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Foreign Capital Inflows and Environmental Degradation: Evidence from Developing Countries

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ARTICLE DETAILS	ABSTRACT
History: Received August 30,2021 : Accepted May 11, 2022 :	The primary focus of this study is to investigate the impact of foreign inflows of capital on environmental degradation in developing countries. The study is based on panel data for the period 1980 to 2017. The techniques like Pedroni test of co integration, panel ARDL and Granger causality are used for data analysis. The outcomes show that total population, affluence, technology, and foreign inflows are positively related to environmental degradation while agricultural land is negatively associated with environmental degradation although the influence of total population and technology on environmental degradation is found to be statistically insignificant in the long run. In the short run total population, foreign inflows, and agricultural land area are found to be inversely related to environmental degradation however their impact is statistically insignificant. Granger causality analysis shows that there is a unidirectional causality between total population and environmental degradation, unidirectional causality between GDP and environmental degradation, and unidirectional causality between industrial production and environmental degradation. No causality is observed between foreign inflows and environmental degradation, agricultural land area, and environmental degradation. It suggested that developing economies should adopt the policies for population control and use the foreign resources in such a way that environmental safety is maintained.
Keywords: Environmental Degradation Foreign Inflows Developing Countries	
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1. Introduction

Environmental protection has become an international goal. The issue of environmental degradation is not only severe in developing economies but developed nations are combating this problem a little bit. Foreign direct investment is considered the main source of external resources

for developing economies from developed economies are major form maybe technology transfer. FDI provides benefits to the developing countries and derives a comparative advantage as a result of the use of new expertise, experience, production methods, and management. The “catch up effect” in technical progress between emerging and developed countries explains the current successful economic growth of developing countries (Melnik et al. 2014). Foreign direct investment (FDI) is critical to a developing country’s economic development. It affects wages, productivity, prices, income, imports, exports, the receiving country’s general welfare, and the balance of payments. FDI is one of the most important sources of economic development in developing countries (Aga, 2014).

Many countries’ tendencies toward economic progress, which includes attracting foreign direct investment (FDI), are often at odds with enhancing stringent emission management requirements at both the domestic and global levels. Obtaining a balance between these trends has become a growing source of concern for ecological economists, particularly in economies that do not historically export their wealth, i.e., countries that do not generate enough financial resources for domestic investment (Pavlović et al. 2021). The contribution of FDI in bringing and applying innovative technologies, skills, training, and other necessary crucial resources to developing economies is the most significant benefit for them (Hossain & Hossain, 2012). Furthermore, the ability to work is a significant benefit for the host nation. When multinational companies expand their operations in their home countries, they bring with them more efficient management and higher-tech production. It offers developing countries the opportunity to compete with global rivals in the future and produce higher-quality services and products. However, the primary driver of FDI is the need for funds to spend in developing countries. As a result, FDI could help them raise their living conditions and grow their countries by generating more jobs and introducing strategic initiatives that involve large amounts of capital (Aga, 2014).

The inflows of FDI can play a significant role in the host country by increasing and boosting the availability of funds for domestic investment. This can be accomplished by international buyers purchasing locally produced inputs and selling intermediate products to local businesses via the supply chain. Furthermore, the inflows of FDI can boost the host countries' export capability, resulting in higher foreign exchange earnings for the developing countries. FDI can also help host countries to create new opportunities, improve technology transfer, and increase overall economic development (Belloumi, 2014).

Foreign inflows may lead to environmental degradation in host countries. Some foreign investors bring technologies with high environmental consequences to the host countries (To et al. 2019). The loss of natural resources, infrastructure damage, and loss of human health and lives are the causes of environmental degradation (Cohen et al. 2018). Pollutants in the atmosphere influence economic growth. There is evidence of air pollution’s global nature and its impact on the earth’s surface. The distressing existence of environmental degradation, as well as its long-term negative effects, may have negative implications for human well-being and the economy. As a result, health-care and welfare costs may rise (Borhan et al. 2012). As a result, CO₂ emissions could reduce production directly by lowering the efficiency of man-made capital and labor. Pollution seems to be a detrimental externality in this case. The quality of industrial equipment is declining as a result of health issues and contaminated air or water. Second, as companies reduce pollution emissions, their production prices increase (Abdouli & Hammami, 2017).

