

How foreign green finance drives ESG outcomes in the context of global value chains: new insights for Vietnam

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Thi Phuong Mai Vu

Foreign Trade University, Hanoi, Vietnam

Nhat Minh Trinh

FiinGroup Joint Stock Company, Hanoi, Vietnam

Ngoc Tien Dao

Foreign Trade University, Hanoi, Vietnam, and

Ha Doan

Economic Research Institute for ASEAN and East Asia, Central Jakarta, Indonesia

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Abstract

Purpose – This paper examines the impact of foreign green finance on environmental, social and governance (ESG) metrics in developing economies, with a focus on policy implications for Vietnam in the context of deepening integration in global value chains (GVCs).

Design/methodology/approach – The study employs a balanced panel dataset covering 85 developing countries over the period 2010–2022. To address common panel data issues such as heteroskedasticity, autocorrelation, cross-sectional dependence and endogeneity, the analysis applies Feasible Generalized Least Squares (FGLS), Panel-Corrected Standard Errors (PCSE) and the System Generalized Method of Moments (GMM).

Findings – The findings reveal that while carbon-intensive infrastructure development from foreign green finance often leads to increased CO₂ emissions, trade openness facilitates access to cleaner technologies and stricter environmental standards. Foreign green finance contributes to social sustainability by creating jobs, enhancing skills and improving social infrastructure, complemented by trade openness that fosters access to global resources and markets. However, equitable human development requires inclusive policies, as rapid economic growth alone is insufficient. Additionally, foreign green finance promotes governance by encouraging transparency and regulatory reforms, while trade openness drives institutional improvements. Nonetheless, economic instability, such as high inflation or erratic growth, poses risks to governance quality.

Originality/value – This study fills a key gap in the literature by moving beyond aggregate green finance measures to isolate the role of foreign green finance in emerging economies. The paper further shows how trade openness and macroeconomic stability condition these effects, offering policy-interpretable evidence to support sustainable development in Vietnam.

Keywords Foreign green finance, ESG, FDI, GVC, Emerging economies, Vietnam

Paper type Research article

1. Introduction

The global urgency to address environmental degradation, social inequities and institutional weaknesses has catalyzed a shift toward sustainable development, emphasizing responsible investment in projects that deliver long-term environmental, social and governance (ESG) benefits. This transition increasingly intersects with the architecture of global value chains (GVCs), where multinational firms diffuse standards, technologies and compliance

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requirements across borders. In this context, green finance has emerged as a critical mechanism supporting the Sustainable Development Goals (SDGs). By channeling capital toward environmentally and socially responsible activities, green finance enables investors to address ecological challenges while achieving financial returns. This dual role strengthens global efforts to mitigate climate change, enhance social welfare and improve governance quality by embedding ESG principles directly into investment and production networks operating across GVCs (Shafique and Majeed, 2020).

In developing countries, the significance of green finance is amplified by the ESG pressures that accompany rapid industrialization, urbanization and integration into GVCs. Firms in emerging economies often operate as suppliers within these chains, facing stringent sustainability requirements from lead firms and international buyers. Yet these countries generally lack the domestic financial and technological base needed to meet such standards independently. Foreign green finance helps bridge this gap by mobilizing external capital, technology and expertise to support sustainable upgrading. This dependency underscores the need for coherent policy frameworks that facilitate foreign green finance through regulatory incentives, credible governance institutions and transparent disclosure systems capable of aligning local practices with the sustainability expectations embedded in GVCs (Li *et al.*, 2023).

Vietnam, one of Southeast Asia's fastest-growing economies, demonstrates the vital role of green finance in advancing sustainable development in emerging markets. Rapid industrialization and population growth have intensified ESG challenges, including pollution, resource scarcity and inadequate social infrastructure. In response, the Vietnamese government has actively promoted green finance, with initiatives such as the State Bank of Vietnam (SBV) green banking programs and plans to integrate ESG risk assessments into lending practices by 2025. However, domestic resources alone are insufficient to achieve Vietnam's ambitious sustainability goals. By combining external capital with technical expertise, Vietnam has accelerated its transition to a low-carbon economy, improved ESG metrics and aligned with global sustainability standards.

