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# Fresh insights on the nexus between green foreign financing and efficient use of natural resources: The moderating role of institutional quality

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## Abstract

It is more probable that both industrialized and developing nations have a great deal of potential for putting sustainable logistics into practice, but they are also severely disrupted by climate change. The goal of this article is to establish a link between Green Foreign Direct Investment (FDI) and Natural Rents through the use of a worldwide database. In order to quantify natural rents, five different measures are used, including those for coal, minerals, natural gas, forests, and aggregates. We find that the expansion of Green FDI contributes to the growth of natural rents as a result of the empirical findings of our investigation. To elucidate the correlation between Green Foreign Direct Investment and Natural Rents, various indicators such as economic growth (INC), trading activities as a percentage of GDP (EXP), industrialization level (IND), net foreign direct investment (FDI), government effectiveness (GE), ISO 14001 certificates (EI_ISO), and environmental performance index (EPI) are considered. To enhance the accuracy of the model, variables related to institutional quality are also taken into account. Based on our research, we believe the long-term impact of Green FDI will be stronger, particularly in nations with an advanced stage of growth. Within the framework of the analysis, the robustness and reliability of the findings are maintained regardless of heterogeneity, fixed effects, and endogeneity.

**Keywords:** Green FDI, global database, natural rents, short- and long-run influences.

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## 1. Introduction

Environmental pollution, resource depletion, ecological cataclysm, and land issues have all gained international attention due to the influence of global climate change. Alvarado et al. [1] and Chen [2] list total heating as one of these problems. Thus, issues that endanger human life include food scarcity, climate change, environmental deterioration, and resource depletion [3, 4]. Additionally, the globe is worried as sea levels are rising every day due to rising temperatures [5]. The Sustainable Development Goals (SDGs) were created by the Miščević [6] in an attempt to address these problems. Among these are programs aimed at halting global warming and encouraging the application of reasonably priced renewable energy sources. Additionally, Pakistan's environment has suffered greatly from the output of greenhouse gases. The harmful substances of carbon dioxide ($CO_2$) and other greenhouse gases have devastated the ecosystem in Pakistan, in addition to raising air pollution and temperature [7, 8]. In addition, between 1983 and 2012, Pakistan underwent its warmest period in the preceding 1,400 years, according to [9]. Over the past few decades, in industrial areas, the usage of fossil fuels and energy consumption have been the leading causes of greenhouse gas emissions. Additionally, the energy, forestry, and agricultural sectors have increased their share of greenhouse gas emissions, accounting for nearly 76% of the total. Pakistan's climate situation is dire and concerning, as evidenced by the country's ranking seventh among those with high carbon emissions. This presents a problem for global resource-efficient use and energy safety. Rahman et al. [10] have revealed a connection between air pollution and an increased risk of multiple illnesses, including stroke, heart attacks, and lung cancer. Under these circumstances, many countries have begun implementing green economic development in response to these challenges [11-13].

In rich and developing countries, human attempts toward economic expansion endanger the ecological equilibrium [14]. Global warming is the primary cause of climate change, a worldwide problem that has prompted coordinated national and international attempts to lessen its unexpected effects. According to recent studies, unsustainable methods of production and consumption exacerbate climate change and environmental degradation [15]. Researchers have conducted research using a variety of approaches to address this global issue. Several indicators have been used to study climate change and try to come up with workable solutions. These indicators include $CO_2$ releases, greenhouse gases (GHGs), methane (CH4), and other pollution criteria. The massive carbon footprint of many highly industrialized nations that rely extensively on fossil fuels attests to their significant contribution to pollution, as measured by the amount of $CO_2$ discharged into the environment due to industrial and human activity. Although studies on environmental performance have used the carbon footprint as a measure, some scholars suggest using the ecological footprint (EF) as a more complete indicator of the state of the environment. Wackernagel and Rees [16] proposed the idea of EF, which measures the whole influence of human usage on the ecosystem. EF is the total impact of human activity on soil, air, and water. It is identified by Golub et al. [17] as human pressure or movements quantified regarding water and land necessary for generating client goods and waste absorption in a specific area. Since it is more internationally comparable, trustworthy, and all-encompassing than $CO_2$ emissions, it has gained favor [18, 19]. This indicator is frequently used by the UN Environmental Programme (UNEP) in social science and policy publications [20].

Industrialization is necessary for economic development and growth [21]. However, energy consumption and releases from industrial operations, which are essential to this process, lower the quality of the surrounding air. Foreign enterprises that invest in foreign nations and gain control over production and assets are known as foreign direct investment (FDI) [22]. FDI is a significant engine of industrial expansion. Deng et al. [23] demonstrate that FDI improves human capital through skill and knowledge transfer and has a favorable impact on the environment of the host country by advancing technology and expanding its scope of operations. On the other hand, Wang and Shao [24] argue that foreign direct investment (FDI) carries a significant cost to environmental quality since it uses natural resources in production procedures, which may result in environmental harm. Debatable topics include how foreign direct investment affects the environment. According to Destek and Okumus [25], wealthy countries that invest in creating non-eco-friendly products or industrial methods may cause environmental harm to other nations. Natural resource exchanges (such as those involving coal and crude oil) have been shown to harm biological capacity and raise the ecological footprint (EF) in MENA countries [19, 26]. Following Grossman and Krueger [27], trade openness a crucial element of economic development is connected to unfavorable environmental outcomes, especially in developing nations, because of the size and composition impacts. This link may be attributed, in part, to the pollution haven theory (PHH), which postulates that polluting enterprises may relocate to developing nations with lenient environmental rules [28]. Political concerns and misgivings among environmental activists stem from the trade-off between ecological security and economic momentum. Fast population expansion, as seen in countries like India, puts pressure on the demand for and usage of natural resources, creating a problem on a worldwide scale.

The reasons listed above demonstrate that this study addresses the current research gap in several ways. Initially, it uses carbon emissions based on consumption as a stand-in for other metrics to assess the level of environmental sustainability. A detailed evaluation of the literature suggests that most of the study has focused on samples from either group of a country's development status. However, little consideration has been given to the developing nations on the topic. Additionally, in the targeted region's literature, it is noted that the measurement of consumption-based emissions has yet received adequate attention. Furthermore, the literature's main emphasis indicates that the majority of studies have only looked at how natural resources as a whole directly affect ecological issues; the sub-measures referred to as coal and mineral rents, on the other hand, have not been fairly investigated in order to calculate trade-adjusted carbon emissions. Furthermore, foreign investment has been used as a proxy for carbon emissions in most studies. Nevertheless, this work surely contributes both theoretically and empirically to the interaction term with the coal and mineral rents. Climate change is anticipated to cause significant disruptions in both industrialized and developing nations, and both have an important opportunity for implementing sustainable logistics [29, 30]. Because of this, green logistics is a practical method to help governments along their route to sustainable growth. However, most logistics companies in these nations are quite limited in their resources, which reduces the industry's competitiveness. In this context, implementing sustainable logistics practices may help these economies increase the competition of logistics enterprises [31].

