

Article

How Can Foreign Direct Investment Trigger Green Growth? The Mediating and Moderating Role of the Energy Transition

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Abstract: Developed countries have the resources/technologies to combat pollution even at the expense of economic growth. Developing countries are in a less fortunate position. Foreign Direct Investment (FDI) can be a tool for developed countries to transfer polluting industries, which increases pollution in host countries. However, as FDI might reduce pollution by reducing energy consumption, the pollutant effect might also be influenced. Therefore, this study examines the mediating effect of energy consumption on the impact of FDI on pollution, and the role of FDI to attain Green Growth via energy transition. The main findings indicate that FDI impacts pollution through energy consumption and that energy transition plays a vital role in reducing this mediating effect. Developing countries appear to use non-renewable energy to fill energy demand. In both groups of countries, FDI is a driver of Green Growth. However, developing countries require larger efforts to achieve Green Growth through the energy transition.

Keywords: energy transition; Foreign Direct Investment; Green Growth

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1. Introduction

The climate change debate is at the core of most international discussions and agreements. The United Nations Conference of the Parties (COP) on Climate Change is the most current international agreement on climate action. The COP allows countries to debate and set their climate targets. However, what happens if countries do not meet those targets? The debate and the imposition of targets are both critical, but they are only effective when the targets are met. The absence of penalties may discourage countries from undermining economic growth at the expense of environmental protection. This is especially true in developing countries, which have lower wealth.

FDI is one of the primary sources of economic growth in developing countries. This study concerns one of the strategies adopted by developing countries to attract FDI: Reducing environmental regulations to attract investment. By following this strategy, developing countries gain a comparative advantage in polluting goods and industries. Although developed countries are leading climate action, they are still the most polluting countries. To reach climate targets and avoid tighter environmental restrictions, developed countries may choose to relocate their polluting industries. This phenomenon is known in the literature on the FDI–Environment nexus as the Pollution Haven Hypothesis (PHH). This relocation goes against the efforts of the COP, as it only results in a transfer of the territorial source of emissions, not a pollution reduction.

The FDI–Environment nexus focuses on analysing the environmental impact of FDI in recipient countries, but the findings are controversial. While some scholars have noticed a pollutant effect of FDI, the reverse effect was also found: FDI might reduce pollution due to the transfer of cleaner/more efficient energy processes that can reduce energy consumption (Balsalobre-Lorente et al. 2019). This is generally defined in the literature as the Pollution Halo Hypothesis (PHIH).

This latter hypothesis prompted some reasoning: As FDI could reduce pollution by reducing energy consumption, could FDI be increasing pollution by the indirect effect of FDI increasing energy consumption? Therefore, more than just analysing the impact of FDI on the level of CO₂ emissions, the main objective of this paper is to examine whether the pollutant effect is mediated by the increased energy consumption from non-renewable sources. In addition, this study also aims to assess whether the energy transition from the fossil-fuel-based energy mix to the renewables-based energy mix could soften the potential mediating effect.

This study innovates in four ways: (i) By filling a gap in the literature supporting the transfer of polluting industries only based on the polluting effect of FDI in host countries; (ii) by scrutinizing the environmental impact of FDI in both developed and developing countries, which allows a comparison between the effects of investment; (iii) by understanding, through a moderated mediation model, whether policies directed toward the energy transition might influence the mediating effect of energy consumption on the impact of FDI on Carbon Dioxide (CO₂) emissions; and (iv) by analysing the role of the energy transition in mitigating the harmful effect of FDI, thus leading to Green Growth (economic growth that also considers environmental depletion).

The central questions of this study are: (i) Does FDI increase pollution due to the fossil fuel-based energy mix of the host countries? (ii) What is the role of FDI and the energy transition for countries achieving Green Growth? (iii) Does the energy transition soften the PHH? To answer these central questions, this study analyses a group of 19 developed and 20 developing countries through a Structural Equation Model (SEM). This model examines the mediating effects of energy consumption and energy transition on the impact of FDI on CO₂ emissions and Green Growth, respectively. Furthermore, a dynamic game with incomplete information is carried out to clarify whether the imposition of penalties on international commitments to climate action could be crucial for countries to achieve climate targets. The main findings show that developing countries have been using non-renewable energy to meet the increased energy demand provoked by increased FDI. Therefore, pollution has been driven by FDI in developing countries. On the contrary, FDI encourages the energy transition and reduces pollution in developed countries. The moderated mediation model uncovers the potential role of the energy transition to reduce the mediating effect of energy consumption in both groups of countries. FDI seems to be a driver of Green Growth in both developed and developing countries. However, developing countries are required to make larger efforts to make the energy transition an ally to meet Green Growth. Encouraging foreign and/or private investment in renewable energy infrastructure appears crucial.

