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Global Change, Local Consequences: A Review of the Relationships Between FDI, Globalization, GDP, Carbon Dioxide Emissions, and Ecological Footprint

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Abstract
The main goal is to examine the effects of GDP, globalization, urbanization, FDI, and energy on CO2 emissions and ecological footprint. The research was conducted between 2003 and 2022. The investigation of the asymmetric effects of FDI as its primary goal. It begins by providing an overview of the effects of globalization, urbanization, FDI, energy, GDP, and CO2 emissions on the ecological footprint and CO2 emissions of the G7 countries. Secondly, the literature is identified by drawing on the theoretical and empirical insights found in published literature. In addition, this article put light on theoretical methods that describes how/ why these methods work. Third, this paper suggests three productive areas for more study. This study adds to the body of knowledge on the effects of foreign direct investment (FDI), energy, globalization, urbanization, and GDP on CO2 emissions and the ecological footprint of G7 nations by critically evaluating and synthesizing previous theories and studies in this field.
Keywords: Foreign Direct Investment, Ecological footprint, G7 countries

1. Introduction

Increasing human demand for biologically productive land and ocean areas has started to have a significant impact on nature's ability to recover its ecosystems. The Global Footprint Network estimates that currently more than 80 percent of the world's population lives in countries that are running ecological deficits, using more resources than what their ecosystems can renew. (Parveen et al., 2024; Parveen et al., 2024; Amin et al., 2024). We set out to examine the effects of foreign direct investment (FDI) on the rate of exhaustion of bio productive physical land through testing for the differential ecological performance of FDI in developed vs. developing countries, as well as in "clean" vs. "dirty" sectors. We use the Ecological Footprint (EF), compiled by the Global Footprint Network as the measure of biologically productive land. EF is a physical, rather than an economic indicator.2 It measures the amount of ecologically productive land area that is needed to support the resource demands and absorb the wastes from a given economic activity (Ali & Audi, 2016; Rabbia Syed, Sehrish Arshad, 2024; Zubair et al., 2024; Song et al., 2024; Ali et al., 2021).

The Global Footprint Network defines four different kinds of ecological footprints: Consumption EF, Production EF, Imports EF, and Exports EF, computed based on the National Footprint Accounts of Global Footprint Network. The Consumption EF indicates the consumption of bio capacity embedded directly in human consumption of goods and services; the Production EF indicates the consumption of bio capacity resulting from production processes (Shen et al., 2024; Irfan et al., 2023; Abro et al., 2024).

Foreign Direct Investment (FDI) is a financial flow traditionally associated with the transfer of knowledge, technology, and management practices from home to host countries. In the past two decades, FDI has become a very significant part of planetary-scale globalization activities. On the production side of the economy, FDI is known to have a scale effect, a composition effect, and a technological effect on the receiving economies. The scale effect is an effect on the level of economic activity, induced by the influx of additional investment in the economy. The scale effect is expected to contribute to pollution, waste, and ecological degradation (Saeed et al., 2024; Arshad et al., 2024; Shahid et al., 2023).

The composition effect of FDI is reflected in a structural shift that changes the industry mix of the receiving economies. Depending on what kinds of industries are expanding or shrinking, the composition effect can translate into different environmental and ecological outcomes. The technological effect refers to a transfer of new knowledge and techniques, including superior technologies that have the potential to improve productivity and state of ecosystems. On the consumption side of the economy, FDI has an impact on income and income inequality. We can argue that the more uniformly (equally) income is distributed among populations, the greater the number of consumers with average income, and the greater the ecological impact of consumption(Shahzadi et al., 2023; Ur Rahman & Bakar, 2018; A. U. Shahid et al., 2022; Ali et al., 2021; Ali et al., 2022; Ashiq et al., 2023).

