assert that economic expansion kills environmental sustainability. As a result, in order to protect environmental quality, development should be controlled. In their seminal study, Grossman and (Krueger 1991) examined the environmental consequences of the North American Free Trade Agreement (NAFTA), concluding that economic growth will damage the environment related to scale, composition, and technology effects. They also discovered that at low levels of national income, two pollutants, smoking and SO2, expand with GDP but decline as income grows.

The relationship between economic growth and sulphur dioxide emissions, found that the income-sulphur dioxide emissions relationship follows a classic environmental Kuznets curve pattern (Panayotou, 1993; Shafik 1994; Apergis and Ozturk, 2015; Bilgili, 2015) while estimating the EKC hypothesis, (Shahbaz 2017; Montasser, 2018). As a consequence, they concluded that the EKC model is fundamentally incorrect and biased due to a missing variable. When a similar variable was employed as a proxy measure for environmental quality, the same result was achieved (Harbaugh 2002). On the other hand, Dasgupta (2002) cast doubt on the EKC hypothesis's widespread acceptance. Pal and Mitra (2017) argue that there is still another turning moment, even if evidence for the classic EKC relationship exists.

From 1980 to 2010, (Wang 2013) investigated the influence of economic development, population, technology level, urbanization, service level, industrialization, energy consumption structure, and international trade on energy-related CO2 emissions in Guangdong Province, China, using an enhanced STIRPAT model. The data reveal that a drop in CO2 is caused by a fall in technical level, international trade degree, and energy consumption structure.

Recent research used the autoregressive distributed lag (ARDL) model and a nonlinear form of the same to evaluate the relationship between economic growth and CO2 emissions, concluding that the two variables had a positive long-term correlation. Riti (2017), Toumi & Toumi (2019)

III. RESEARCH GAP

The study of Environmental Kuznets curve was not done in India with an impact on FDI

1.   To examine the evidence of Environment Kuznets Curve in India

2.   To explore the impact of green growth and environmental degradation.

IV. CONCEPTUAL FRAMEWORK

Growth depends on various factors, such as, CO2 emissions, industrialization, migration and employment.

Depending on the economic sector that a country already has in place, the effects of industrialisation might be varied. When it comes to the environmental repercussions of industrialization, the outcome depends not only on the national economic situation, but also on the smaller framework for identifying inside a country. For example, Liu et al. (2016) found that industrialisation and the environment have a negative connection, with the ecosystem deteriorating as industry expands in a nation.

Industrialization, deindustrialization, urbanization, and income all have positive impacts on CO2 emissions. Trade openness and renewable power, on the other hand, contributed to cut CO2 emissions. Dong (2019) discovered a double-threshold effect of urbanization on emissions in developed nations in their urban-environment research. The effects on the environment become more intense and destructive as the country moves towards the middle stage of urbanization. Industrialization has certain clear effects on an economy, and when a country begins to focus on strengthening its industry, the rate of emissions rises, degrading the environment. People have additional off-farm employment possibilities as a result of industrialization, which can assist to offset the negative impacts on the environment.

Green GDP is directly dependent on GDP and CO2 emissions, and the two are positively related. As a result, trade and FDI have a positive impact on GDP (Zeqiri, 2011), and urbanization may be said to be signified by industrialisation. Similarly, when industrialization progresses, migration to urban regions increases, resulting in additional industrialization; nevertheless, this leads in massive CO2 emissions. The relocation of industry to rural areas will hasten rural growth while severely damaging the environment. Growth in these areas may be seen in India's interiors, but at the price of rising CO2 emissions. By lowering CO2 emissions through renewable energy and energy efficiency, clean energy technologies are critical for minimizing global warming and safeguarding ecosystems.