2. Literature Review

Attracting FDI is a global strategy adopted to increase income in both developed and developing countries (Weimin et al. 2021). However, as economic growth has expanded, the environment has degraded. All strategies adopted by both developed and developing countries have one main concern: Their impact on economic growth.

Climate action policies might require, for example, investment in Research and Development (R&D) to increase countries' technology absorptive capacity for greener technologies, as announced by Adom et al. (2019). As stated by Sultana and Turkina (2020), the absorptive capacity of countries can be defined as the ability of countries to identify, assimilate, and exploit knowledge from their environment. Briefly, this capacity reflects the capacity of countries to learn fast (Adom et al. 2019). This is especially relevant in developing countries that commonly have a lower technology-absorptive capacity, thus representing higher adjustment costs hindering the potential benefits of FDI.

Investment in renewable energy infrastructure also appears crucial on the path to climate action, as increased renewable energy consumption is directly associated with reduced environmental degradation (e.g., Balsalobre-Lorente et al. 2019; Zafar et al. 2020). Moreover, as suggested by Sarkodie and Strezov (2019), energy efficiency plays a vital role in climate action to reduce CO₂ emissions levels. As stated by Gaspar et al. (2017), it can

prevent environmental degradation without lowering the production level of the economy. However, countries must be willing to potentially undermine economic growth to preserve the environment, which might be more difficult for countries with less wealth or those that generally have fewer resources to allocate to climate action (Zaidi and Saidi 2018).

The environmental impacts of FDI are analysed through two main hypotheses: The Pollution Haven and the Pollution Halo. The PHH postulates that the transfer of polluting industries occurs from countries with strict environmental regulations to countries with lower environmental restrictions (e.g., De Pascale et al. 2020; Singhanian and Saini 2021; Yilanci et al. 2020). This transfer can lead developing countries to relax their environmental restrictions further to attract FDI and thus increase income. The PHIH states that FDI can reduce pollution by transferring green technologies that consume less energy (e.g., Nepal et al. 2021; Yilanci et al. 2020; Yin et al. 2021). The latter hypothesis might disclose that the environmental impact of FDI can be influenced by the impact of FDI on energy consumption.

The results of the FDI–Environment nexus are controversial, perhaps because the transfer of polluting industries has been supported only based on the polluting effect of FDI in recipient countries, without profoundly analysing what is at the origin of this effect. In fact, FDI could increase the output of countries, which could demand higher energy, as stated by Balsalobre-Lorente et al. (2019). As is known, the energy consumption of non-renewable sources can harm the environment. Therefore, this effect might stem from the increased consumption of non-renewable energy. Based on the above-mentioned information, the first hypothesis is formulated as follows:

H1: *Energy consumption mediates/influences the impact of FDI on the pollution level of the host country.*

Some literature focuses on the impact of FDI on energy consumption, also considering its sources as, for example, Caglar (2020), who analysed nine countries with the highest score on the Climate Change Performance Index. The author found mixed effects of FDI on renewable and non-renewable energy consumption in these countries. For example, FDI negatively affects renewable energy consumption in Morocco, thus contributing to environmental pollution. In contrast, in Portugal, FDI increases renewable energy consumption and has no impact on CO₂ emissions. Furthermore, Nepal et al. (2021) found that FDI reduces CO₂ emissions in India by reducing non-renewable energy consumption in the long run. In this regard, the second hypothesis has been developed:

H2: *Energy transition can reduce the pollutant effect of FDI provoked by increased energy consumption, thus softening PHH.*

With this in mind, the energy transition from fossil fuels to renewable energy might be crucial to reduce the pollutant effect of FDI and avoid the relocation of polluting industries. Indeed, renewable energy consumption may be more effective for economic growth than energy consumption from non-renewable sources (Buhari et al. 2020). Through the energy transition, countries might increase their income while preserving the environment. This is commonly known as Green Growth (e.g., Sun et al. 2021). The development of green technologies appears to be able to reduce pollution and preserve natural resources (Castellani et al. 2022).

However, developing countries are generally dependent on technologies and innovations that evolved in developed countries. The exhaustive exploitation of natural resources in developing countries is a reality that must be prevented (see, e.g., Cheng et al. 2021). Therefore, developed countries might play a relevant role in preventing this exploitation, perhaps through FDI in renewable energy. As stated by Yasmeen et al. (2021), FDI can support renewable energy projects and ensure countries' ecological energy security. Therefore, foreign investors play a vital role in improving worldwide environmental conditions.