Over the past few years, the association between international inflows, and CO₂ emissions have been studied extensively and empirically. The majority of previous research has focused on the issue of whether increased international inflows result in increased additional economic growth while little evidence is found between the association between foreign inflows and environmental degradation so this study primarily focused on the impacts of foreign inflows on environmental degradation in developing countries. The rest of the research is arranged as follows. After a detailed discussion on the introduction, the second section provides the reviews of near past studies to strengthen the research. The issue relating to the data and methodology are noted in section three. Section four discusses the findings of the study. Finally, the concluding remarks and policy recommendation.

2. Literature Review

This section discusses the empirical and theoretical literature on foreign inflows of capital and environmental degradation in developing countries. According to literature foreign inflows of capital and environmental degradation plays an important role in developing countries. The negative impact of foreign inflows of capital on environmental degradation is empirically proved in many studies that will be the major discussion of this section.

Farooq et al. (2020) investigated the influence of FDI and globalization on environmental quality in OIC countries. The GMM methodology was used in this analysis to resolve the problem of endogeneity in variables. It was found that globalization and FDI increase the CO₂ emissions and also lead to a decline the CO₂ emissions while urbanization and industrialization have a significant influence on CO₂ emissions in high-income OIC countries. Li et al. (2019) analyzes the influence of foreign direct investment on environmental performance. This analysis uses panel data from 1990 to 2014. The outcomes exposed some main conclusions: first, for the whole study, FDI does not affect EP. Second, there is variation in the effect of FDI on environmental performance between developing and developed countries. In developed countries, there was also variation in the influence of foreign direct investment on environmental performance at various quantile of EP. On the other side in developed countries, the result was statistically negligible at the lowest quantile of EP, but it became strongly optimistic at the middle and high quantile, and the positive effect increased as the quantile of environmental performance increased.

Waqih et al. (2019) examined the role of economic growth, FDI, and energy use in rising carbon dioxide emissions in the case of the South Asian zone. This study used data from the period of 1986 to 2014. In the short term, the findings verified the presence of Pollution Heaven Hypotheses (PHH) and the Environmental Kuznets Curve. A panel long-run estimate, on the other hand, validates the nonexistence of PHH and the presence of the Kuznets curve for the Environment. Moreover, the region's energy use contributes greatly to environmental degradation. Hadi et al. (2018) investigated the influence of FDI on environmental quality as measured by CO₂ emissions. Besides FDI, other macroeconomic factors were used to examine the effect of the climate on the overall economy. The outcomes exhibited that the existence of FDI has a substantial positive influence on an increase in CO₂ emissions. Poverty and population growth were the two other macroeconomic variables that positively affect the CO₂ emissions.

Abdouli & Hammami (2017) pointed out the effect of inflows of FDI, capital stock, and environmental quality on economic growth in North African and Middle East countries. This study used data from the period of 1990 to 2012. The outcomes showed that an increase in the inflows of FDI and capital stock improve the process of economic growth while economic development was adversely impacted by environmental degradation in MENA countries. Kostakis et al. (2017) investigated the influence of inflows of FDI on environmental quality as determined by CO₂ emissions in the case of Brazil and Singapore. For the period from the early 1970s to 2010, the methodological research was conducted in a multivariate environment. The findings revealed that FDI inflows have harmed the climate in Brazil but not in Singapore. The results revealed that while the EKC theory holds in Singapore, its applicability in Brazil was doubtful.