India's energy infrastructure and investment prospects have shifted to clean energy technology (Kumar and Sinha, 2014). FDI has the ability to provide three sorts of greening impacts; transfer of clean technology to affiliates that are less polluting and more input-efficient than domestic production, technological leapfrogging, through which FDI transfers cutting-edge manufacturing and pollution-control technologies to affiliates & spill overs to domestic enterprises, in which superior environmental management practices are passed down to affiliates and disseminated to domestic competitors and suppliers (Gallagher and Zarsky, 2007). A study of carbon emission trends in developing countries found a positive correlation between cumulative FDI and energy efficiency increases (Golub and Strukova, 2006). The investigation of the link between falling GDP energy intensity and FDI flows in 20 emerging nations is seen (Mielnik and Goldemberg 2002); thus, we assume an inverse relationship between GDP and FDI.

The Kuznets curve shows the first stage of development in India i.e., India has not yet reached the threshold period; as with the increase in GDP the CO2 emissions are also increasing. If the GDP growing in the stead state leads to a decline in the CO2 emissions, we would have concluded that India is in a second stage.

The EKC emanated from the famous Kuznets Curve developed by Simon Kuznets in 1955 which hypothesizes that as the economy grows, there is pressure on the nation's economic inequality, which increases up to a certain level before declining (Kuznets, 1955; Apergis and Ozturk, 2015). Nations encounter industrialization and urbanization during the economic development process, which worsen economic disparity until a certain point before reducing.

Environmental improvement is dependent on government policies, social institutions, and the completeness and functionality of markets. Because market forces will eventually decide the price of environmental quality, policies that enable market forces to function will be unequivocally good. The pursuit of meaningful environmental protection is a pursuit of methods to improve property rights and markets.

V. METHODOLOGY

Green GDP components - Previous study has focused just on CO2 emissions, with no mention of the other components; thus, we're looking at green GDP, which is calculated by taking all of these aspects into account.

However, the environment is extremely vital to be ignored just because an appropriate measure could not be found. This is why the quest for alternatives has gained some traction. The Green GDP is one such alternative metric. Green GDP was adopted by superpower economies like China as early as 2004. India wants to implement it by 2015. This has given this theory a lot of legitimacy, and as a result, analysts from all around the world are now closely studying the Green GDP supplement that is issued alongside the original GDP data.

In India the key components for green GDP are to be focused upon are GDP, CO2 emissions, FDI, FPI, trade, urban growth, employment in industries, change in industries, and growth of GDP as well as green GDP.

Calculated Green GDP or GGDP = GDP - [(CO2*CDM) * 1000] - (waste*energy*kwh) - (GNI/100*natural)

Where, GDP is Gross Domestic Product of India, CO2 is Carbon-dioxide emissions (kt), CDM is Clean Development Mechanism, Waste - Total commercial and industrial waste, Energy is Energy price, kwh - kwh energy in 1 tonne, GNI is Gross National Income, Atlas method (current US$) & NATURAL is Adjusted savings: natural resources depletion (% of GNI)

The data is from the World Bank, and line charts are used to show changes in FDI, CO2 emissions, GDP, and Green GDP from 1990 to 2020. This study looks at the relationship between GDP, FDI inflows, and CO2 emissions in India at the provincial level, in order to make conclusions regarding the role of FDI in India's green growth strategy.

The unit root test and ARDL model (HAC standard errors & covariance (Bartlett kernel, Newey-West fixed) are used to check the long run relationship. These tests examine the relation and interdependence of the selected variables. One of advantage of ARDL model is that we can use this model for a smaller size of data. ARDL is more efficient in case of a finite data.

Figure 1 Drawn by the authors compiling the information from the world bank

We should have the trend regression analysis of the key variables namely, GGGP, GDP FDI & CO2 emission. There is a contrast between simple and multiple linear regression in statistics which is used in this paper. In simple linear regression, a linear function is used to represent the relationship between a dependent variable and one independent variable, here the dependent variable being GGDP and the independent variables affecting GGDP directly and indirectly are FDI, CO2 emissions, trade, FPI, industrialization, urbanization & migration. When predicting the dependent variable, multiple linear regression is utilized the nonlinear regression is used instead of linear regression if the dependent variable is represented as a nonlinear function since the data linkages aren't straight.