Our research analysis makes a substantial contribution to the ongoing investigations. This is the first research evaluating the relationship between GFDI and effective natural resource use. As a result, our study adds to and strengthens our knowledge of how the economy affects the environment or how energy use patterns [32-35]. In this research, we assess

GFDI's effectiveness. The dataset used in this study allows for an examination of various types of natural resources, offering an extensive view of the connection between GFDI implementation and resource efficiency. Our study covers the period from 2011 to 2021, employing a number of different strategies and empirical methodologies. Due to the dearth of comprehensive GFDI data in the region, we chose this database. In the subsequent section, we examine the connection between GFDI acceptance and natural resources efficiency by implementing the Panel-Corrected Standard Error (PCSE), the Feasible Generalized Least Squares (FGLS), the two-step Generalized Method of Moments (GMM) models, and the Autoregressive Distributed Lag (ARDL) method. The PCSE model is fitting for the dynamic analysis of panel data, accounting for cross-sectional dependence after testing for longitudinal correlations and asymmetry. For further validation, we applied the FGLS model to account for heteroscedasticity. We also utilized the two-step GMM approach to address endogeneity concerns. Additionally, using the Dynamic Fixed Effects (DFE) estimator, ARDL is employed to estimate the effects in the short-term and long-term. Ha [36] and Ha [36] asserted that both time-fixed and country-fixed effects can be identified through the DFE-ARDL method.

The paper's sectional organization is shown below. Literature on the variables is covered in the second section. Section three provides an explanation of the variables and data, as well as the study methodologies. In Section 4, the outcomes and discussion are addressed. The final reflections, policy ramifications, and constraints for additional tactics are presented in Section 5.

## 2. Literature Review

### *2.1. Definition And Measures of Green Foreign Direct Investment*

#### *2.1.1. Formal Concept of Green FDI*

In 2009, the three major low-carbon business categories garnered US$90 billion in FDI, accounting for around 8% of worldwide FDI flows. FDI into the three businesses on a greenfield basis segments totaled approximately US$82 billion in 2016.37. While this is a large sum, it is significantly less than the US$121 billion spent on greenfield natural gas, oil, and coal projects in 2016. In this context, the exclusion of greenfield FDI may be significant since M&As might reflect a transfer of major assets (through, for example, privatization), and if included in statistics, views of new contributions to the green economy may be exaggerated [37].

The OECD defines “green investment” as (a) investments in the transfer of substantial assets (for example, through privatization), (b) sustainable natural resource and service management they offer (forests, fisheries, tourism based on nature, wildlife, protection of water, soil productivity, and minerals), and (c) the environmental products and services sector, as well as throughout entire parts of green value chains (e.g., conventions). This idea spans a broader variety of activities than UNCTAD’s definition of low-carbon foreign direct investment. However, due to the complexity involved in defining activities that qualify as “sustainable resource management,” the OECD does not disclose green FDI estimates based on this criterion.

The OECD proposes two alternative methodologies for assessing green FDI using current data in an experimental article. The first method approximates foreign direct investment in environmental services and products, such as gas, electricity, and investments in water, which, between 2005 and 2007, averaged $41 billion a year. The second technique finds ecologically relevant FDI, which is defined as investments in sectors with a high potential for environmental spillovers, therefore providing a ceiling for possibly green FDI. The green share is then isolated by assuming that foreign direct investment from home nations with better ecological performance adheres to more stringent environmental standards than local investments in the host nation. This results in yearly estimates ranging from $268 billion to $299 billion. Both methodologies have drawbacks, and the resulting green FDI estimates, which vary from 2.8% to almost 50% of possible green FDI between 2005 and 2007, serve more to show the difficulties in assessing green FDI than to offer reliable numbers.

To improve the accuracy of measuring GFDI, the Working Group on International Investment Statistics (WGIIS) of the OECD has research on this subject on its agenda. To calculate how much foreign direct investment is coming into the UK that is green, the British government used an initial experimental approach. This method included three components: (1) identifying foreign direct investment firms classified as “environmental” in the Standard Industrial Classification; (2) conducting surveys with enterprises in the government’s FDI databases to see if they produce environmentally friendly goods or services and estimating the proportion of their turnover related to these relevant offerings; and (3) estimating green foreign direct investment from FDI firms not covered by these components. Using these criteria, the UK calculated that green FDI equities in the nation totaled GBP 8.1 billion in 2013, accounting for 0.8% of the UK’s overall FDI stock value.

Some definitions of green FDI and efforts to quantify it usually focus on the amount spent on environmental goods and services (EGS) [37]. However, a precise knowledge of what comprises ecological goods and services and whether they have already been assessed is required. Several institutions collaborated to develop the System of Environmental-Economic Accounting: Central Framework (CF) to address this issue, including the FAO, the IMF, the European Commission, the World Bank, and the OECD. This CF, established as a worldwide standard in 2012 by the UNSC, is a critical instrument in solving and clarifying the above issue, and it is acknowledged as the first global standard for accounting for environmental and economic factors.

The Central Framework (CF) divides the environmental goods and services sector (EGSS) into: (1) products and services for the environment and (2) resource management goods and services. “Environmental protection” activities are primarily concerned with preventing, minimizing, and eliminating pollution and other types of environmental degradation, whereas “resource management” activities are mainly concerned with protecting and sustaining natural resource stocks to avoid depletion.

Environmental goods and services (EGSS) exclude products and services generated to fulfill technological, human, and economic demands, even if they have a secondary benefit for the environment and those essential for human health [37]. Furthermore, products and services related to mitigating the effects of natural catastrophes, weather conditions linked to the change of climate, and the utilization, exploitation, and application of natural resources are not covered. The EGSS highlighted environmental products and services as follows:

- Environmental-specific services (for example, water and wastewater management, as well as environmental remediation services);
- Goods with a single purpose for the environment (goods or services "whose use directly serves an environmental protection or resource management purpose and that have no other use except for environmental protection or resource management" (for example, solar panel installation);
- Adapted goods, within the context of EGSS, refer to products that have undergone specific alterations to enhance their environmental friendliness. This category includes items that exhibit reduced pollution levels during consumption or disposal compared to standard goods, such as low-emission vehicles, and products designed to be more resource-efficient either in their production or usage.
- Environmental technology (including pollution treatment and preventative technologies). EGSS statistics include outputs of EGS for private consumption and outputs for sale, including expenditures on improving the energy efficiency of non-EGS manufacturing facilities.

Economic monitoring efforts associated with environmental goods and services (EGSS) are still in their infancy. A notable change is that beginning in January 2017, European Union (EU) member states are expected to gather and transmit economic activity statistics that fall into specific categories linked to the Central Framework (CF). While Eurostat and EU member states previously ordered data in these categories, obligatory reporting at the EU level, introduced in 2017, may provide us with significantly more insight into this industry. It will also give helpful information for developing policies to encourage further investment in EGSS.

Green FDI definitions may also be found in financial institutions and development banks that employ criteria to examine and manage the consequences of specific projects. Many of these organizations have set detailed standards at the project level over the last few decades to identify what qualifies as an environmentally responsible investment. These frameworks are primarily used to inform choices about whether or not to offer support to a specific project, rather than simply for monitoring purposes. The presence of an exclusion list enumerating activities unsuitable for financing is a trait shared by these rules as implemented by development banks. These lists frequently contain events related to nuclear power, non-sustainable forestry practices, environmentally hazardous fishing methods, and manufacturing practices that are prohibited under international environmental agreements.