Building on this context, this study examines how foreign green finance shapes ESG outcomes in developing countries, especially as Vietnam deepens its integration into GVCs. The research aims to address a clear gap in literature, where many studies use broad green finance measures, give limited attention to causal identification and rarely isolate the role of foreign inflows in emerging economies. Our primary contribution is to construct a sector-informed measure of foreign green finance and deliver credible estimates of its separate ESG effects using panel methods that address unobserved heterogeneity, cross-sectional dependence and endogeneity. We also assess how trade openness and macroeconomic stability condition these effects and report magnitudes that are directly interpretable for policy. In doing so, the study provides context-sensitive evidence that can align foreign investment with SDGs, strengthen economic resilience and support diversification in Vietnam.

The paper is structured as follows. [Section 2](#) reviews the literature on international green finance and ESG sustainability. The theoretical foundation and the hypotheses are developed in [Section 3](#). [Section 4](#) outlines the methodology, data and variables. [Section 5](#) reports empirical results, including robustness checks and heterogeneity analyses. [Section 6](#) discusses the findings and implications for Vietnam. The study is concluded in [Section 7](#).

2. Literature review

2.1 Overview of green finance

Green finance refers to investments that promote environmental sustainability alongside economic returns (Lindenberg, 2014; Ozili, 2020). It includes public and private funding for activities that reduce environmental harm and support conservation, such as renewable energy, energy efficiency and biodiversity protection. Lindenberg (2014) emphasizes investment in environmental goods and services, while Ozili (2020) highlights the dual objectives of sustainability and profitability. This study focuses on foreign green finance (FGF), a key

component of sustainable development financing that channels international resources into ESG-aligned projects in emerging economies. FGF mobilizes global investments to reduce emissions, mitigate environmental degradation and foster sustainable growth, aligning with the Paris Agreement's call for climate-resilient financial flows. It enables wealthier nations to support green initiatives in developing countries, promoting resilience and shared progress. Consensus holds that green finance channels capital toward ESG-aligned projects, but the literature diverges on how to classify and quantify "foreign green" flows across countries. Prior work alternately proxies green finance with bonds, bank credit, or broad financial development, complicating cross-study comparisons.

2.2 Foreign green finance and environmental sustainability

A substantial body of work documents the environmental benefits of green finance. [Wang and Zhi \(2016\)](#) show that green funding mechanisms can reduce pollution and resource use, while evidence from developing economies suggests improved air quality and lower emissions when supportive policy frameworks are present. [Nasreen et al. \(2016\)](#) identify financial efficiency as a key channel through which financial development lowers carbon emissions. Green bonds further enable large-scale emissions reductions and accelerate clean-energy transitions ([Glomsrød and Wei, 2018](#)).

Despite these gains, concerns remain about the credibility and consistency of environmental impacts. [Flammer \(2020\)](#) highlights the risk of greenwashing, where environmental benefits are overstated, distorting project evaluation and weakening investor confidence. Cross-country regulatory inconsistencies also complicate assessments, and [He et al. \(2019\)](#) note that green finance can unintentionally restrict lending to other energy-efficient projects. The empirical evidence therefore points to conditional environmental benefits: FGF reduces emissions when credible taxonomies, strong institutions and technology diffusion are present but may have weaker or even adverse effects where regulatory capacity is limited. These conditions motivate the need for interaction tests and econometric strategies capable of identifying FGF's net environmental impact.

2.3 Foreign green finance and social sustainability

FGF also contributes to social sustainability, particularly in regions with limited domestic resources. [Ali et al. \(2023\)](#) show that foreign green investment in renewable energy sectors generates employment, reduces poverty and promotes inclusive growth. Beyond infrastructure, FGF can strengthen community engagement and enhance the "social license to operate" ([Lee and Hussain, 2023](#)). Green banking initiatives such as online services and green loans reinforce community responsibility, while China's green loan disclosure rules illustrate the role of transparency in strengthening social accountability.

However, the social effects of FGF are uneven. [Srouji et al. \(2023\)](#) caution that reliance on foreign capital may constrain domestic policy autonomy, and [Wilkinson and Pickett \(2018\)](#) argue that poorly designed projects risk reinforcing existing inequalities by favoring wealthier communities over marginalized groups. The literature therefore indicates that while FGF has the potential to enhance social inclusion and expand access to essential services, weak project screening and inadequate safeguards can deepen regional disparities. Empirical evidence remains fragmented, with limited work linking FGF to broader social outcomes using consistent metrics and rigorous identification strategies.