(Zulfiqar et al., 2022; Dawood et al., 2023; Awan et al., 2023) find in favor of the opposite in a study of OECD countries. In their evidence, FDI increases and does not decrease income inequality. Such results would imply a mitigating role of FDI on EF. The existing environmental economics literature links FDI to pollution, primary to air pollution, but not to overall ecosystem degradation. The "pollution heaven hypothesis" states that FDI flows tend to go to countries where the environmental regulations are lax and therefore bring enterprises with environmentally dirty production processes from more developed to less-developed nations. (Rahman & Bakar, 2019; Qureshi et al., 2022; Zhao et al., 2023) The "FDI halo" hypothesis states that multinational firms that originate from more developed countries have the ability and resources to disseminate superior knowledge and environmental practices to local firms in less developed economies. In that way, multinationals become a vehicle for spreading of improved environmental laws and environmental standards. The "Environmental Kuznets curve (EKC)" hypothesis assumes an inverse U-shaped relation between pollution and income. This is a reflection of the fact that countries tend to pollute more in the industrialization phase of their development and less as they develop and decrease the share of their "dirty" economic sectors.

The impact of FDI on the rate of exhaustion of bioproductive land, and therefore, on the ecological footprint has not been studied.7 In this study, we set out to investigate whether the three hypotheses, previously tested for the impact of FDI on pollution, apply for FDI impact on the four ecological footprints of host nations. We formulate a hypothesis similar to the pollution haven, which tests whether FDI is more ecologically degrading in developing countries than in industrialized nations (Zahra et al., 2023). We further refer to as an FDI ecological haven hypothesis.

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We also test whether FDI in certain sectors transfers superior technologies helping with ecological preservation. If such effects occur, they could be regarded as FDI ecological halo effects. Both potential effects, the ecological haven, and the FDI ecological halo depend on the industry mix of the receiving economies. On one hand, the industry ratio of clean to dirty sectors matters for environmental pollution and ecosystems exhaustion; on the other, it matters for the potential transfer of ecology-improving technologies. We argue that FDI flows to different industries are of a different nature (Rahman et al., 2022).

1.1. Problem Statement

One of the most popular topics of discussion these days is the relationship between energy use, carbon emissions, economic expansion, and environmental quality. This subject has received significant attention in a large body of prior literature. Any nation's economic growth and carbon dioxide emissions have a complex relationship that requires careful consideration Levels of output and consumption rise in tandem with economic expansion. Still, there are environmental consequences to the overindulgent consumer and the overly aggressive producer who wants to maximize profits. Many academics and decision-makers throughout the world are deeply concerned about the potential long-term environmental consequences of rising energy consumption and economic expansion, which could result in global warming and dramatic changes to the climate due to an increase in carbon dioxide emissions into the atmosphere.

1.2. Research Question

- What unequal effects does foreign direct investment have on the G-7 countries' ecological footprint and CO2 emissions?
- Is there a non-linear long- and short-term relationship between energy and globalization and CO2 emissions and ecological footprint in the G-7 countries?
- What is the G-7 countries' causal relationship between urbanization, CO2 emissions, and ecological footprint?

1.3. Research Objectives

- To look into how FDI affects CO2 emissions and the ecological footprint in the G-7 countries asymmetrically
- To analyse the long-run and short-run non-linear impact of energy and Globalization on CO2 emission and Ecological footprint in G-7 countries
- To explore the causal relationship between urbanization and CO2 emission and Ecological footprint in G-7 economies

2. Literature Review

This section's first portion covers the impact of foreign direct investment (FDI) on CO2 emissions and ecological footprints, its second section addresses the impact of energy and globalization on CO2 emissions and ecological footprints, and its final section describes the study's contributions and highlights research gaps.

2.1. FDI and CO2 emission and ecological footprint

This study observed the relationship between sector-specific foreign direct investment (FDI) and CO2 emissions using panel Granger causality tests. Employing a sample of eighteen Latin American nations spanning the years 1980–2007, they revealed a causal relationship between FDI in industries with high pollution levels (often known as "the dirty sector") and CO2 emissions per person. Using the CO2emissions to GDP ratio and directing additional CO2 emission-related parameters yields a robust conclusion. We could not find strong indication linking FDI and CO2 emissions in other areas (Audi & Ali, 2017; Shahid et al., 2023; Audi & Ali, 2023; Audi & Ali, 2023; Shahid, 2024; Nazik Maqsood, 2024).