It is worth noting, however, that activities connected with high greenhouse gas emissions are not always included on these exclusion lists. This omission permits development banks to continue backing projects, including coal-fired power stations, as well as other fossil fuel infrastructure, even though these investments may entail environmental risks and harm [37]. As a result, exclusion lists are created to identify investments that pose significant risks to the environment or cause damage. However, they now allow banks to support ecologically unsustainable ventures. Development banks need proof of environmental effect evaluations commensurate with the potential impact of the projects they fund, and they enforce environmental, safety, and health requirements on the projects they finance. Standards establish specific technical and environmental requirements and recommendations, such as the Performance Standards of the International Finance Corporation.

In addition to adhering to established, several development banks have imposed extra laws and conditions for a subset of projects to meet environmental and social principles or programs designated as "green." For example, green bonds have been created by the World Bank and other development organizations to track and finance efforts to lessen and adjust to the effects of climate change. These institutions' procedures for identifying qualifying projects for green bonds and allocating money can also be used for initiatives aimed at defining and measuring green FDI inflows.

Several industry groups, certifying authorities, multi-stakeholder efforts, and non-profit organizations have developed a variety of standards, recommendations, and methods to assess and evaluate compliance with environmental performance initiatives aimed at specific sectors or issues. These initiatives include sector-specific programs like the Forest Stewardship Council Principles and recommendations on specific topics like the Climate Bonds Initiative (CBI). These efforts may also include third-party validation or certification of conformance with applicable standards, which is advocated for or required. In some cases, these efforts have the potential to aid in the growth of a definition of green FDI and the measurement of green FDI. To illustrate, the CBI developed criteria that match the IPCC's 5th Assessment Report for low-carbon scenarios within specific industries.

The Climate Bonds Initiative (CBI) requires certification before and after bond issues to ensure that assets and projects linked to the bonds comply with applicable requirements. Notably, this certification excludes any projects or purchases connected to fossil fuels or efficiency measures supporting fossil fuels [38]. The CBI's activities are intended to increase green bond credibility and increase the supply of green bonds to encourage funding for initiatives and projects that are low-carbon and climate-resilient. Although the CBI reports on certified bonds, it does not publicly release detailed statistics about foreign direct investment facilitated or facilitated by bonds certified by the CBI [39].

ISO 14001 is an internationally recognized standard that provides enterprises with a framework for environmental preservation and adaptability to changing environmental circumstances while considering socioeconomic demands [40-42]. It defines the conditions enterprises must meet to achieve the desired outcomes for environmental management systems. This standard has been certified in over 300,000 enterprises globally and has typically shown improvements in certified firms' ecological management procedures. One option might be to use the extent of FDI covered by ISO 14001 certification as a baseline for evaluating performance in terms of environmental responsibility. However, it is important to remember that ISO 14001 certification does not guarantee a precise level of ecological "green" performance in processes or address the consequences of manufactured goods [34, 42].

Because ISO 14001 does not accurately assess environmental performance in terms of processes and product impacts, using it to measure green foreign direct investment could lead to overestimation. On the other hand, it may result in underestimating green FDI because not all enterprises desire or can get ISO 14001 certification [34, 42]. While this criterion may help identify environmentally responsible businesses within certain sectors, industries, or nations, it raises numerous issues when used to measure on a larger scale [43].

These examples show that green FDI development and measurement are still in their early phases. Several international and national projects have attempted to include FDI in the arena of EGS within the green FDI criteria and to measure EGSS data. While complete EGSS data gathering is not yet ubiquitous, the 2012 Central Framework allows for growth in this area. Alternatively, other techniques have focused on tracking investments in certain areas, such as renewable energy. However, a fundamental concern shared by various methods, standards, and instruments is the risk of overemphasizing and pushing what counts as "green," thus disregarding sustainability in general. This narrow focus runs the risk of omitting or undermining other environmental, economic, and social goals, which contradicts SDG 17, the importance of policy consistency in promoting long-term development. For instance, there are worries about possible abuses of human rights as well as the financial effects of initiatives to reduce $CO_2$ and utilize renewable energy.

Similarly, business organizations' water and water services FDI, which may qualify as green FDI according to EGSS statistics, might contribute to other environmental concerns and risk human rights. Labeling foreign direct investment projects as "green" merely based on their industry sector may encourage corporations to have a limited view, as well as the markets and regulations that support them, of their more significant influence on sustainable development. While it may be impractical to use such a broad definition of "green" FDI in the extensive compilation of macro green FDI flows and FDI stocks, public and private sector lenders, consumers, investors, and other stakeholders must conduct thorough assessments of social, economic, and environmental factors while assessing their relationship to FDI and investment projects. These assessments are critical in choosing whether to provide tax breaks for the project or lend money to it.

### *2.1.2. Green FDI: Towards a Common Understanding and Measurement*

Inconsistent and unrealistic definitions of "green FDI" cause several issues: The lack of a consistent definition of "green" might jeopardize the credibility of ecologically sustainable projects and raise the transaction costs associated with building truly eco-friendly FDI operations. This might make it difficult for the public and commercial sectors to fund such initiatives. Difficulties in differentiating between green and non-green foreign direct investment make it impossible to compare the risk-reward schedules for the corresponding FDI projects in the specific industry or activity. Thus, this study is critical for implementing policies that alter these characteristics, such as those mandating the internalization of externalities, and for gathering support for green FDI initiatives from the public and private sectors. Due to incomplete data, it is challenging to determine if the economy is undergoing the required reforms and, more particularly, the roles that FDI plays in promoting or weakening long-term development goals.

This is also true in green FDI, where attempts to conceive and operationalize the notion remain in their early stages. Building on the current groundwork connected to EGSS, sector-specific efforts, and continuing projects focused on defining and assessing green finance, progress in this area will be required. The goals and needs of sources supplying company or project funding frequently impact FDI choices, including whether to invest, where to invest, and how to invest. Aligning the criteria used by financial providers with those used by receivers downstream could assist both multinational corporations seeking finance for foreign direct investment projects and investors seeking feasible business opportunities.

When evaluating how to build and unify understandings of green FDI, the following aspects must be considered:

- The definition's major focus will most likely be on the rules, regulations, and consequences of foreign direct investment (FDI) formed or purchased within the host country, such as foreign-owned energy production facilities or mining operations. This emphasis is related to the key characteristics of FDI, which is defined by foreign investor ownership and control, typically a multinational corporation (MNE). Nonetheless, the definition should recognize the participation of other essential stakeholders throughout the business chain, such as the policies, practices, and outcomes stemming from choices made at the headquarters level by the FDI investor. As a result, the definition should largely focus on the host country's influence and initiatives. Furthermore, it should include standards and guidelines designed specifically for MNEs.
- Methods and products: Foreign direct investment can be environmentally friendly based on the techniques used and the products created. Definitions should allow for both to be considered. While being environmentally friendly in one area (for example, the product produced) may justify green FDI classification, an adverse effect on the environment in another aspect (for example, the method utilized) should lead FDI to lose its green classification.
- Amounts and timing: Green FDI marks must be defined and used with the understanding that the environmental impacts of FDI initiatives might evolve. As a result, the procedures for defining, evaluating, and measuring green FDI

cannot be merely early investments; they must foresee and accept changes in the green status of FDI projects, including reinvestments. Furthermore, these definitions may need to include thresholds for determining the amount of green FDI, particularly if not all project components match green standards.