VI. DATA ANALYSIS

Before we go for the estimation let see check the trend of CO2 emission, per capita GDP and overall environmental degradation
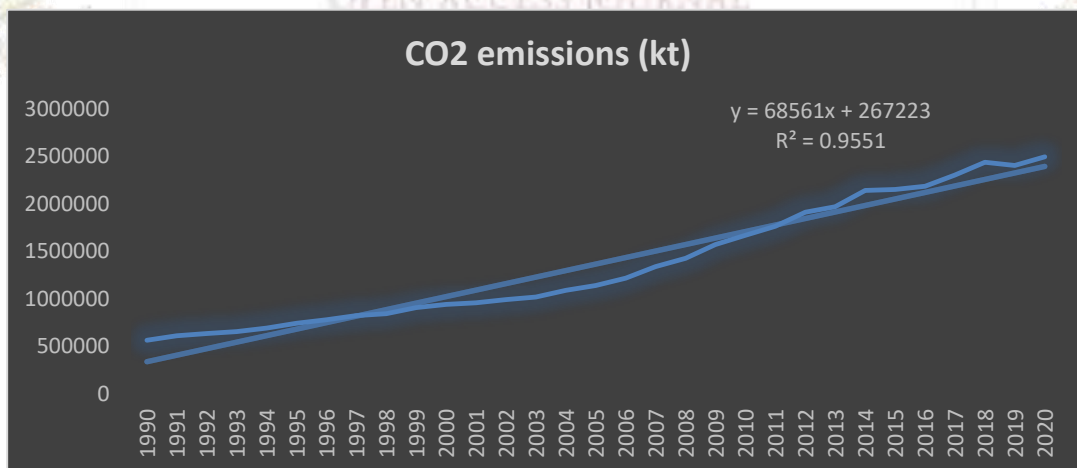

Figure 2 Drawn by the author

The carbon emissions are increasing at a steady rate due to increase in the industrialization. Energy, in the form of electricity generated from coal and fuel, is a determinant of economic development. Since countries are attempting to increase their productive capacity, growth is defined as an increase in energy usage. It has been stated that that as energy usage increases, so do carbon emissions. CO_2 emissions are released into the atmosphere when fossil fuels are used as a source of energy.
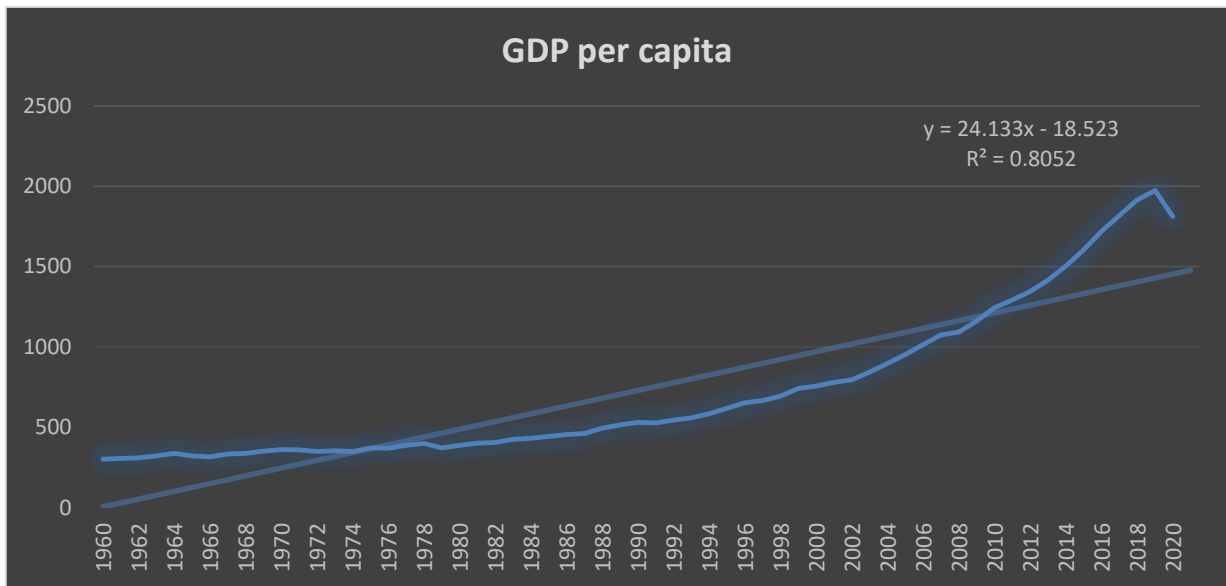