2.4 Foreign green finance and governance sustainability

FGF can influence governance sustainability by encouraging stronger regulations and institutional reforms. [Campiglio et al. \(2018\)](#) find that green capital inflows are associated with stricter environmental standards and improved reporting practices, while [Buchner et al. \(2013\)](#) show that international climate finance has supported the creation of new regulatory bodies in

developing countries. At the same time, concerns persist regarding dependency and policy capture. [Shishlov et al. \(2016\)](#) argue that overreliance on foreign finance may shift policy priorities toward investor interests, and [Berensmann and Lindenberg \(2016\)](#) warn that weak governance environments allow investors to exploit regulatory gaps. [Delmas and Burbano \(2011\)](#) further show how FGF can facilitate misleading sustainability claims, undermining public trust.

These divergent findings reflect the tension between a disciplining-standards view and a dependency or policy-capture view. Cross-country evidence suggests that both dynamics may operate simultaneously. Yet most studies do not adequately address simultaneity: stronger institutions both attract FGF and may be reshaped by it, making causal inference challenging. Differences across income groups further heighten heterogeneity. These limitations highlight the need for dynamic panel approaches and credible instruments that can separate institutional persistence from the causal effects of FGF on governance quality.

2.5 Research gap

Overall, the literature shows that FGF contributes to ESG sustainability, but important analytical gaps remain, particularly for emerging economies such as Vietnam. Existing studies ([Wang et al., 2022](#); [Xu et al., 2022](#)) highlight green finance's role in structural transformation but rely on broad quantitative methods that overlook causal mechanisms and local context. Governance-oriented work ([Campiglio et al., 2018](#); [Buchner et al., 2013](#)) often ignores econometric issues like endogeneity and autocorrelation, weakening inference. Research on adverse effects ([Shishlov et al., 2016](#); [Berensmann and Lindenberg, 2016](#)) depends on narrow case studies with limited generalizability. Large-scale econometric studies ([Nasreen et al., 2016](#)) reveal broad patterns but neglect sectoral heterogeneity and the role of foreign investment, leading to attribution risks. This paper seeks to fill these gaps.

3. Theoretical background

3.1 Green Solow model

The Green Solow model ([Brock and Taylor, 2010](#)) extends the neoclassical Solow framework by incorporating environmental dynamics and emphasizing technological progress in pollution abatement. Sustainable growth becomes feasible when investments in technologies such as renewable energy and energy-efficient infrastructure reduce pollution intensity. In developing countries, FGF supports this process by funding cleaner technologies and accelerating the transition toward lower pollution levels. The model is consistent with the Environmental Kuznets Curve ([Grossman and Krueger, 1991](#)), which posits that environmental degradation rises in early stages of development but declines once technological and policy improvements take hold. FGF enables developing economies to reach this turning point earlier by financing sustainable projects and strengthening environmental performance. Based on this framework and the literature, the hypothesis for FGF and environmental sustainability is

- H1.* Higher FGF is associated with improved environmental sustainability in emerging economies.

3.2 Social investment theory

Social investment theory emphasizes directing financial resources toward initiatives that improve human well-being, equity and community resilience ([Hemerijck, 2018](#)). In the realm of FGF, this includes projects that yield both environmental and social benefits, such as clean energy access, sustainable agriculture, and improved water and sanitation. These efforts advance the social dimension of ESG by enhancing public health, reducing poverty and empowering marginalized groups ([Desaegn and Tangl, 2022](#)). Incorporating social impact

assessments into green finance ensures alignment with broader development goals and fosters inclusive growth. Nonetheless, issues like poor transparency, weak accountability and regulatory inefficiencies can undermine effectiveness, especially in low-capacity governance settings. Based on the proposed theory and literature review, the hypothesis for FGF and social sustainability is

H2. Higher FGF promotes social sustainability in developing countries.

3.3 Institutional theory

Institutional theory adds that formal and informal institutions (i.e. rules, norms and governance structures) are crucial in shaping FGF outcomes (Schout and North, 1991). Strong institutions enable strategic deployment, monitoring and evaluation of green funds, ensuring policy coherence and participatory governance. This reinforces the ESG governance pillar. Conversely, fragile institutions marked by corruption or inefficiency can misdirect funds or render them ineffective (Pahl-Wostl, 2009). Therefore, green finance should also support institutional capacity-building to enhance transparency and resource management in recipient countries. Based on the proposed theory and literature review, the hypothesis for FGF and governance sustainability is

H3. Higher FGF is associated with improved governance sustainability in developing nations.