- Feasibility: The definition should be generally operationalizable, utilizing data and indicators that will likely change depending on the FDI project's industry or sector, that are widely gathered across nations, and that can be monitored and verified.
- Usefulness: Green FDI definitions should be purpose-driven and aligned with specific objectives. The definition should be harmonized with other financial flow definitions where applicable, depending on the goal, whether to streamline transaction costs associated with green project development, facilitate the measurement of private sector impacts, or identify projects eligible for government support through fiscal or financial incentives. In circumstances where the goal is to identify initiatives deserving of particular government support, to define green FDI, it may be necessary to include rejecting FDI that already complies with established or legally mandated environmental norms for the goods or processes involved.

Policy coherence: Although "green FDI" is considered a more specialized term than "sustainable FDI," green FDI should be considered for sustainable development. Failure to do so may result in governmental and private sector support for green FDI initiatives unwittingly impeding efforts to ensure that economic development aligns with social justice, equity, and the SDGs' overall objectives. Although "green FDI" does not have to encompass all aspects of sustainability as "sustainable FDI" does, at the very least, it should consider them and, in particular, eliminate FDI projects that have the potential to undermine other aspects of sustainable development.

### *2.2. Utilizing Natural Resources Effectively and Minimizing Pollution*

Researchers, decision-makers in government, and macroeconomic analysts have all paid close attention to the connection between carbon emissions and natural resources. There have been both favorable and negative results in this regard. The influence of resource extraction and aging exerted on $CO_2$ emission in European members has been studied recently by Lorente et al. [44]. Second-generation panel analysis was used to evaluate data that were gathered for the five EU member states from 1990 to 2017. The author's findings show an inverse U-shaped relationship among economic expansion, globalization, overseas funding, and carbon emissions. Furthermore, the validation of EKC's presence in the chosen economies serves as a theoretical framework for analyzing the trends in several sustainable development objectives. In order to analyze how carbon emissions, natural resource depletion, and fiscal decentralization are related over time, Tufail et al. [45] apply the cointegration test in conjunction with the CSARDL to a sample of industrialized nations from the OECD between 1990 and 2018. The results demonstrate that natural resource rent and fiscal decentralization can enhance the atmosphere by lowering carbon emissions. Nonetheless, the targeted countries' overall economic growth in the economy and the natural resource rent are rising as well [46].

Panel threshold and STIRPAT models are used by Le [42] to investigate how China's natural resource endowment affected the manufacturing structure and $CO_2$ emissions within the country from 2003 to 2014. According to the findings, resource dependency on carbon emissions has less of a restraint as the ratio of industrial output to economic growth rises. The Sub-Saharan African economies that produce oil are taken into account by Gyamfi [47] in order to analyze the patterns in carbon emissions resulting from consumption based on natural resources and foreign investment. There have been numerous applications of econometric techniques, such as the AMG, the CCEMG, and the Driscoll-Kraay (DK) OLS and GMM. Ren et al. [48] indicated that natural resources also raise the carbon emissions stemming from consumption (DK and CCEMG) within the respective ranges of 0.0159–0.2304%.

From 1995 to 2017, Shen et al. [49] carried out an empirical investigation on the elements influencing the amount of CO2 emitted in China. The CS-ARDL estimation technique has been utilized for three primary carbon emission indicators: natural resources, energy consumption, and monetary advancement. Findings from the research indicate that CO2 and natural resources are positively correlated, green investment is negatively correlated Shahbaz et al. [50]. Wang et al. [51] and Zahoor et al. [52] asserted that the shift to resource-based regions has gained international attention due to growing environmental issues such as greenhouse gases. In order to investigate the patterns in carbon emissions across several Chinese provinces between 2003 and 2016, their study used window analysis and the Slack-Based measure. The results indicate that the efficiency of carbon emissions and resource availability are significantly correlated negatively. More precisely, the efficiency of carbon emissions decreases with increasing resource abundance and vice versa. Furthermore, the authors implied that resource-based areas have to advance and rationalize to make room for the industrial structure, which might have an indirect impact on how efficiently carbon emissions are produced.

*2.3. Green Foreign Investment and Sustainability*

As was previously mentioned, information about FDI can impact the host economy's environment in both advantageous and adverse ways. Thus, the purpose of the pollution halo effect hypothesis (PHEH) is to comprehend the benefits of foreign direct investment (FDI), while the pollution haven hypothesis (PHH) explains how the environment is harmed. PHH's presumptions are based on the notion that financial globalization draws foreign investment to polluting manufacturing procedures, especially in developing and underdeveloped countries, where it is anticipated that the host economies' $CO_2$ levels will rise. This phenomenon arises when investors feel obligated to make investments in developing nations that have looser environmental laws because of the rigorous environmental laws in developed nations. Therefore, these financiers capitalize on the lack of environmental laws in developing nations to invest in industries that generate substantial pollutants. As a result, the expansion of industries that produce pollution within economies that accept foreign direct investment (FDI) increases the FDI-led $CO_2$ emissions of those countries [53]. Additionally, it seems sensible to presume that countries possessing substantial fossil fuel reserves will have a comparative advantage when it comes to producing products that emit a lot of pollution. According to Banerjee et al. [54], these nations could act as hubs for attracting dubious foreign direct investments (FDIs), increasing the possibility that their economies will become hotspots for pollution.

Global warming is currently considered one of the planet's greatest threats. As a result of the United Nations (UN) Sustainable Development Goals (SDGs), which brought to light the increasing concern about environmental degradation and resource exhaustion, contemporary ideas such as sustainable development were developed. The objective of environmentally friendly HRM processes is to inspire employees to reduce environmental emissions by raising their awareness of environmental issues [55]. The finance industry, which had previously ignored the ecosystem, is now starting to pay more attention to environmental issues. As a result, several financial products have been introduced that are specifically meant to conserve the environment, such as investments in projects that generate electricity from renewable sources [56-58]. Studies connecting ecology and economics are currently scarce.

## 3. Empirical Methodology

The analytical framework employed for examining the interconnection between green foreign direct investment (*GFDI*) and natural rents (*NR*) may be articulated subsequently:

$$NR_{it} = \beta_0 + \beta_1 GFDI_{i,t} + \beta_2 INC_{i,t} + \beta_3 EXP_{i,t} + \beta_5 GE_{i,t} + \beta_5 FDI_{i,t} + \beta_6 EPI_{i,t} + \beta_7 IND_{i,t} + \beta_8 EI\_ISO_{i,t} + \varphi_t + \omega_i + \varepsilon_{ijt,} \quad (1)$$

where *i* and *t* respectively represent country *i* at year *t*. $\varphi_t$ and $\omega_i$ captures the country-fixed and year-fixed effects and $\varepsilon_{ijt,}$ is the white noise.

*3.1. Indicators of Natural Rents*

We employ a comprehensive set of five measures to encompass natural rents, including Coal, Gas, Minerals, Forest, and Natural rents, computed as the fraction of the aforementioned rents to Gross Domestic Product (GDP). Utilizing WDI data from the years 2007 to 2021, we derive insights from these variables. Our panel's unique features require careful empirical examination to ensure there are no missing data points. By removing countries with missing observations, we have developed a dataset of 46 nations. The data is sourced from worldwide references within the time frame from 2007 to 2021.