Figure 3 Drawn by the authors

The trendline of GDP is increasing at a constant rate, and has a dip in the year 2020-2021 due to COVID-19 pandemic. To put this drop in context, consider that India expanded at a rate of roughly 7% per year from the early 1990s until the epidemic struck. According to the most recent GDP figures (2020), it is not an outlier. Instead, even before the Covid-19 outbreak, India's economy has been slowly deteriorating throughout and currently economy is in the phase of recovery.

Now we will proceed towards the estimation of EKC In India

Estimation of EKC

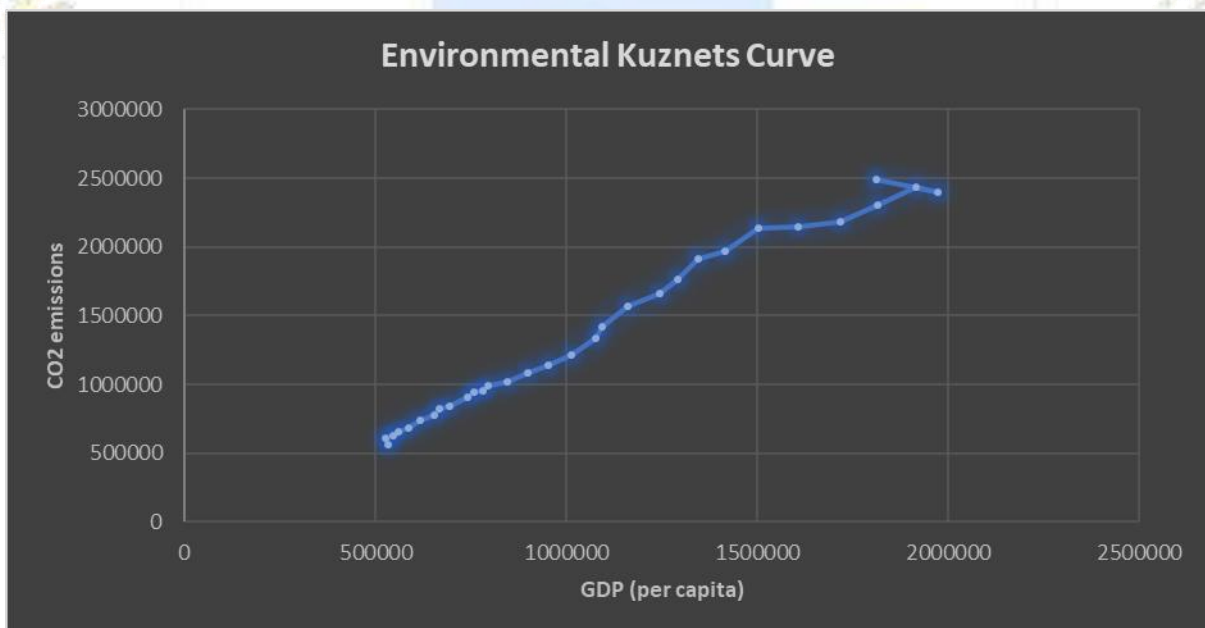Regression result (table) dependant CO_2 emissions

Figure 4 Drawn by the authors

So, we have regressed our ordinary least square model as the unit root test for the variable CO_2 emissions and GDP was stationary at I (1).

Variables	Coefficient
c	19529.06
Per Capita GDP	1277.8
Adjusted R-squared	0.954454
Log likelihood	-409.4155
F-statistic	629.6813
Prob(F-statistic)	0.01

Table: Estimated by authors

The Adjusted R-squared is 0.95 which is a good fit and the f-stat is 0.01 which shows us the significance of the model. Thus we conclude that there is a positive relationship between CO_2 emissions and Per Capita GDP.