As suggested by Stern and Valero (2021), investment in innovation ought to be accompanied by investment in infrastructure (for instance, in renewable energy infrastructure

aimed at energy transition). In fact, FDI can be an ally in accelerating the development of the renewable energy sector (Xu et al. 2021). Briefly, efforts are required to incorporate renewable energy consumption and FDI inflows (to benefit from technology know-how transfer), as announced by Qamruzzaman (2022), in both developed and developing countries. Thus, the last hypothesis is proposed as follows:

H3: *Energy transition mediates/influences the impact of FDI on Green Growth.*

This study thus fills a gap in the literature by going further into the analysis of the environmental impact of FDI, considering the potential role of energy consumption in predicting this impact in both developed and developing countries. In addition, this study analyses the role of the energy transition for countries aiming to achieve Green Growth, which should be a global goal. Furthermore, this study provides an analysis of how FDI could lead countries to achieve the goal of Green Growth more easily. Therefore, this study analyses a group of 19 developed countries and a group of 20 developing ones from 1995 to 2018. The SEM is used to analyse the mediating mediated effects. The main findings expose that the pollutant effect of FDI is mediated by energy consumption in both developed and developing countries. The energy transition plays a vital role as a moderator in reducing the mediating effect of energy consumption. FDI is a driver of Green Growth. However, developing countries ought to make larger efforts to ensure the energy transition drives Green Growth.

3. Data

This study aims to analyse the role of energy consumption and the energy transition to predict the impact of FDI on CO₂ emissions and Green Growth, respectively. A group of 19 European Union countries is under analysis, namely: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom; and a group of 20 developing countries: Argentina, Bangladesh, Brazil, Cambodia, China, Colombia, Costa Rica, Guatemala, India, Indonesia, Malaysia, Mexico, Nicaragua, Pakistan, Peru, Philippines, the Russian Federation, Sri Lanka, Thailand, and Vietnam from 1995 to 2018. The European Union countries were chosen mainly because they are under similar policy guidance, especially on climate action. The group of developing countries was selected according to the World Bank's PPI database; these countries have received investment in energy infrastructure, which is crucial to the energy transition. Table 1 gives the description and source of the variables used in this study.

The inward FDI stock measures FDI stock-in, and CO₂ emissions are used as a proxy for pollution. The energy transition is measured through the Clean Energy Transition as in Afonso et al. (2021). Green Growth could be measured through several methods (see Sun et al. 2021). According to the System for Integrated Environmental and Economic Accounting released by the United Nations Statistics Division (which laid the fundamental framework for green accounting), Green Growth must consider natural resource depletion and environmental pollution. Thus, such as in Sun et al. (2021), Green Growth is measured using the following Equation (1):

$$\text{Green GDP} = \text{GDP} - \text{resources depletion} - \text{environmental pollution costs} \quad (1)$$

All variables are converted into per capita and then into natural logarithms.

Table 1. The variable's description, sources, and descriptive statistics.

Variable	Description	Source
<i>IFDI</i>	Inward Foreign Direct Investment stock in millions at constant United States Dollar	(United Nations Conference on Trade and Development n.d.)
<i>CO₂</i>	Carbon Dioxide emissions in million tonnes	(International Energy Agency n.d.a)
<i>ET</i>	Clean Energy Transition: the ratio between renewable energy supply and fossil fuel energy supply	Renewable energy supply: (International Energy Agency n.d.b) Fossil fuel energy supply: (International Energy Agency n.d.c)
<i>EC</i>	Total energy consumption in kilotonnes of oil equivalent	(International Energy Agency n.d.d)
<i>Green Growth</i>	Gross Domestic Product (GDP) in constant 2015 United States Dollar prices; Resources depletion: mineral depletion as a share of Gross National Income; Environmental pollution costs: carbon dioxide damage as a share of Gross National Income; Gross National Income in constant 2015 United States Dollar prices	GDP: (World Development Indicators n.d.a) Resources depletion: (World Development Indicators n.d.b) Environmental Pollution costs: (World Development Indicators n.d.c) Gross National Income: (World Development Indicators n.d.d)

4. Methodology

4.1. Mediation Model

The SEM was used to analyse the indirect effect of energy consumption on the impact of FDI on CO₂ emissions (Model I), and the indirect effect of the energy transition on the impact of FDI on Green Growth (Model II). This model allowed both direct and indirect effects to be analysed (Atahau et al. 2021).

The main motivation for the Model I analysis was the PHIH, which holds that FDI might reduce pollution by reducing energy consumption (e.g., Balsalobre-Lorente et al. 2019). The rationale behind this analysis is that FDI could increase pollution by boosting consumption from non-renewable sources. Therefore, it appears relevant to analyse whether the impact of FDI on CO₂ emissions is indirectly affected by the impact of FDI on energy consumption. To reach this, energy consumption was used as a mediator variable.