*3.2. Key Explanatory Variable*

In the absence of accurate FDI data, the characterization of component 1 in the concept of green FDI suffers from intrinsic imprecision when using Energy, Gas, and Water (EGW) investment flows according to the ISIC categorization. This category includes critical environmental services, notably those related to water management and energy. However, because of the inclusion of conventionally generated energy and the absence of waste treatment, as well as other non-infrastructure environmental services and the generation of environmental commodities, there exists confusion. As a result, the precision with which the initial dimension of green FDI may be estimated remains unknown. Within this context, EGW is perceived as providing an approximate magnitude rather than a precise delineation of part 1 in the green FDI definition. The scope of environmentally relevant FDI, or the potential for green FDI, encompasses EGW, manufacturing, mining, agriculture and forestry, construction, and transport. Data pertaining to these variables are extracted from the International Trade Center for the years 2007 through 2021.

*3.3. Control Variables*

This study relies on real-world data and analyses, based on previously conducted studies and published works, exemplified by Aladejare [59], Hong [60], and Nham [61], to determine the control variables. The chosen control variables encompass the level of economic growth (INC), trading activities as a proportion of GDP (EXP), and industrialization level

(IND). Per Nham & Ha's (2022) study, the model also integrates the significance of net FDI. Additionally, factors such as the level of government (GE) Wang and Shao [24] ISO 14001 certificates (EI_ISO) Akram et al. [62] and Golub et al. [17], and the environmental performance index (EPI) Akram et al. [62] and Tahir et al. [63] are incorporated as control variables. Table 1 furnishes the correlation matrix of the variables. It presents a positive correlation with GFDI for three dimensions of Natural Resources (NR), namely Coal, Mineral, and Gas. In contrast, the remaining two dimensions, Rent_Total and Rent_Forest, as well as EI_ISO, exhibit an inverse correlation with GFDI.

The examination of cross-sectional dependence (CD) involves a sequence of procedural steps. Using cross-sectional dependency tests, the data's CD validity is verified. We employ the methods presented by Pesaran [64] based on the features of our database. Im et al. [9] unit root tests are chosen in order to verify the regularity of the examined series using the proper approaches, demonstrated in Table 2. It illustrated the first-difference stationary for all variables. However, cross-dependence is noted in all variables except for GE and EI_ISO. Table 3, in parallel, presents the results of cointegration tests using the Kao, Perioni, and Westerlund tests. At a significance level of 5%, all five dimensions of Natural Resources (NR) and GFDI exhibit cointegration in all three methods.

In analyzing the relationship between GFDI and Natural Resources (NR), characterized by cross-sectional dependence and stationarity through the first-difference, the PCSE model is viewed as the most suitable empirical methodology [14, 33-35]. Furthermore, our estimations are replicated through various models to address concerns related to heterogeneity, following the methodology outlined by Ha [34]. Specifically, the FGLS approach was employed in this endeavor. To tackle potential endogeneity issues in Equations 1 and 2, we utilized the two-step GMM system. Evaluating the impacts over time is essential; thus, we applied the Pesaran and Shin [65] ARDL method. Lastly, to consider causal relationships between variables and the degree of heterogeneity across countries, we used dynamic fixed-effects (DFE) estimation, accounting for possible variations, as proposed by Pesaran and Shin [65].

**Table 1.**
Correlation coefficients.

| | **Rent_Total** | **Rent_Coal** | **Rent_Mineral** | **Rent_Gas** | **Rent_Forest** | **GFDI** | **INC** | **EXP** | **GE** | **FDI1** | **EPI** | **IND** | **EI_ISO** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rent_Total | 1 | | | | | | | | | | | | |
| Rent_Coal | 0.503$^{***}$ | 1 | | | | | | | | | | | |
| Rent_Mineral | 0.732$^{***}$ | 0.558$^{***}$ | 1 | | | | | | | | | | |
| Rent_Gas | 0.384$^{***}$ | 0.688$^{***}$ | 0.574$^{***}$ | 1 | | | | | | | | | |
| Rent_Forest | 0.620$^{***}$ | -0.0725 | -0.0252 | -0.180$^{*}$ | 1 | | | | | | | | |
| GFDI | -0.162 | 0.111 | 0.205$^{*}$ | 0.375$^{***}$ | -0.425$^{***}$ | 1 | | | | | | | |
| INC | -0.655$^{***}$ | -0.548$^{***}$ | -0.389$^{***}$ | -0.339$^{***}$ | -0.453$^{***}$ | 0.380$^{***}$ | 1 | | | | | | |
| EXP | -0.182$^{*}$ | -0.453$^{***}$ | -0.229$^{**}$ | -0.291$^{***}$ | 0.0321 | 0.352$^{***}$ | 0.708$^{***}$ | 1 | | | | | |
| GE | -0.135 | -0.278$^{**}$ | -0.180$^{*}$ | -0.229$^{**}$ | 0.0387 | 0.485$^{***}$ | 0.469$^{***}$ | 0.612$^{***}$ | 1 | | | | |
| FDI1 | 0.0928 | -0.0941 | -0.0780 | -0.137 | 0.198$^{*}$ | 0.219$^{*}$ | 0.158 | 0.484$^{***}$ | 0.401$^{***}$ | 1 | | | |
| EPI | -0.174$^{*}$ | -0.168 | -0.172$^{*}$ | -0.116 | -0.0852 | 0.312$^{***}$ | 0.386$^{***}$ | 0.667$^{***}$ | 0.399$^{***}$ | 0.368$^{***}$ | 1 | | |
| IND | -0.741$^{***}$ | -0.466$^{***}$ | -0.332$^{***}$ | -0.280$^{**}$ | -0.630$^{***}$ | 0.385$^{***}$ | 0.933$^{***}$ | 0.531$^{***}$ | 0.310$^{***}$ | 0.0377 | 0.346$^{***}$ | 1 | |
| EI_ISO | 0.0183 | -0.447$^{***}$ | -0.285$^{***}$ | -0.452$^{***}$ | 0.353$^{***}$ | -0.377$^{***}$ | 0.125 | 0.278$^{**}$ | 0.0717 | 0.319$^{***}$ | -0.102 | -0.00632 | 1 |

**Note:** * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

**Table 2.**
Cross-sectional dependence and stationarity tests.

| Variable (in level) | CD-test, Pesaran (2004) | Im-Pesaran-Shin test (Z-bar) | Variable (in difference) | Im-Pesaran-Shin test (Z-bar) |
|---|---|---|---|---|
| Rent_Total | 7.712*** | 4.135 | DRent_Total | -2.524*** |
| Rent_Coal | 25.85*** | -3.55*** | DRent_Coal | -20.20*** |
| Rent_Forest | 115.3*** | 1.23 | DRent_Forest | |
| Rent_Gas | 166.5*** | 7.89 | DRent_Gas | -12.55*** |
| Rent_Mineral | 153.85*** | -0.36 | DRent_Mineral | -11.78*** |
| GFDI | 21.66*** | -9.66*** | DGFDI | -25.77*** |
| INC | 42.070*** | 3.007 | DINC | -3.698*** |
| EXP | 14.973*** | 0.463 | DEXP | -3.241*** |
| GE | 0.103 | -4.056*** | DGE | -4.653*** |
| FDI | 7.381*** | 0.247 | DFDI | -3.663*** |
| EPI | 12.463*** | 1.136 | DEPI | -3.219*** |
| IND | 32.791*** | 4.124*** | DIND | -2.238*** |
| EI_ISO | 0.034 | 9.771 | DEI_ISO | -3.370*** |

**Note:** Regarding the CD test, the null hypothesis is cross-sectional independence in panel data. A close-to-zero P-value implies panel data is correlated across groups. The CIPS (Pesaran Panel Unit Root Test with cross-sectional and first difference mean) assumes "panels are homogeneous non-stationary". The LLC unit-root test null hypothesis is "Panels are non-stationary".