the impact of foreign direct investment (FDI) on the rate at which physically creative land becomes exhausted. We examine whether foreign direct investment (FDI) has a distinct ecological performance in industrialized versus developing nations and between "clean" and "dirty" industries. They looked at the effects of six sector-level FDI flows on the Global Footprint Network's four ecological footprints (EF): consumption, production, imports, and exports. Using an Environmental Kuznets Curve (EKC) and accounting for differences in national development levels, they generated a dynamic panel model (Audi et al., 2020; Shahid, 2023; Minhas et al., 2024; Maqsood1 et al., 2023). The results are intriguing. First, FDI classically has an ecological impact connected to consumption in high-income nations and an ecological impact related to production in low- and middle-income countries. Second, Middle Income Countries bear a disproportionate amount of the burden of FDI-generated Exports EF, while High Income Countries bear no such load (indicating an ecological sanctuary for FDI). Third, financial services FDI lowers the Production EF in high-income nations (proof of the ecological halo of FDI). Lastly, FDI in non-financial services has a greater negative environmental impact than FDI in manufacturing (Shahid et al., 2024; Audi et al., 2024; Li et al., 2022; Chaudhary et al., 2023).

2.2. Globalization on CO2 emission and Ecological footprint

In order to provide flexible and comprehensive results about the relationship between globalization and CO_2 emissions for the G7 countries. we introduce the KOF globalization index into traditional Stochastic Impacts by Regression on Population, Affluence and Technology model, and conduct the empirical analysis by applying a semi-parametric panel fixed effects model. The data covering the period of 1970–2015 consists of CO_2 emissions, KOF globalization index, renewable energy consumption and GDP. Our results indicate that the relationship between globalization and CO_2 emissions are inverted U-sharped, which strongly support the Environmental Kuznets Curve hypothesis. Furthermore, an increase of economic output is associated with statistically significant growth in CO_2 emissions. On the contrary, an increment of renewable energy consumption lowers CO_2 emissions. Related policy proposals are then offered according to our empirical results (Ahman et al., 2023).

Dynamic impact of renewable and non-renewable energy consumption, globalization, urbanization, and economic growth on the environmental quality. Unlike previous study, this study used multi-dimensional indicator of environmental quality that is ecological footprint. Given the importance of renewable energy, a sample of top renewable energy consuming countries has been selected for analysis spanning the period 1991–2016. The analysis is carried out in panel data framework that considers the issues of cross sectional dependence and heterogeneity. The results of cointegration test illustration the existence of long-run equilibrium relationship between the variables. The long-run elasticity of pooled mean group displays positive impact of economic growth and

non-renewable energy consumption on ecological footprint while negative impact is observed in case of renewable energy consumption, globalization and urbanization (Javaid et al., 2023).

2.3. Energy on CO2 emission and Ecological footprint

Thailand's Nationally Determined Contribution (NDC) intends to minimize CO2 emissions by 20–25%. Similarly, to focus on achieving the Paris Agreement's long-term target of remaining well below 2 °C, aggressive mitigation steps are necessary beyond 2030. Given the importance, the study examines the impact of energy depletion rate, renewable energy consumption, depletion rate of non-renewable energy, and GDP on CO2 emissions in Thailand from 1980 to 2018. The research using a novel dynamic ARDL simulations model and frequency domain causality (FDC) test. The empirical outcomes indicate that the pace of depletion has a significant adverse impact on CO2 emissions both in the long run and short run. Additionally, we found that renewable energy has a negative and statistically significant impact on CO2 emissions in the short run. However, the depletion rate of non-renewable energy and GDP revealed a positive and statistically substantial effects on CO2 emissions in the short and long run. Also, the FDC test confirmed the short, medium, and long-run causality among DR, RE, DRNRE, and CO2 emission. The findings show that without a radical shift in Thailand's economic environment and energy infrastructure, the nation will have to face high costs in decreasing its CO2 emission (Ullah et al., 2023).

Although the impact of fossil fuel consumption is known worldwide, oil-producing countries stay away from using renewable energy sources due to commercial concerns, which causes an increase in global warming. They investigated the relationship between economic growth, renewable energy consumption, and ecological footprint in the oil-producing USA, Russia, Saudi Arabia, Canada, China, Brazil, Kuwait, and Nigeria for 1999–2017 using a dynamic panel data analysis and panel causality analysis. Their motivation was to demonstrate the oil-producing countries' growing ecological footprint/environmental pollution and the influence on global warming (Ur Rahman & Bakar, 2019).