Both developed and developing countries aim to attract FDI to increase economic growth. However, the literature has exposed the detrimental effects of FDI on the environment. Therefore, countries must consider the urgency of climate change by shifting the goal from purely economic growth to a goal of Green Growth (economic growth that also considers environmental depletion). Therefore, since FDI can boost the output of economies (Balsalobre-Lorente et al. 2019), support sustainable renewable sources (Yasmeen et al. 2021), and contribute to accelerating renewable energy development (Xu et al. 2021), FDI appears to have the potential to help countries achieve Green Growth more easily through the energy transition. Given that, the energy transition was used as a mediator variable in Model 2.

Figure 1 presents the general path diagram from the SEM results where the direct and indirect effects are shown.

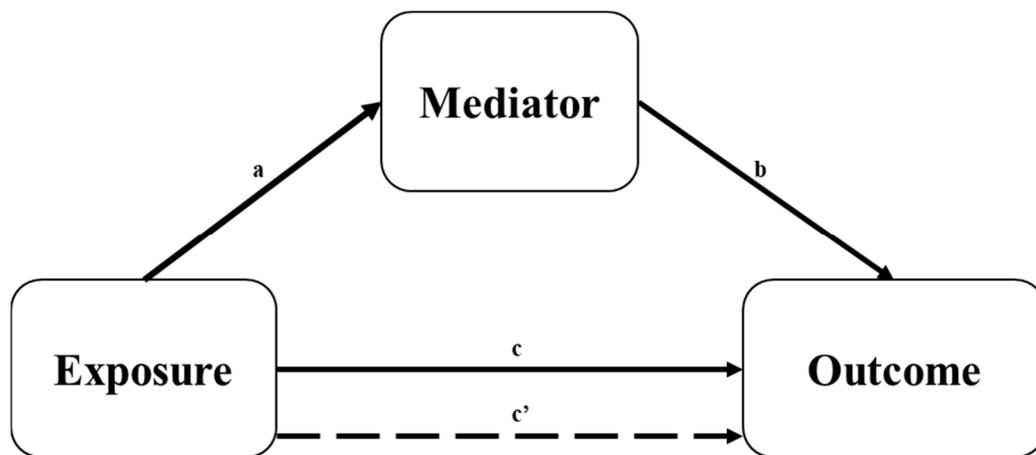


Figure 1. Path diagram of mediation test.

Six equations are derived from Figure 1. Equations (2)–(4) are from Model 1, where the exposure variable is *FDI*, the outcome variable is *CO₂* emissions, and the mediator variable is energy consumption.

$$CO_2 = i_1 + c_1 FDI + \varepsilon_1 \quad (2)$$

$$EC = i_2 + a_1 FDI + \varepsilon_2 \quad (3)$$

$$CO_2 = i_3 + c'_1 FDI + b_1 EC + \varepsilon_3 \quad (4)$$

The intercept is denoted as *i* in all equations, and the error term is ε . The overall effect of the exposure variable on the outcome variable is outlined by *c* in Equation (2). The impact of the exposure variable on the mediator variable is given in Equation (3). The direct impact of the exposure variable on the outcome variable is expressed by *c'*, and the indirect effect of the mediator variable on the outcome variable is given by *b* in Equation (4). Equations (5)–(7) are from Model 2.

$$Green\ GDP = i_4 + c_2 FDI + \varepsilon_4 \quad (5)$$

$$ET = i_5 + a_2 FDI + \varepsilon_5 \quad (6)$$

$$Green\ GDP = i_6 + c'_2 FDI + b_2 ET + \varepsilon_3 \quad (7)$$

The SEM was performed with 1000 bootstrap repetitions. Then, the Sobel test was carried out to check the robustness of the findings (Sobel 1982). To establish a mediated relationship, a few conditions are required, according to Baron and Kenny (1986): (i) The independent variable must significantly affect the mediator and the dependent variable; and (ii) the mediator ought to have a significant effect on the dependent variable.

4.2. Moderated Mediation Model

This study intends to analyse the mediating effect of energy consumption on the impact of FDI on *CO₂* emissions. The potential role of the energy transition to influence this mediating impact is under analysis as well. Thus, a moderated mediation model was conducted to examine if the mediating effect of energy consumption varies according to the value of a moderator (energy transition). Such as suggested by Hayes (2015), this analysis was based on the Moderated Mediation Index (MMI) and the Condition Indirect Effects (CIE).

5. Empirical Findings

5.1. Mediation Model Results

The presence of collinearity and multicollinearity is tested through the correlation matrix and VIF statistics, revealing that these phenomena are not a concern. The results

are not presented to preserve space but are available upon request to the authors. Table 2 shows the direct, indirect, and total effects, and the Sobel (1982) test. The latter is performed based on the Baron and Kenny (1986) approach to test for mediation using the Ratio of Indirect to Total effect.

Table 2. Direct, indirect, and total effects, and Sobel test results.