**Table 3.**
Cointegration test.

| Model: f(GFDI and NR) | Kao test | Pedroni test | Westerlund test |
|---|---|---|---|
| | Dickey-Fuller test | Phillips-Perron t | Variance ratio |
| Rent_Total | -4.91*** | -4.83*** | 5.34*** |
| Rent_Coal | -4.67*** | -4.14*** | 4.24*** |
| Rent_Mineral | -5.28*** | -4.02*** | 2.32*** |
| Rent_Gas | -3.14** | -2.24*** | 4.51*** |
| Rent_Forest | -2.56*** | -3.34*** | 4.25*** |

## 4. Empirical Results

*4.1. Green FDI and Natural Rents*

Table 4 presents the results obtained from the PCSE, FGLS, and Two-step SGMM methods, where Panel A simulates two scenarios with and without the inclusion of two variables, IND and EI_ISO, while Panel B records the regression outcomes of the remaining two methods. In the PCSE estimation without the addition of two control variables, the positive impact of Green FDI is only observed when influencing Rent_Forest; for other dimensions, the effects are consistently negative, extending to the composite index of natural rents. However, including the two control variables in the model strengthens and uniformly aligns the negative influence of Green FDI across all four dimensions, except for the final composite index. Moreover, the control variables themselves, IND and EI_ISO, exhibit significant effects on most dimensions of natural rents. Specifically, IND increases Rent_Coal, but for Rent_Forest and the composite index of natural rent, the impact decreases significantly at a 1% significance level. Despite the significant results at the 5% significance level for four out of five dimensions of natural rents, the influence of EI_ISO is deemed inconsequential. The outcomes of the FGLS and Two-step SGMM methods are depicted in Panel B. The effect of green FDI on natural rent variables is notably detrimental in both methods, but for the FGLS estimated effect on Rent_Mineral, which demonstrates that, despite the use of several econometrical approaches in our calculations, this negative influence is constant. Put another way, our results suggest that drawing in green FDI would probably contribute to a decrease in natural rents domestically. This is a significant contribution to the current context. It indicates that nations trying to curtail natural rent-seeking should consider the significance and possibilities of green foreign direct investment schemes.

*4.2. Fresh Insights on A Link Between GFDI And Natural Rents*

*4.2.1. Short-Run and Long-Run Effects: ARDL Model*

The author employed the ARDL method, outlined in Table 5. Panel A involves an analysis of the entire dataset, while Panel B presents results segmented by development levels. Panel A suggests that green FDI in the long run negatively impacts natural rents, with the exception of an insignificant positive impact on Rent_Forest. Conversely, in shorter terms, the aforementioned impact is insignificant. The study further reveals that the negative coefficient of EC is statistically significant across all five metrics. This implies that the imbalances in NR and its four constituents, constituting 65%, 71%, 52%, 58%, and 55%, respectively, induced by previous shocks, will converge to equilibrium in the long term. Subsamples in Panel B display differences among countries with varying development statuses. Notably, the results show that green FDI significantly increases natural forest rent for developing economies, while all other impacts are insignificant in the short term. Similarly, the positive impact of Green FDI on Rent_Forest continues to be present in the long term for all countries but remains statistically insignificant. For other dimensions, the stimulating effect of Green FDI on natural rents is noted, leaving a more pronounced imprint in developed economies. Specifically, in the long term, promoting green FDI reduces the total natural rent and gas rent for developing countries, while for developed countries, it reduces total natural rent, as well as for coal and mineral. The study also computes the EC term, and all are found to be statistically significant. In general, 10-19% of the model's instability caused by previous shocks is restored to equilibrium in the long run.

**Table 4.**
Linear impacts of green FDI inflows on natural rents.

Panel A

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | **PCSE estimates** | | | | | **PCSE estimates with the inclusion of IND and EI_ISO** | | | | |
| VARIABLES | NR | Rent_Coal | Rent_Mineral | Rent_Gas | Rent_Forest | NR | Rent_Coal | Rent_Mineral | Rent_Gas | Rent_Forest |
| L.GFDI | -0.33*** | -0.22*** | -0.20** | -0.09*** | 0.14** | -8.40 | -11.69*** | -33.83*** | -3.83*** | -19.67*** |
| | (0.108) | (0.038) | (0.085) | (0.022) | (0.057) | (14.532) | (2.839) | (12.848) | (0.487) | (3.498) |
| L.INC | -1.04*** | -0.03 | -0.39*** | 0.08*** | -0.45*** | -1.06* | -0.59*** | -0.61 | -0.05* | -0.14 |
| | (0.116) | (0.022) | (0.102) | (0.018) | (0.048) | (0.611) | (0.133) | (0.559) | (0.031) | (0.264) |
| L.EXP | -0.17 | -0.39*** | -0.30 | -0.12*** | 0.39*** | 1.31*** | 0.12 | 0.31 | 0.04*** | 0.58*** |
| | (0.238) | (0.068) | (0.208) | (0.027) | (0.071) | (0.307) | (0.074) | (0.272) | (0.015) | (0.153) |
| L.GE | 0.65*** | 0.17*** | 0.24*** | 0.07*** | 0.06 | -0.08 | -0.08* | 0.03 | -0.05*** | -0.04 |
| | (0.120) | (0.032) | (0.086) | (0.024) | (0.063) | (0.168) | (0.042) | (0.151) | (0.009) | (0.055) |
| L.FDI | 0.12** | 0.01 | -0.00 | 0.01 | 0.05*** | 0.04 | -0.00 | 0.02 | -0.00 | 0.02** |
| | (0.046) | (0.010) | (0.030) | (0.007) | (0.018) | (0.038) | (0.011) | (0.031) | (0.001) | (0.012) |
| L.EPI | 0.01 | 0.01*** | 0.01 | 0.00 | -0.01* | -0.06*** | -0.00 | -0.07*** | 0.00 | -0.00 |
| | (0.012) | (0.003) | (0.011) | (0.001) | (0.003) | (0.024) | (0.006) | (0.022) | (0.001) | (0.005) |
| L.IND | | | | | | -1.21*** | 0.22** | -0.17 | 0.01 | -0.53*** |
| | | | | | | (0.451) | (0.100) | (0.410) | (0.023) | (0.203) |
| L.EI_ISO | | | | | | -0.00** | -0.00** | -0.00*** | -0.00** | 0.00 |
| | | | | | | (0.001) | (0.000) | (0.001) | (0.000) | (0.000) |
| Observations | 189 | 189 | 189 | 189 | 189 | 126 | 126 | 126 | 126 | 126 |
| Number of economies | 9 | 9 | 9 | 9 | 9 | 6 | 6 | 6 | 6 | 6 |
| S.E. in parentheses | | | | | | | | | | |