Raza & Hussain (2016) explored the influence of sectoral FDI on economic growth and carbon dioxide emissions in the case of Pakistan. ARDL model was exercised to analyze the data from the period of 1972 to 2011. The findings revealed that the inflows of FDI into the manufacturing, transportation, and communication sector, as well as energy consumption, have a positive impact on Pakistan's GDP growth. Further, CO₂ emissions in Pakistan were caused by FDI inflows in the manufacturing, transportation, storage, and connectivity sectors, as well as population growth. Environmental Kuznets Curves were also validated in the long and short term, according to the findings. Belloumi (2014) looked at the association between FDI, trade transparency, and economic growth. This research used a bound test to investigate this problem for Tunisia by using data from 1970 to 2008. In the short term, the findings showed no significant Granger causality between FDI and economic growth, economic growth and FDI, trade and economic growth, and economic growth and trade. FDI creates positive spillovers for the host countries although this situation was not supported for Tunisia.

Aga (2014) investigated the influence of FDI on the economic development of Turkey. The research used annual statistics from 1980 to 2012. There was no causal relationship between GDP and both FDI and DIN, according to the causality result. In the case of Turkey, there was also a one-way causality between GDP and trade liberalization. On the other hand, OLS estimates showed that FDI had a statistically negligible but optimistic short-run impact on GDP. Anwar & Nguyen (2010) used a panel dataset covering 61 Vietnamese provinces from 1996 to 2005 to observe the correlation between FDI and economic development. Overall, the outcomes found that in Vietnam, there was a mutually reinforcing bi-directional association between FDI and economic growth. This was not the case in every area of Vietnam, however. The findings of this study indicated that if more money were spent on education and training, financial sector creation, and closing the technology gap between domestic and international firms, the effect of foreign direct investment on economic growth in Vietnam would be greater. Zaman et al. (2011) examined the association between population and environmental degradation in the case of SAARC countries from the period years 1985 to 2009. The outcomes exhibited that high growth rates of population adversely impact the environment quality. To sum up, the empirical literature finds a negative and significant relationship between foreign inflows of capital and environmental degradation in developing countries.

3. Data and Methodology

The data sources, model specifications, and econometric techniques for the analysis of data are discussed.

3.1. Data Sources

The study is based on a panel dataset for the period of 1980 to 2017 for 24 developing countries. The developing countries are selected based on the data availability. The main sources of data collection are World Development Indicators and Statistical View of World Energy. The selected developing countries for estimation are as follows:

- | | | | |
|--------------|---------------|----------------|---------------|
| ➤ Argentina | ➤ Ecuador | ➤ Paraguay | ➤ Brazil |
| ➤ Bangladesh | ➤ Indonesia | ➤ Sri Lanka | ➤ Kenya |
| ➤ Bolivia | ➤ Malaysia | ➤ South Africa | ➤ Morocco |
| ➤ China | ➤ Pakistan | ➤ Thailand | ➤ Nigeria |
| ➤ Colombia | ➤ Panama | ➤ Iran | ➤ Turkey |
| ➤ Costa Rica | ➤ Philippines | ➤ India | ➤ El Salvador |

3.2. Model Specification and Estimation Techniques

The study explores the influence of foreign inflows, as measured by foreign direct investment on environmental degradation in developing countries. The STRIPAT model is applied that is developed by Dietz & Rosa (1994) and reformulated in 1997 as a stochastic version of the IPAT model. STRIPAT model explains the stochastic impacts by regression on population, affluence, and technology. The mathematical form of the model is given as follows:

$$I = \beta_0 P^{\beta_1} A^{\beta_2} T^{\beta_3} u \quad (1)$$

Where I shows the impact of the environment and P indicates the population, A indicates affluence, T indicates technology that degrades the environment, u is the stochastic error term and β 's are the parameters to be estimated. However, we extend the STRIPAT model to analyze the impact of foreign inflows on environmental degradation. The extended form of the model is as follows:

$$I = \beta_0 P^{\beta_1} A^{\beta_2} T^{\beta_3} F^{\beta_4} L^{\beta_5} u \quad (2)$$

Where F is the financial inflows and L indicates agricultural land area while β_4 and β_5 are parameters of financial inflows and agricultural land area respectively. The econometric form of the model is as follows:

$$ED_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 AFL_{it} + \beta_3 TEC_{it} + \beta_4 FIN_{it} + \beta_5 AGL_{it} + u_{it} \quad (3)$$

Where POP is total population, AFL is affluence as measured by the natural log of GDP, TEC is technology as measured by industrial production, FIN is financial inflows, AGL is agriculture land, u_{it} is error term and β 's are the parameters to be estimated.