		Model I			Model II	
		Developed Countries	Developing Countries		Developed Countries	Developing Countries
Direct Effect	<i>FDI → CO₂ emissions</i>	−0.0274 ***	0.3288 ***	<i>FDI → Green Growth</i>	0.2466 ***	0.4860 ***
Indirect Effect	<i>FDI influences CO₂ emissions via energy consumption</i>	0.0265 ***	0.1471 ***	<i>FDI influences Green GDP via energy transition</i>	0.0364 ***	0.0845 ***
Total effect	<i>FDI → (energy consumption) → CO₂ emissions</i>	−0.0009 ***	0.4759 ***	<i>FDI → (energy transition) → Green Growth</i>	0.2830 ***	0.5705 ***
Sobel test		29.694	0.309		0.129	0.148

Notes: *** means statistical significance at the 1% level.

The Sobel test reveals that 2969% of the effect of FDI on CO₂ emissions is mediated by energy consumption in developed countries. In developing ones, the amount mediated is approximately 31%. Regarding Model II, the effect of FDI on Green Growth is approximately 13% mediated by energy transition in developed countries and 15% in developing countries. FDI has a statistically significant impact on CO₂ emissions via energy consumption in both developed and developing countries, which verifies *H1*. The mediating effect of the energy transition on the impact of FDI on Green Growth uncovers that energy transition can be an ally to ensure FDI drives Green Growth, thus *H3* is verified.

Focusing on Figure 2 and Model I, FDI stock-in reduces CO₂ emissions in developed countries, such as found by Demena and Afesorgbor (2019), Singhania and Saini (2021), and Yin et al. (2021), thus supporting the PHIH. Notwithstanding, it increases energy consumption. This might suggest that although FDI increases energy consumption in developed countries (which increases pollution), these countries also appear to be receiving green technologies and energy-efficient processes that can mitigate the pollutant effect of increased energy consumption, as suggested by Balsalobre-Lorente et al. (2019). The authors also state that increased FDI seems to be able to improve the manufacturing sector and the use of cleaner technologies.

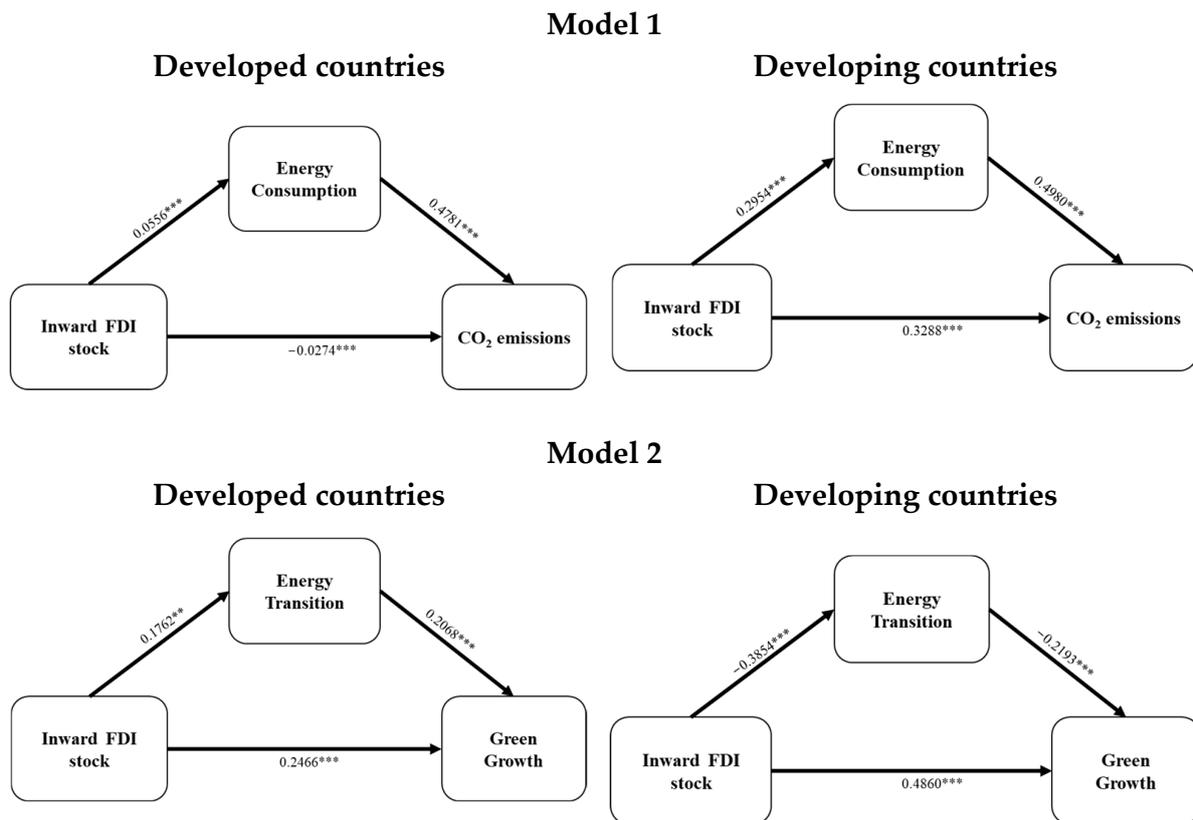


Figure 2. Path diagram of SEM. Notes: ***, and ** mean statistical significance at 1% and 5% levels. Source: Own elaboration.