**Note:** *** p<0.01, ** p<0.05, * p<0.1.

Panel B

| | (1) | (2) | (3) | (4) | (5) | (11) | (12) | (13) | (14) | (15) |
|---|---|---|---|---|---|---|---|---|---|---|
| | **FGLS estimate** | | | | | **Two-step GMM estimate** | | | | |
| VARIABLES | NR | Rent_Coal | Rent_Mineral | Rent_Gas | Rent_Forest | NR | Rent_Coal | Rent_Mineral | Rent_Gas | Rent_Forest |
| L.GFDI | -0.33* | -0.22*** | -0.20 | -0.09*** | -0.14** | -0.38** | -0.74** | -0.25* | -0.27* | -0.08* |
| | (0.173) | (0.036) | (0.121) | (0.022) | (0.057) | (0.083) | (0.304) | (0.119) | (0.068) | (0.050) |
| L.INC | -1.04*** | -0.03 | -0.39*** | 0.08*** | -0.45*** | -0.01 | 0.00 | 0.00 | 0.02*** | -0.00 |
| | (0.146) | (0.031) | (0.102) | (0.018) | (0.048) | (0.069) | (0.005) | (0.025) | (0.007) | (0.001) |
| L.EXP | -0.17 | -0.39*** | -0.30** | -0.12*** | 0.39*** | 1.72 | 0.13 | 0.20 | -0.29** | 0.02 |
| | (0.215) | (0.045) | (0.151) | (0.027) | (0.071) | (1.959) | (0.166) | (0.676) | (0.126) | (0.041) |
| L.GE | 0.65*** | 0.17*** | 0.24* | 0.07*** | 0.06 | -0.27 | -0.03 | -0.11 | 0.03 | 0.00 |
| | (0.191) | (0.040) | (0.134) | (0.024) | (0.063) | (0.184) | (0.069) | (0.102) | (0.027) | (0.004) |
| L.FDI | 0.12** | 0.01 | -0.00 | 0.01 | 0.05*** | 57.06*** | 2.83 | 15.24* | 2.09 | 0.08 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (0.055) | (0.012) | (0.039) | (0.007) | (0.018) | (16.426) | (2.904) | (7.980) | (1.747) | (0.382) |
| L.EPI | 0.01 | 0.01*** | 0.01 | 0.00 | -0.01* | 0.06 | -0.02* | 0.04 | -0.01 | -0.00 |
| | (0.010) | (0.002) | (0.007) | (0.001) | (0.003) | (0.094) | (0.012) | (0.038) | (0.013) | (0.002) |
| Observations | 189 | 189 | 189 | 189 | 189 | 198 | 198 | 198 | 198 | 198 |
| Number of economies | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| S.E. in parentheses | | | | | | | | | | |
| **Note:** *** p<0.01, ** p<0.05, * p<0.1 | | | | | | | | | | |

**Table 5.**
The influence of the green FDI inflows on natural rents: Short-run and long-run effects.

Panel A: Whole sample

| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
|---|---|---|---|---|---|
| **VARIABLES** | **NR** | **Rent_Coal** | **Rent_Mineral** | **Rent_Gas** | **Rent_Forest** |
| | Short-run effects | | | | |
| EC term | -0.65*** | -0.71*** | -0.52*** | -0.58*** | -0.55*** |
| | (0.018) | (0.015) | (0.015) | (0.017) | (0.016) |
| D.GFDI | -0.14 | 0.42 | 0.06 | -0.04 | 0.05 |
| | (0.262) | (0.411) | (0.611) | (0.251) | (0.010) |
| | Long run effects | | | | |
| GFDI | -0.44*** | -0.67*** | -1.32** | -0.47** | 0.17 |
| | (1.350) | (0.187) | (0.667) | (0.168) | (0.051) |

Panel B: Subsamples by development status

| | **(1)** | **(3)** | **(5)** | **(7)** | **(9)** | **(11)** | **(13)** | **(15)** | **(17)** | **(19)** |
|---|---|---|---|---|---|---|---|---|---|---|
| | Developing economies | | | | | Developed economies | | | | |
| VARIABLES | NR | Rent_Coal | Rent_Mineral | Rent_Gas | Rent_Forest | NR | Rent_Coal | Rent_Mineral | Rent_Gas | Rent_Forest |
| | Short-run effects | | | | | | | | | |
| EC term | -0.12*** | -0.13*** | -0.19*** | -0.16*** | -0.12*** | -0.13*** | -0.10*** | -0.12*** | -0.19*** | -0.16*** |
| | (0.018) | (0.014) | (0.016) | (0.014) | (0.013) | (0.011) | (0.017) | (0.014) | (0.015) | (0.017) |
| D.GFDI | -0.17 | -0.011 | -0.011 | -0.19 | 0.10* | 0.02 | 0.57 | -0.06 | -0.01 | -0.03 |
| | (0.548) | (0.139) | (0.115) | (0.174) | (0.055) | (1.737) | (0.498) | (0.830) | (0.226) | (0.057) |
| | Long run effects | | | | | | | | | |
| GFDI | -1.12*** | -0.19 | -0.15 | -0.53* | 0.03 | -1.81*** | -0.15*** | -0.74** | -0.14 | 0.07 |
| | (0.651) | -0.138 | (0.114) | (0.254) | (0.091) | (0.115) | (0.075) | (0.003) | (0.026) | (0.063) |

***Note***: DFE-ARDL is utilized in this research.
*** p<0.01, ** p<0.05, * p<0.1.
S.E. in parentheses.

**Table 6.**
The moderating effects of institutional quality on the relationship between GFDI and resource rents.

Panel A

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NR | | | | | | Rent_Coal | | | | | |
| VARIABLES | VA | PV | GE | RQ | RL | CC | VA | PV | GE | RQ | RL | CC |
| L.GFDI | -0.24*** | -0.17*** | -0.05 | -0.16*** | -0.11*** | 0.03 | -0.23*** | -0.06 | -0.23*** | -0.23*** | -0.27*** | -0.04 |
| | (0.019) | (0.015) | (0.010) | (0.016) | (0.011) | (0.017) | (0.016) | (0.010) | (0.013) | (0.041) | (0.014) | (0.012) |
| L.InstQ | 0.08*** | -0.40*** | -0.38*** | 0.09 | -0.40*** | 0.41*** | 0.03 | -0.23*** | -0.32*** | -0.14*** | -0.31*** | 0.21*** |
| | (0.029) | (0.070) | (0.061) | (0.056) | (0.037) | (0.145) | (0.024) | (0.068) | (0.050) | (0.038) | (0.046) | (0.081) |
| L.InstQ* GFDI | -0.26*** | -0.21** | -0.04 | -0.22*** | -0.33*** | -0.15 | -0.18*** | -0.05 | -1.61*** | -0.51*** | -0.29*** | -0.08 |
| | (0.052) | (0.082) | (0.212) | (0.074) | (0.035) | (0.118) | (0.067) | (0.103) | (0.348) | (0.098) | (0.036) | (0.137) |
| L.INC | -0.01* | -0.02*** | -0.01* | -0.01* | 0.01 | -0.01* | -0.03*** | -0.04*** | -0.03*** | -0.03*** | -0.02*** | -0.03*** |
| | (0.007) | (0.008) | (0.007) | (0.006) | (0.006) | (0.007) | (0.006) | (0.005) | (0.006) | (0.005) | (0.007) | (0.005) |
| L.EXP | 0.04*** | 0.04*** | 0.03*** | 0.03*** | 0.03*** | 0.03*** | 0.01*** | 0.01*** | 0.01*** | 0.01*** | 0.00*** | 0.01*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.002) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| L.GE | -0.19*** | -0.06 | -0.06 | -0.15*** | -0.01 | -0.03 | -0.36*** | -0.27*** | -0.34*** | -0.37*** | -0.27*** | -0.28*** |
| | (0.051) | (0.043) | (0.053) | (0.056) | (0.034) | (0.045) | (0.039) | (0.043) | (0.042) | (0.042) | (0.040) | (0.036) |
| L.FDI | -0.03*** | -0.05*** | -0.02 | -0.04*** | -0.08*** | -0.04*** | -0.02** | -0.03*** | -0.02* | -0.02 | -0.05*** | -0.03** |
| | (0.012) | (0.014) | (0.015) | (0.012) | (0.013) | (0.015) | (0.011) | (0.011) | (0.010) | (0.011) | (0.011) | (0.012) |
| L.EPI | 0.09 | -0.11 | -0.37*** | -0.10 | -0.22*** | -0.11 | -0.11 | -0.24*** | -0.26** | -0.16* | -0.22*** | -0.19** |
| | (0.086) | (0.079) | (0.108) | (0.095) | (0.071) | (0.103) | (0.083) | (0.078) | (0.112) | (0.087) | (0.065) | (0.095) |
| Observations | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 |
| Number of countries | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