According to the environmental Kuznets curve, economic expansion initially causes environmental degradation, but at a certain degree of economic growth, a society's interaction with the environment improves and levels of environmental degradation decrease. From the estimated results it is also seen that there is environmental degradation due to increase in per capita GDP and steady increase in CO_2 emissions. Due to increase in per capita GDP the country's economy rises leading the factors of urbanization, industrialisation in India; thus leading to excess CO_2 emissions.

The Kuznets curve demonstrates that when GDP rises, CO_2 emissions climb in lockstep, indicating that India is in its growing stage of development. Thus, it is yet to meet the threshold level.

The relationship between economic levels and environmental deterioration is fairly modest. Economic expansion may be consistent with improved environmental conditions, but this needs a highly intentional set of regulations and a desire to generate energy and things in the most ecologically friendly way feasible.

Our analysis demonstrates that, while no single connection matches all pollutants for all places and periods, the inverted-U EKC best approximates the link between environmental change and economic development in many circumstances. Acceptance of the EKC theory for certain contaminants has substantial policy consequences. Specifically, measures that promote growth (trade liberalization, economic restructuring, and pricing reform) should be beneficial to the environment over time.

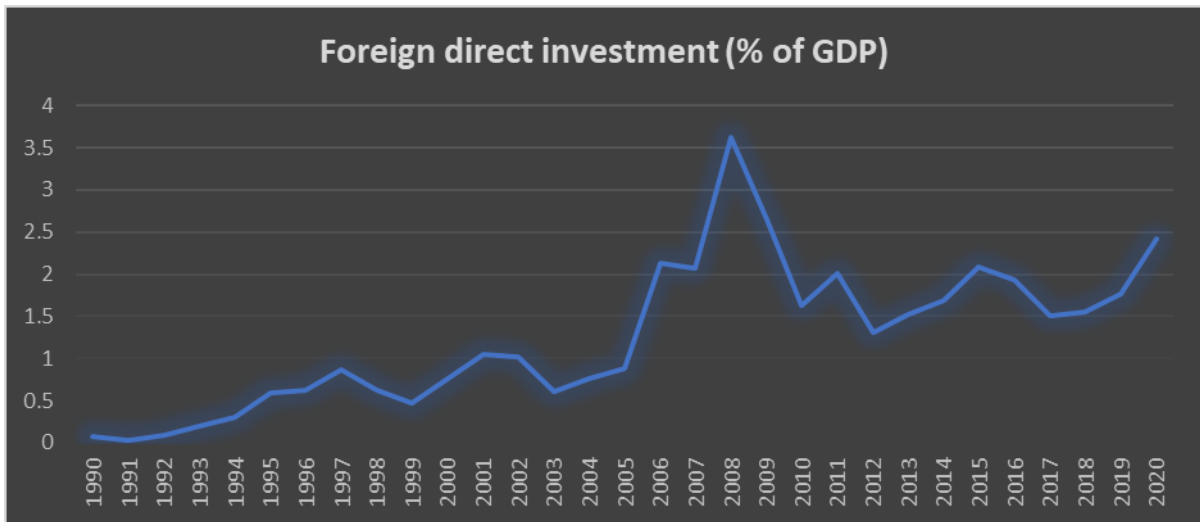Role of FDI - the impact on green growth and environmental degradation.