3.4 Mediating effect of trade openness and institutional quality

Trade openness intensifies the ESG payoff of FGF through well-established technique and composition effects: open economies import cleaner capital and reallocate activity toward relatively less-polluting sectors, so each unit of FGF purchases more abatement and better practices (Antweiler et al., 2001). Openness is also a conduit for knowledge spillovers: import-embodied foreign R&D raises domestic productivity and facilitates adoption of cleaner processes, amplifying the FGF-ESG transmission (Coe and Helpman, 1995). In addition, liberalization and exposure to export markets trigger technology upgrading, strengthening the pathway from FGF to green innovation and governance improvements (Bustos, 2011). Meanwhile, institutional quality conditions both the absorption of green technologies and the enforcement of ESG commitments. Strong institutions, secure property rights, contract enforcement and regulatory quality, raise the returns to investment and learning and are first-order determinants of development outcomes relative to geography or trade. Based on the proposed theory and literature review, we propose two hypotheses for trade openness and institutional quality

H4. Trade openness strengthens the beneficial effects of FGF on ESG by intensifying environmental improvements and magnifying governance gains.

H5. Institutional quality strengthens the effects of FGF on ESG by amplifying technology absorption and ensuring effective governance.

4. Methodology

4.1 Model specification

Based on the results developed by Alshubiri (2024) and the above literature, this research proposes the following model to measure the impact of FGF on ESG metrics:

$$f(ESG)_{i,t} = \beta_0 + \beta_1 \ln FGF_{i,t} + \beta_2 \ln TO_{i,t} + \beta_3 INF_{i,t} + \beta_4 GDPG_{i,t} + \varepsilon_{i,t} \quad (\text{Eq.1})$$

where $f(ESG)$ is denoted as the three functions of environmental sustainability (1), social sustainability (2) and governance sustainability (3). $\ln FGF$, $\ln TO$, $\ln INF$ and $\ln GDPG$ are natural logarithms of the value of announced greenfield FDI projects multiples by green ratio, natural logarithm of trade openness, inflation and GDP growth rate, respectively. i signifies a particular country, while t denotes a specific year and ε_{it} represents the error term.

4.1.1 Measurement of ESG. Three indicators are used to assess ESG performance. For environmental sustainability, CO₂ emissions from fuel combustion are a widely accepted proxy, reflecting energy use and industrial activity, key contributors to climate change. Higher CO₂ emissions are linked to greater challenges in achieving sustainable development (Liu *et al.*, 2021). Social sustainability is measured by the Human Development Index (HDI), which captures life expectancy, education and income. Enhancing HDI fosters sustainable outcomes by improving education and healthcare, thereby promoting environmental awareness (Anand and Sen, 1994). Governance is evaluated through government quality (GQ), which reflects the quality of public services, policy formulation and implementation capacity. Strong governance is essential for attracting a green flow of greenfield FDI and enforcing environmental policies that support sustainable development (Kaufmann *et al.*, 2009).

4.1.2 Measurement of foreign green finance. To quantify foreign green finance across countries and over time, this study adopts the bottom-up greenness assessment framework developed by the International Finance Corporation (IFC, 2017). Under this approach, each sector is assigned a “green proportion,” representing the estimated share of its activities that positively contribute to environmental sustainability. These proportions, drawn from empirical benchmarks such as climate bond standards, sustainable finance taxonomies and lifecycle emissions research, are then applied to actual inflows of foreign capital. By multiplying the green proportion by the amount of investment directed to each sector, the framework identifies the environmentally sustainable component of total foreign investment. In this study, clean energy sectors such as solar, wind and hydropower are treated as 100% green, while oil, gas, coal and petrochemical industries are assigned 0%. Sectors with mixed environmental characteristics receive partial proportions, including 17% for real estate, 13% for agriculture, forestry, and food and beverages, and 10% for infrastructure and transport.

4.1.3 Control variables. The control variables include trade openness (TO), measured as the sum of exports and imports of goods (% of GDP); inflation (INF), represented by the annual percentage change in the consumer price index; and GDP growth rate (GDPG), calculated as the annual growth rate of GDP at market prices based on constant local currency (%). Trade openness enhances economic resilience and supports sustainable growth by facilitating foreign exchange and investment flows (Frankel and Romer, 2017). Inflation stability is essential for preserving purchasing power and economic stability, which are foundational to sustainable development (Fischer, 1993). GDP growth rate serves as a key indicator of economic progress and its influence on industrial and environmental advancements (Barro, 1991).