**Note:** S.E. in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Panel B

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rent_Mineral | | | | | | Rent_Gas | | | | | |
| VARIABLES | VA | PV | GE | RQ | RL | CC | VA | PV | GE | RQ | RL | CC |
| L.GFDI | 0.01 | 0.17** | 1.33*** | 0.12*** | 0.14*** | -0.11 | -0.00*** | -0.00 | -0.00*** | -0.00*** | -0.00*** | -0.00 |
| | (0.043) | (0.095) | (0.358) | (0.111) | (0.043) | (0.131) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.InstQ | -0.26** | 2.27*** | -0.15* | 0.11 | 1.09*** | -1.16*** | -0.00 | -0.00 | -0.00*** | -0.00*** | -0.00*** | 0.00 |
| | (0.125) | (0.235) | (0.088) | (0.155) | (0.077) | (0.252) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.InstQ* GFDI | -0.11** | -0.34*** | -0.61*** | -0.71*** | -0.83*** | -0.06 | -0.00*** | -0.00 | -0.00*** | -0.00*** | -0.00*** | -0.00 |
| | (0.118) | (0.124) | (0.124) | (0.182) | (0.106) | (0.342) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.INC | 0.22*** | 0.27*** | 0.22*** | 0.22*** | 0.11*** | 0.22*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** | -0.00* | -0.00*** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (0.015) | (0.018) | (0.015) | (0.016) | (0.014) | (0.013) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.EXP | -0.01*** | -0.02*** | -0.02*** | -0.01** | 0.00 | -0.01*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** |
| | (0.004) | (0.003) | (0.006) | (0.004) | (0.003) | (0.003) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.GE | 0.31*** | 0.34*** | 0.30*** | 0.26*** | 0.77*** | 0.89*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** |
| | (0.182) | (0.145) | (0.180) | (0.178) | (0.142) | (0.157) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.FDI | 0.32*** | 0.25*** | 0.33*** | 0.34*** | 0.24*** | 0.30*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00*** |
| | (0.070) | (0.055) | (0.070) | (0.077) | (0.052) | (0.071) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.EPI | -0.16** | 1.07*** | -0.13* | 0.15 | 1.09*** | -0.16*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** | -0.00*** |
| | (0.025) | (0.135) | (0.081) | (0.155) | (0.056) | (0.132) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Observations | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 |
| Number of countries | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

**Note:** S.E. in parentheses
*** p<0.01, ** p<0.05, * p<0.1.

*4.3. Does Institutional Quality Matter?*

The caliber of institutions is essential for encouraging green FDI. Examining institutional quality from an empirical perspective, this study fully explores its importance. The robustness of our belief is evaluated by introducing interactions involving the natural rent variable and indicators that encompass the excellence of an institution. A specific metric used to assess the quality of the institutional system is its dimensions. Selected in the International Country Risk Guide, the dimensions (or the variables), i.e., the six indices1, are individually examined within the four dimensions of natural rents, serving both as independent variables (InstQ) and interaction variables when combined with Green FDI.

The findings, as illustrated in Table 6, outline the estimates. For overall natural rents and Rent_Coal, Panel A consistently demonstrates a significant negative impact of Green FDI on NR and Rent_Coal. Concerning the dimensions of NR, the InstQ variable, except for CC and VA, registers a positive influence; however, in general, it adversely affects natural rents. The interactive effect generated by the combination of InstQ and Green FDI consequently diminishes natural rents. Panel B presents results for the dimensions of Rent_Mineral and Rent_Gas. Although Rent_Gas records several significant effects, the models show only a very small impact from these variables. Rent_Mineral exhibits a contrary trend to Panel A, where Green FDI overall boosts natural rents, but InstQ and the interaction variable still negatively impact natural rents in most dimensions. These findings highlight the significance of the moderating impact of institutions on the scrutinized relationship.

## 5. Conclusions

This article offers essential policy recommendations directed at policymakers to guide Green FDI in the management of natural rents. An integral aspect of this study posits that the influx of Green FDI can alleviate the rental costs associated with valuable natural resources. It follows that in order to draw in more investment, rising nations' governments need to think of and suggest measures. It is crucial for governments to establish a strong institutional framework that ensures the expansion of Green FDI in a way that guarantees the efficacy of this capital flow.

The introduction of unforeseen outcomes is achieved by emphasizing the correlation between augmenting the role of the institutional system and achieving a heightened control effect on foreign investment. The viability of our proposals in the face of empirical scrutiny remains a potential area for future research. Within this conceptual framework, the quality of the institutional system and foreign aid can function as policy-independent variables. The significance of energy investment, particularly in clean energy infrastructure, cannot be overstated for environmental protection [11, 66]. We support government and institutional systems' active engagement in removing obstacles, managing subsidies, addressing disincentives, and resolving regulatory and market rigidities that may adversely affect the utilization of clean energy investment. This is in line with the contributions of Cammack [67] and Zahoor et al. [52].

Furthermore, our proposal emphasizes that achieving the goal of reducing natural rents necessitates a continuous inflow of Green FDI. To prevent rent-seeking behavior and guarantee adherence to environmental regulations, this entails strengthening regulatory frameworks and putting in place strong monitoring and enforcement procedures [68]. By delving deeper into the specifics of each country group, we provide nuanced insights to identify nations leading in this context and pinpoint areas requiring additional policy interventions. More focused and complex policy suggestions will result from expanding these insights through specialized research that is country-specific. Future research endeavors can enhance the depth of this study by investigating varying levels of indices or regional disparities, delving into the distinctive characteristics of each country group.

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1 VA: Voice and accountability, PV: political stability, GE: government effectiveness, RQ: regulatory quality, RL: rule of law, CC: control of corruption.

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## Appendix

**Table A.1.**
Countries in the sample.

| **EU countries** | | |
|---|---|---|
| Austria | Hungary | Portugal |
| Belgium | Iceland | Slovak Republic |
| Bulgaria | Ireland | Slovenia |
| Czech Republic | Italy | Sweden |
| Denmark | Lithuania | |
| Spain | Luxembourg | |
| Estonia | Latvia | |
| United Kingdom | Malta | |
| Greece | Netherlands | |
| Croatia | Poland | |