The stationarity of data is checked by using LLC, IPS, and Fisher ADF test. Based on the stationary results, an appropriate technique is suggested Panel ARDL. Descriptive statistics,

Correlation, panel Pedroni test of cointegration and Panel Granger causality analysis are used to estimate the influence of foreign inflows on environmental degradation in developing countries.

Table 1: Description of Variables

Variable		Description of Variables
Dependent Variables		
ED	Environmental Degradation	CO ₂ Emissions in metric tons per capita
Independent Variables		
POP	Population	Total Population
AFL	Affluence	Natural log of value of GDP at current US dollars
TEC	Technology	Industrial production as a percentage of GDP
FIN	Foreign Inflows	Foreign direct investment as a percentage of GDP
AGL	Agriculture land	Percentage of total land area

4. Results and Discussions

This section is designed to present the empirical analysis of the impact of foreign inflows on environmental degradation in developing countries.

4.1. Elementary Data

Table 2 demonstrates the descriptive statistics of variables that are used to analyze the role of foreign inflows in influencing environmental degradation in developing countries. Outcomes show that the mean value of environmental degradation as measured by CO₂ emissions metric ton per capita is 2.143, the median value is 1.403, the maximum value is 9.979 and the standard deviation is 2.196 while skewness value and kurtosis value are 1.855 and 5.828 respectively. Similarly, the descriptive outcomes of other variables like population affluence, technology foreign inflows and agricultural land are shown in Table 2.

Table 2: Descriptive Statistics of foreign inflows of capital and environmental degradation: Evidence from developing countries (1980-2017)

Variables	ED	POP	AFL	TEC	FIN	AGL
Mean	2.143	17.543	25.014	30.172	1.834	46.290
Median	1.403	17.580	25.058	28.344	1.190	43.277
Maximum	9.979	21.050	30.141	49.637	16.229	80.888
Minimum	0.096	14.498	21.681	13.557	-7.801	14.872
Std. Dev.	2.196	1.561	1.624	7.760	2.139	16.313
Skewness	1.855	0.258	0.219	0.432	1.912	0.441

Kurtosis	5.828	2.750	2.737	2.502	9.766	2.231
Jarque-Bera	827.118	12.446	9.896	37.869	2295.626	51.990
Probability	0.000	0.002	0.007	0.000	0.000	0.000

4.2. Pair wise Correlation Matrix

The correlation matrix is important in assessing the degree of association among two variables. Table 3 shows the pairwise matrix. The outcomes show that environmental degradation is positively correlated with a population (0.099), affluence (0.453), technology (0.410), foreign inflows (0.097), and agricultural land area (0.063).

Table 3: Pairwise Correlation Matrix

Correlation	ED	POP	AFL	TEC	FIN	AGL
ED	1.000					
POP	0.099	1.000				
AFL	0.453	0.800	1.000			
TEC	0.410	0.283	0.352	1.000		
FIN	0.097	-0.209	0.037	-0.032	1.000	
AGL	0.063	0.231	0.081	-0.255	-0.228	1.000

4.3. Findings of Unit Root Test

The results indicate that the variables like environmental degradation, affluence, technology, and agricultural land area are stationary at a level while the variables foreign inflows and the total population is stationary at 1st difference. Findings suggest that for long-run panel ARDL is a appropriate technique for estimation.