Focusing on developing countries, FDI boosts pollution as found by, for example, [Singhania and Saini \(2021\)](#), [Yilanci et al. \(2020\)](#), and [Yin et al. \(2021\)](#), thus supporting the PHH and the transfer of polluting industries. However, this effect appears to be a consequence of increased energy consumption from fossil fuels. These findings seem to be consistent with [Castellani et al. \(2022\)](#), who stated that there is a prerequisite of green technology knowledge in host countries for FDI to increase environmental sustainability. Commonly, developed countries have higher levels of human capital and green technologies, while developing countries appear to be more dependent on the technologies that evolved from developed countries. As suggested by [Xu et al. \(2021\)](#), developing countries should assimilate advanced technologies (perhaps brought in by FDI) to improve energy efficiency, as this could reduce the polluting effect of FDI.

Relative to Model II, FDI stock-in appears to be a driver of the energy transition in developed countries, as found by [Xu et al. \(2021\)](#), suggesting that FDI can increase renewable energy consumption in developed countries. This may occur due to self-sufficient firms producing their energy through solar photovoltaic systems, for example. Regarding developing countries, FDI stock-in appears to be a barrier to the energy transition. FDI stock-in can increase the production level of countries, which might increase energy demand. As stated by [Balsalobre-Lorente et al. \(2019\)](#), FDI can increase the output of the economy due to a higher level of industrial production, which, in turn, can mean more energy required. To meet this demand, countries use the energy they have available. Therefore, the negative effect of FDI on energy transition in developing countries might suggest that the energy used to meet this demand is from non-renewable sources, which also explains the effect of energy transition in reducing Green Growth. This effect might also suggest a lack of renewable energy infrastructures to fill demand in developing countries. The energy transition is only effective in promoting Green Growth in developed countries. [Stern and Valero \(2021\)](#) concluded that to achieve innovation-led sustainable growth, investments in innovation

must be accompanied by investments in sustainable infrastructure (in this case, in the form of clean energy production). Therefore, investment in sustainable infrastructure appears vital to driving Green Growth in developing countries.

FDI stock-in is a driver of Green Growth in both developed and developing countries. This outcome is unexpected and deserves further discussion. FDI stock-in can increase Green Growth by increasing economic growth and/or reducing environmental depletion. As the energy transition reduces Green Growth in developing countries, it appears that FDI increases it by stimulating both economic growth and environmental depletion, perhaps by increasing overall energy consumption, which, in these countries, mostly comes from fossil fuels. Another explanation could be that by investing in renewable energy infrastructure, developing countries may no longer have the required wealth to invest in concerns such as corruption control and poverty reduction, which could shrink Green Growth. In developed countries, the impact suggests that FDI reduces environmental depletion. In developed countries, FDI appears to improve environmental conditions.

5.2. Moderated Mediation Model Results

As the impact of FDI on CO₂ emissions in both developed and developing countries is mediated by energy consumption, the moderated mediation model was used, aiming to provide evidence on the role of the energy transition on this mediating effect. Table 3 shows the moderated mediation effects based on the MMI and CIE. The latter was generated with a Standard Deviation of the proposed moderator below the mean (CIE low), at the mean (CIE mean), and above the mean (CIE high).

Table 3. Moderated mediating effects.

	Conditional Indirect Effect at Means and \pm Standard Deviation					
	Effect		Bootstrap SE		Bootstrap 95% LLCI-ULCI	
	Developed Countries	Developing Countries	Developed Countries	Developing Countries	Developed Countries	Developing Countries
MMI	−0.011 **	−0.022 **	0.005	0.010	[−0.021; −0.001]	[−0.042; −0.001]
CIE Low	0.021 ***	0.097 ***	0.008	0.019	[0.006; 0.036]	[0.058; 0.135]
CIE Mean	0.009	0.058 ***	0.008	0.023	[−0.007; 0.026]	[0.014; 0.103]
CIE High	−0.004	0.041	0.012	0.028	[−0.026; 0.021]	[−0.014; 0.096]

Notes: (1) and (2) present the results for developed and developing countries, respectively. This analysis was carried out with 1000 bootstrap replications; SE: Standard Deviation Errors; LLCI: Lower limit confidence interval; ULCI: Upper limit confidence. ***, and ** mean statistical significance at 1% and 5% levels, respectively.