2.4. Urbanization and CO2 emission and Ecological footprint

The countries in the Middle East and North Africa (MENA) region have the greatest potential for renewable energy consumption in the world and is likely to be the most vulnerable to the horrendous effects of climate change. Unfortunately, only a few of the countries have tapped into this potential, as non-renewable energy still dominates the total energy mix of these countries. This study explores the effect of renewable and non-renewable energy consumption on the environment in MENA countries from 1990 to 2016 by applying the Augmented Mean Group algorithm while accounting for urbanization, financial development, and economic growth. The panel result suggests that financial development, economic growth, and urbanization add to environmental degradation. Also, findings reveal that renewable energy does not contribute meaningfully to environmental quality, while non-renewable energy consumption significantly adds to environmental degradation. A uni-directional causality flows from urbanization, economic growth, and energy use to environmental degradation. One way to abate this damage is for countries in this region to embrace and promote the consumption of clean energy sources. This paper examines the relationship between urbanization and the intensity of CO_2 emissions on a panel of 48 African countries over the period 1980–2016. Using an augmented STIRPAT model, we found that if urbanization is a highly significant factor for pollution in Africa, the effect is heterogeneous for different levels of pollution (Saif Ur Rahman, Salyha Zulfiqar Ali Shah; Bakar, 2019).

3. Method

In this study author following the literature review procedure under the principles of systematic literature review to collect and critically analyze the relevant literature. For the comprehensive and critical analysis, author develop a critical review form to analyze several key points of the previous studies namely focus of the paper, bibliographic details, theory used (where relevant), research philosophy key findings, methodology, definition of FDI, energy, globalization ,urbanization and GDP on CO2 emission and Ecological footprint in G7 Countries , geographical location of the study, theoretical and practical review, and further conclusion and reported limitations. For the critical review of this study (Naz et al., 2022).

Author searched literature since November 2017 to April 2018. To identify utmost relevant

GF papers as possible, after identification of the papers researcher conducted a comprehensive search by evaluating in the relevant papers downloaded from (1) Economics journals listed in the clarivate analytics (The Master Journal List 2017 and JCR report 2016); (2) Comprehensive databases (Business Source Premier by Ebsco and Scopus). (3) Google Scholar; (4) extensive cross-disciplinary bibliography on FDI (consisting of several references), published in the different journals. For this literature review, author design the literature selection criteria based on following characteristics, for instance, paper omitted that not dealing with FDI, and also that are not empirical or conceptual such as (book, commentaries, summaries of conference summaries, abstracts and keywords, executive abstracts, editorials, literature reviews and newspaper/magazine articles). In total, after repetition author identified almost 600 articles. To set up each paper's importance, Author examined its abstract, title, and, methodology where important (Shahzadi, Ali, et al., 2023).

4. Conclusion

After the critical review of the literature, it is concluded that, as compare to total value of FDI, both the negative and the positive effects are revealed. It is very much interesting to see both the findings are separately fill the gap in the literature. So, the effect of FDI on the manufacturing growth is still under discussion and various studies have been conducted to check the impact of foreign investment on the overall economy

4.1. Future Direction

Three reasons are raised in this review of the literature requiring additional investigation First, the RDL model, OLS regression, and GMM technique are employed in the majority of research conducted to examine FDI. It has been noted that only a small number of studies have used a dynamic vector error correction model (VCEM) to conduct the investigation during the literature review. In order to ensure that endogeneity and causation issues are addressed concurrently, the VCEM process helps to capture the time series dynamics under discussion appropriately. Furthermore, any potential indirect impacts and feedback are also recorded using the

VECM process. It is suggested that more research be done to determine how best to execute manufacturing growth when FDI inflows are substantial in the host country, as the majority of FDI studies conducted in the past have mostly focused on the GDP and economic growth of the host country. Only a small number of studies have looked at manufacturing growth in this context. Third, the research was done in the past and was examined in relation to underdeveloped states as well as southeast Asian nations like Malaysia and the US economy, which also included capital and growth in the manufacturing sector in Japan, France, Germany, and the UK. However, not much research has been done in south Asian countries like Pakistan.

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