Table 4: Unit Root Analysis

Variable	Individual Intercept				Intercept and Trend				None			Results
	LLC Test	IPS	ADF-Fisher	PP-Fisher	LLC	IPS	ADF-Fisher	PP-Fisher	LLC	ADF-Fisher	PP-Fisher	
		Test	Chi-Square	Chi-Square	Test	Test	Chi-Square	Chi-Square	Test	Chi-Square	Chi-Square	
ED	4.595	6.611	17.454	21.986	1.583	0.897	50.873	50.919	9.479	7.054	6.531	I(1)
	1.000	1.000	1.000	1.000	0.943	0.815	0.361	0.360	1.000	1.000	1.000	
AFL	2.203	7.943	7.452	4.815	-1.523	-1.257	53.512	48.303	12.746	1.089	0.407	I(1)
	0.986	1.000	1.000	1.000	0.064	0.104	0.271	0.461	1.000	1.000	1.000	
FIN	-3.961	-4.679	98.794	155.985	-3.373	-4.565	98.874	158.293	-4.346	77.071	105.958	I(0)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	
TEC	-1.806	-0.558	47.119	56.493	1.135	1.354	34.929	37.162	-2.179	53.460	76.784	I(1)
	0.035	0.288	0.509	0.187	0.872	0.912	0.921	0.871	0.015	0.273	0.005	
POP	-1.532	0.882	87.543	617.657	-15.883	-9.085	242.010	139.823	-3.263	102.077	0.000	I(0)
	0.063	0.811	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	
AGL	-5.770	-0.696	76.727	86.242	-3.718	0.689	56.874	49.874	1.508	19.093	16.235	I(1)
	0.000	0.243	0.005	0.001	0.000	0.755	0.178	0.399	0.934	1.000	1.000	

4.4. Long-Run Panel ARDL Estimates

The independent variables are total population (POP), affluence (AFL), technology (TEC), foreign inflows (FIN), and agriculture production (AGL). The results point out that total population, affluence, technology, and foreign inflows are positively related to environmental degradation while agricultural land negatively influences environmental degradation in developing countries. The influence of total population and technology on environmental degradation is found to be statistically insignificant.

Table 5: Long-Run Panel ARDL Estimates

Dependent Variable: Environmental Degradation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
POP	0.1273	0.2419	0.5262	0.5989
AFL	0.4920	0.0437	11.249	0.0000
TEC	0.0013	0.0060	0.2189	0.8267
FIN	0.0183	0.0090	2.0375	0.0420
AGL	-0.0196	0.0075	-2.6009	0.0095

We have found in the analysis that the coefficient affluence is not only positive but highly significant. The environmental degradation increases by about 0.4920 per cent as the affluence level in the developing economies raises. We observed that to increase their affluence through GDP, they use the resources abundantly by using old or outmoded technology that creates the externalities. Ultimately environmental degradation remains friendly. We also examined foreign inflows have positive and statistically significant effects on environmental degradation. The coefficient of foreign inflows in the form of foreign direct investment (FIN) is 0.0183. The coefficient value of FIN points out that as the foreign inflows in a host country increase by one unit the environmental degradation leads to an increase by 0.0183 units. The economic reason may be that FIN in the form of the transfer of high mechanized technology creates a negative effect on our environment. FIN is an important source of increasing productivity and brings modern technology to the host countries. Our finding is related to (Hettige et al. 1996). Optimistic finding is that FIN may help developing economies modernize and upgrade the quality of their capital stock and such technological effects translate into lower environmental degradation. Agriculture land area is found to be negatively and significantly related to environmental degradation. The coefficient of agriculture land points out that as the agriculture land area as a percentage of the total land area is increased by one unit the environmental degradation leads to a decline by -0.0196 units. The reason may be that agricultural land is the leading source of pollution in many economies. Pesticides, fertilizer and other toxic farm chemicals poison freshwater, ecosystem, air and soil.

4.5. Panel ARDL Short-Run Analysis

Panel ARDL short-run estimates are presented in Table 6. In the short run total population, foreign inflows, and agricultural land area are found to be inversely related to environmental degradation however their impact is statistically insignificant. On the contrary affluence, and technology are found to be encouraging factors of environmental degradation in developing countries. The error correction term is found to be negative (-0.2292) and statistically significant (0.0000) it points out that any disturbances in the short-run are corrected by 22.92 per cent when moving from the short-run to the long run.