Under the null hypothesis of no evidence of moderated mediating effect, the MMI confidence interval demonstrates that there is evidence of moderated mediation effects on both developed and developing countries. This index exposes the effect of the interaction between FDI and energy transition on the mediating effect of energy consumption. In both developed and developing countries, the interaction reveals a reduction of the mediating effects.

Since there is evidence of a moderated mediation effect, the CIE can be analysed. Focusing on developed countries, one observes that the mediating effect of energy consumption on the impact of FDI on CO₂ emissions, under the conditions of a low energy transition, was 0.021%. Under the condition of a high energy transition, the impact is reduced and becomes non-statistically significant.

Therefore, as the energy transition level of developed countries increases, the mediating effect of energy consumption changes from statistically significant to non-statistically significant, with the potential to reduce the mediating effect. This effect might suggest that besides investing in energy transition, developed countries should also invest in energy

efficiency. In fact, energy efficiency could reduce the pressure on the energy grid, and contribute to reducing emissions, as concluded by [Muhammad and Khan \(2019\)](#), and, as suggested by [Gaspar et al. \(2017\)](#), energy efficiency is capable of reducing emissions without reducing production. Thus, the potential negative impact of reducing energy consumption on economic growth is avoided.

Moreover, as is well known, the intermittent generation by renewable energies could ensure countries use non-renewable energy sources to meet increased energy demand. This effect might also suggest that through the energy transition, the mediating effect reduces their significance, perhaps because some policies for energy transition (e.g., ending energy from coal) may require time to implement and produce the expected result of a pollution reduction.

Focusing on developing countries, as the energy transition increases, there is a potential reduction in the mediating effect of energy consumption, and the effect changes from statistically significant to non-statistically significant. The absence of statistical significance might reveal a lack of renewable energy infrastructure or can evidence that developing countries should increase their efforts toward the energy transition. According to the International Renewable Energy Agency (IRENA), developed countries have, on average, almost twice as many policies as developing countries. This suggests that developing countries should enhance and increase their efforts toward energy transition policies. Once again, due to the lower available resources of developing countries to allocate to climate action, attracting foreign investment to the renewable energy sector is recommended.

As concluded by [Castellani et al. \(2022\)](#), FDI in renewable energy can reduce pollution. Therefore, attracting greenfield foreign investment in renewable energy might play a relevant role in avoiding the undesirable effect of FDI increasing environmental degradation. However, investment in human capital to increase knowledge in green technologies is recommended as it might accelerate the beneficial effect of FDI ([Castellani et al. 2022](#)). This is also announced by [Zafar et al. \(2020\)](#), who stated that policies aimed at increasing education budget, green energy use, and attracting FDI with green technology are required to improve environmental quality, especially in developing countries. Moreover, energy transition is only effective in reducing pollution after a certain level of electrification. Developing countries may not yet be at the required level of electrification of the economy to fully benefit from the energy transition.

From the moderated mediation model, one observes that in both developed and developing countries, policymakers need to widen the remit of their policies beyond just FDI if their objective is to avoid further environmental degradation. Policies must include strict environmental regulations and encourage both energy efficiency and energy transition to avoid the potential polluting effect of FDI and thus soft the PHH. Keeping all this in mind, energy transition appears to have the potential to reduce the mediating effect of energy consumption. Thus, H2 is verified.

It is worth noting that developing countries have several human concerns to address (besides climate change), such as poverty, corruption, and energy poverty. Indeed, corruption is one of the main concerns when it comes to investing in developing countries, whether it is the hypothesis of a Helping Hand or a Grabbing Hand. The former hypothesis is known as a hand that speeds up bureaucratic processes, and the latter hypothesis is a hand that requires indirect taxes/bribes ([Gossel 2018](#)). Therefore, developed countries play a critical role in controlling investment flows from developed to developing countries. The volume of emissions embodied in developed countries' trade is much higher in imports than in exports ([Cai et al. 2018](#)), mainly because developed countries attempt to reduce their total direct emissions (to reach climate goals) by importing goods with higher levels of embodied emissions ([Wang et al. 2019](#)). Therefore, policymakers of developed countries should impose requirements related to the level of CO₂ emissions embodied in imports from developing countries to developed countries.

In addition, policymakers of developed countries (where the firm's headquarters are located) must control the purpose of the investment, for instance, by controlling the

ecological footprint of the firm or the intensity of CO₂ emissions, and therefore assessing whether the investment is to avoid the stricter environmental regulations. Moreover, the transfer (through FDI) of cleaner technologies evolved by developed countries, including those related to renewable energy production, should be encouraged, perhaps by providing tax benefits in the source country. In this way, developed countries might assist developing countries in achieving economic growth while preserving the environment.