Figure 5 Drawn by author

The country's environmental challenges are caused by foreign direct investments. Polluting businesses from advanced economies have shifted to developing countries. The automobile sector has been impacted the worst. The vast majority of these have been transported to developing countries, where they are safe from pollution. On the other hand, FDI may have a positive influence on the environment, since more FDI reduces environmental emissions. In theory, this is known as the pollution halo hypothesis.
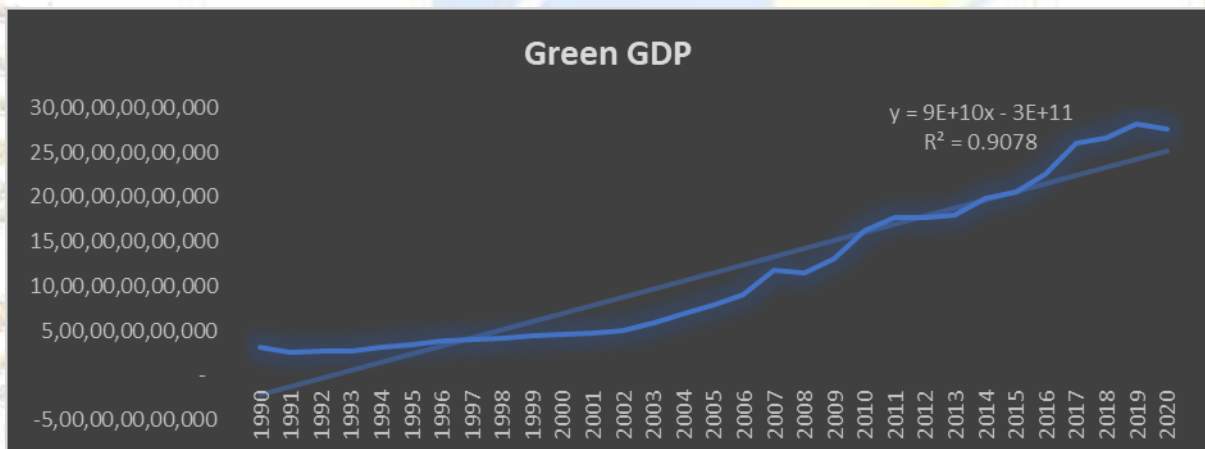

Figure 6 Drawn by the authors

Green GDP refers to GDP that has been adjusted for environmental effect. GDP, CO2 emissions, FDI, FPI, trade, urban expansion, industry employment, industry change, and GDP growth as well as green GDP are the major components deriving the curve.

Trend Regression

	Trend Coefficients	t Stat	P-value	Adjusted R Square
CO2 emissions	68561.26	24.83	0.01	0.953
GDP (per capita)	49.02902581	22.17	0.01	0.942
Green GDP	90975755574.99	16.90	0.01	0.904
FPI	745338292.43	2.67	0.01	
FDI % of GDP	0.072195047	6.32	0.01	0.5648

Source: Estimated by the author

Since the results show that the time variable is statistically significant at the 1 percent level (because the p-value for time is well below 0.01). It is not giving the statistical validity.

In order to capture this objective, the first step is to check the stationarity of the variables

Unit Root Test		
Name of the variable	**Phillips - perron**	**Stationery at**
Industry (growth)	X3	I (1)
Urban population growth (annual %)	X7	I (1)
Employment in industry (% of total)	X8	I (2)
FDI, net inflows (% of GDP)	X10	I (1)
FDI (Constant price)	X11	I (1)
FPI to be calculated %	X14	I (0)
Trade (% of GDP)	X16	I (1)
CO2 emissions (kt)	X17	I (1)
Green GDP(Growth)	X28	I (0)

Source: Estimated by the author

GDP & CO2

This country is an extremely intriguing case study for researching the relationship between economic progress and the environment because of its economic size and CO2 emissions. The so-called environmental Kuznets curve (EKC), with its distinctive U-shape (as in the original curve indicating the connection between income inequality and GDP per capita; Kuznets, 1955), is frequently used to illustrate this.

The Kuznets curve depicts India's initial stage of growth, indicating that the country has not yet passed the threshold phase; as GDP increases, so do CO2 emissions. If continuous GDP growth results in a decrease in CO2 emissions, we may conclude that India is at the second stage.

Long run relationship

A recent study examined the link between economic growth and CO2 emissions using the autoregressive distributed lag (ARDL) model and a nonlinear version of the same, concluding that the two variables showed a positive long-term association. Many studies on the link between economic growth and environmental degradation have been done, with mixed findings. Some of them feel that CO2 emissions and economic growth have a negative relationship (Baek & Pride, 2014).