Table 6: Panel ARDL Short-Run Analysis

Variables	Coefficient	Std. Error	t-Statistic	Prob.*
ECM(-1)	-0.2292	0.0443	-5.1704	0.0000
D(POP)	-5.1437	5.0716	-1.0142	0.3108
D(AFL)	0.2294	0.0904	2.5356	0.0114
D(TEC)	0.0063	0.0046	1.3745	0.1697
D(FIN)	-0.00004	0.0064	-0.0074	0.9941
D(AGL)	-0.0292	0.0448	-0.6522	0.5144
C	-2.5323	0.5572	-4.5441	0.0000

4.6. Panel Granger Causality Test

Panel Granger causality test is applied to investigate the linear causation among variables. The outcomes are presented in Table 7. It is found that there is a unidirectional causality between total population and environmental degradation, unidirectional causality between the natural log of GDP and environmental degradation, and unidirectional causality between industrial production and environmental degradation. No causality is observed between foreign inflows and environmental degradation, agricultural land area, and environmental degradation.

Table 7: Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.
POP $\nrightarrow$ ED	4.0537	0.0177
ED $\nrightarrow$ POP	0.3339	0.7162
AFL $\nrightarrow$ ED	6.1848	0.0022
ED $\nrightarrow$ AFL	0.1716	0.8423
TEC $\nrightarrow$ ED	9.9575	0.0000
ED $\nrightarrow$ TEC	0.3348	0.7155
FIN $\nrightarrow$ ED	1.0128	0.3636
ED $\nrightarrow$ FIN	1.3590	0.2575
AGL $\nrightarrow$ ED	2.9989	0.0504
ED $\nrightarrow$ AGL	2.8082	0.0609

5. Conclusions and Policy Recommendations

The main objective of this study is to explore the impact of foreign inflows of capital on environmental degradation in developing countries. To attain the objectives of the study the panel dataset of 24 developing countries from the period 1980 to 2017 is used. The main source of data collection is World Development indicators and Statistical View of World Energy. The correlation, panel unit root test, panel ARDL model, and Granger causality

analysis are conducted to estimate the results. Correlation analysis shows that environmental degradation positively correlated with population, affluence, technology, foreign inflows, and agricultural land area. Unit root analysis shows that the variables environmental degradation, affluence, technology, and agriculture land area are stationary at a level while the variables financial inflows and the total population is stationary at first difference it suggests that for long-run panel ARDL is a suitable technique for estimation. The panel ARDL long-run outcomes point out that total population, affluence, technology, and foreign inflows are positively related to environmental degradation while agriculture land area is negatively related to the environmental degradation in developing countries. The influence of total population and technology on environmental degradation is found to be statistically insignificant. Panel Short-run estimates show that total population, foreign inflows, and agricultural land area are found to be inversely related to environmental degradation however their impact is statistically insignificant. On the contrary affluence and technology are found to be encouraging factors of environmental degradation in developing countries. Granger causality analysis found that there is a unidirectional causality between total population and environmental degradation, unidirectional causality between the natural log of GDP and environmental degradation, and unidirectional causality between industrial production and environmental degradation. No causality is observed between foreign inflows and environmental degradation, agricultural land area, and environmental degradation. The foreign inflows of capital are the major source of economic development although these foreign inflows also lead to environmental degradation in developing countries. However, some policies recommendations are followed:

- Developing countries need to design environmental policies and entry standards of foreign inflows to enhance their productivity and improve the quality of the environment.
- Policymakers in developing countries not only reply to protect environmental degradation but also support creating new opportunities, improving technology transfer, and increasing overall economic development.
- Developing countries may encourage foreign inflows so that comparative advantage derives as a result of the use of new expertise, experience, production methods, and management.

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