6. Conclusions

This study aims to fill a gap in the literature that currently considers the transfer of polluting industries solely based on the pollutant effect of FDI. The current literature assumes that increased CO₂ emissions are caused by rising energy consumption mainly from non-renewable energy sources. Thus, this study examines the mediating effect of energy consumption on the impact of FDI on CO₂ emissions. This study also intends to understand the role of energy transition in reducing the mediating effect of energy consumption on the impact of FDI on CO₂ emissions. In addition, the potential role of the energy transition to help FDI drive Green Growth is also under analysis. This study examines a group of 19 developed countries and a group of 20 developing countries and compares them. This comparison is crucial to analyse how the transfer of polluting industries affects each group. The SEM scrutinizes the mediating effects of energy consumption and energy transition on the effect of FDI on CO₂ emissions and Green Growth, respectively.

The main findings reveal that FDI reduces CO₂ emissions in developed countries (supporting the PHIH) and increases them in developing ones (supporting the PHH). However, the indirect effect reveals the impacts of FDI are influenced by energy consumption. FDI might raise the production level of countries, which might boost energy demand. The pollutant effect suggests that the energy used to meet this demand mainly comes from fossil fuels, perhaps due to the intermittency of renewable energy and the lack of renewable energy infrastructure (mainly in developing countries). Therefore, policymakers (mainly from developed countries) could adopt strategies that target energy efficiency. For example, governments can provide tax benefits to industries that invest in R&D for energy efficiency, mainly from the industry sector. In addition, governments should strengthen monetary incentives (such as scholarships) to encourage advanced education. Developing countries should also promote advanced education to improve the absorptive capacity of domestic workers on advanced techniques from multinationals and adopt them in domestic industries as well.

Energy transition plays a vital role in reducing the mediating effect of energy consumption in both developed and developing countries. However, the results for developed countries reveal that an energy transition alone may not be enough to mitigate the pollutant effect of increased energy consumption, perhaps due to the intermittency of renewables. Therefore, energy efficiency and the energy transition must go hand in hand. In developing countries, the absence of statistical significance in the CIE under the condition of high energy transition might suggest a lack of renewable energy infrastructure. Attracting investment (both domestically and abroad) in this sector is recommended. This can occur perhaps by providing tax benefits and simplifying the bureaucratic process for investment directed at the energy sector. Developing countries need this investment in renewable energy so that they can direct their available wealth towards internal concerns such as poverty reduction and corruption control.

FDI increases the energy transition in developed countries and reduces it in developing ones. Thus, developing countries appear to be using fossil-fuel energy to meet the increased energy demand provoked by FDI. Since energy transition increases Green Growth in developed countries and reduces it in developing countries, FDI appears to increase Green Growth in developed countries by reducing environmental depletion. When environmental depletion is observed in developing countries and Green Growth is limited, an explanation could be that developing countries may no longer have the wealth to invest in concerns

such as corruption control and poverty reduction because they have been investing in renewable energy infrastructure.

Developed countries' policymakers play a key role in controlling investment flows from developed to developing countries and, consequently, in climate action by developing countries. Policymakers must assess whether investment from developed countries to developing countries is made to avoid stricter environmental regulation in the country of origin (where the firm's headquarters are located), perhaps by assessing the firm's carbon footprint. It is also relevant to impose some requirements related to the level of CO₂ emissions incorporated in imports from developing to developed countries. In addition, the transfer of cleaner technologies through FDI (including those related to renewable energy production) from developed to developing countries should be encouraged, perhaps through the provision of tax benefits in the source country following this type of investment. Developed countries play a vital role in assisting developing countries in achieving Green Growth.

Policymakers should not attempt to prevent polluting FDI by only applying stricter environmental regulation, as this could inhibit all types of investment. Mainly in developing countries, attracting investment in renewable energy infrastructure and the electrification of the economy could be key to shifting the negative effect of energy transition into Green Growth. In developed countries, the energy transition and energy efficiency ought to go together as a package. Energy transition and innovation could reduce pollution in developed countries, assisting them to reach their climate targets. In the future, developed countries might no longer need to transfer polluting industries. International agreements such as the COP must implement penalties on countries that do not comply with the agreed treaty. Without severe consequences, countries will always make decisions that maximise their profits.

The relatively small number of countries under analysis is one of the limitations of this work. For future research, it could be interesting to analyse the countries in groups; for example, developing countries such as the Association of Southeast Asian Nations (ASEAN) and Brazil, Russia, India, China, and South Africa (BRICS). Moreover, the econometric procedure is quite simple because this study is developed mainly with the view of new lines of research on the FDI–Environment nexus, pointing out that energy consumption (and its sources) should always be considered when analysing the environmental impact of FDI.

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