The environmental Kuznets curve (EKC), which is similar to Kuznets's (1955) inverted U-shaped curve for modelling the relationship between income inequality and income levels, has become the most common framework for studying the links between CO2 emissions and economic growth in single countries or groups of countries. In Canada, France, Italy, Japan, the United Kingdom (UK), and the United States, Barassi and Spagnolo (2012) estimated a VAR-GARCH (vector autoregression—generalized autoregressive conditional heteroskedastic) model and find evidence of mean and volatility spill overs between per capita economic growth and CO2 emissions. This shows the long run relationship between CO2 emissions and GDP overall.

Unit Root

Before running any time series regression model the prerequisite is to check stationarity of the data. Empirical studies frequently employ the unit root test to determine if time series data is stable; if the unit root is absent, the data is stationary, and the research may make important conclusions from it.

(Table) unit root results

The data was non-stationary at level so it has been differenced at 1st and 2nd to make series stationary. The variables used in this study were not all at stationary at level or even at the same level. That is why we cannot use Engel-Granger cointegration technique.

ARDL model

Standard least squares regressions with lags of both the dependent and explanatory variables as regressors are known as ARDLs (Greene, 2008). Although ARDL models have been used in econometrics for decades, (Pesaran and Shin, 1998) have popularized them in recent years as a technique of investigating cointegrating correlations between variables.

While a typical least squares approach can be used to estimate an ARDL, EViews' specific ARDL estimator has a number of helpful features, including model selection and post-estimation diagnostics calculation.

ARDL bounds testing, gives both short and long-run connections between variables and does not need variables to be integrated in the same sequence (Sibanda, 2019).

Co-integration analysis

In this approach first we need to confirm the existing long run relationship among variables and it is done by Bounds Test for Cointegration Analysis. Following table shows the results of the test which concludes that there is cointegration.

Bounds Test for Co-integration Analysis		
Calculated F statistic	P - value	Conclusion
6.12	0.025	Cointegration

Source: Estimated by the author

Having confirmed about the existence of long run relationship, we now proceed to estimate the model which provides us with both long and short run dynamics. The long run estimates are shown in following table.

We reject the null hypothesis, which means that there is a long run relationship.

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
X17(-1)	0.534	0.17	3.06	0.0058
X17(-2)	0.249	0.14	1.72	0.1
X3	2707.733	1786.84	1.52	0.1439
X7	-135472.600	40527.11	-3.34	0.0029
X10(-1)	20926.400	6932.41	3.02	0.0063
X8	31374.820	6577.32	4.77	0.0001
C	50654.040	109026.70	0.46	0.6468
Adjusted R-squared	0.997093			
S.E. of regression	33651.48			
F-statistic	1601.553			
Durbin-Watson stat	2.093166			

VII. CONCLUSIONS

Green growth & environmental degradation are correlated but there is no endogeneity present. FDI's role in total infrastructure finance and the implementation of greener technology is quite negligible.

The findings of the ARDL bounds F-statistics show that the variables are cointegrating in the long term. According to the study's findings, FPI and industrialization significantly boost CO2 emissions, with economic expansion accounting for the majority of emissions in India. According to Model 1, we conclude that urbanization and growth of Green GDP have a negative relationship. As a result of ARDL model, CO2 emissions have a negative impact on trade, migration and green GDP; as India is still in recovery stage due to covid-19 pandemic. Due to development and industrialization, maximum population is migrating to urban areas which result in increasing the infrastructure and deforestation. This results negatively on consumption of fossil fuels. Economic expansion causes environmental deterioration at first, according to the environmental Kuznets curve, but beyond a certain level of economic growth, a society's relationship with the environment improves and levels of environmental degradation diminish. According to the estimated results, there is environmental deterioration as a result of rising per capita GDP and rising CO2 emissions. The country's economy grows as per capita GDP rises, causing urbanization and industrialization in India, resulting in excess CO2 emissions.

There are indicators which show that energy is becoming more sustainable and broadly available, which is good. Access to power throughout the country has begun to accelerate, energy efficiency is improving, and renewable energy is making significant advances in the electrical sector, which helps to cut fossil fuel usage and reduce CO2 emissions directly. The SDGs are important for introducing and promoting new technologies, facilitating international trade, and allowing for resource efficiency. India, on the other hand, still has a long way to go before completely realizing its potential.

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