4.2 Data and sample

The research paper examines the effect of FGF on ESG sustainability in developing countries. The study population included 85 developing countries for the period 2010–2022. This is a balanced panel dataset with a total of 1105 observations. Secondary data (Table 1) is collected from UNSTATS, UNCTAD and the World Bank.

4.3 Estimation methods

This study employs three complementary estimators to address unobserved heterogeneity, autocorrelation and endogeneity. FGLS mitigates heteroscedasticity and serial correlation by transforming the data according to estimated variance structures (Baltagi, 2021), while PCSE adjusts for heteroscedasticity, autocorrelation and cross-sectional dependence, improving

Table 1. Definitions and expected signs of variables

Variable	Symbol	Definition	Data source	Expected sign	Literature
Environmental sustainability	lnCO2	Natural logarithm of CO2 emission from fuel combustion	UNSTATS		Liu et al. (2021)
Social sustainability	HDI	Human development index	UNSTATS		Anand and Sen (1994)
Governance sustainability	GQ	Government Quality	World Bank		Kaufmann et al. (2009)
Foreign green finance	lnFGF	Natural logarithm of announced greenfield FDI projects value multiples by green ratio	UNCTAD	+/-	IFC (2017)
Trade openness	lnTO	Natural logarithm of export - import	World Bank	+	Frankel and Romer (2017)
Inflation rate	INF	Calculated by CPI	World Bank	+	Fischer (1993)
GDP growth rate	GDPG	GDP growth rate annually	World Bank	+	Barro (1991)

Source(s): Compiled and proposed by the authors

efficiency in large panels ([Baum, 2006](#)). Both are static-level estimators that exploit between- and within-country variation and thus capture medium- to long-run relationships shaped by persistent cross-country differences. In contrast, the two-step System GMM estimator controls endogeneity, particularly with lagged dependent variables, by relying on internal instruments and first-differencing, which removes fixed effects and past outcomes ([Arellano and Bover, 1995](#)).

We also explicitly address reverse causality: countries with stronger pre-existing ESG (better governance, higher HDI, lower emissions intensity) are more likely to attract FGF, risking upward bias in FGF and ESG estimates (and downward bias for FGF and environmental sustainability). Durbin–Wu–Hausman tests reject exogeneity ($p = 0.000$), motivating System GMM. Technically, System GMM (i) differences the model to remove time-invariant heterogeneity, (ii) includes a lagged dependent variable to handle state dependence and (iii) instrument endogenous regressors using lagged levels for the differenced equation and lagged differences for the levels equation. We treat FGF as endogenous, classify other regressors as predetermined as appropriate, report AR(2) and Hansen/Sargan diagnostics, and curb instrument proliferation. This design directly mitigates simultaneity, selection on unobservables and common-shock bias that can contaminate static-level estimates.

5. Results

5.1 Benchmark regression results

The PCSE regression results in [Table 2](#) offer key insights into the relationship between FGF and ESG sustainability. In model (1), *lnFGF* shows a strong positive correlation with CO₂ emissions, while *lnTO* is negatively associated, indicating that trade openness helps reduce emissions, both significant at the 1% level. In model (2), all variables except *INF* are significant. *lnFGF* and *lnTO* positively influence *HDI*, whereas *GDPG* has a modest negative effect, suggesting that rapid growth may slightly hinder human development in the short term. Model (3) reveals that *lnFGF* and *lnTO* significantly enhance government quality, while *INF* and *GDPG* exert negative impacts, implying that inflation and growth volatility undermine governance alongside the effects of FGF.

Regarding GMM estimation results, the lagged dependent variable *lnCO2* in model (1) is statistically significant, indicating strong persistence in CO₂ emissions over time. Both *lnFGF*

Table 2. FGLS, PCSE and GMM estimation results^a

Variables	FGLS			PCSE		
	(1) lnCO2	(2) HDI	(3) GQ	(1) lnCO2	(2) HDI	(3) GQ
lnFGF	0.028*** [4.98]	0.000 [1.57]	0.009*** [2.95]	0.613*** [9.88]	0.019*** [7.99]	0.111*** [8.72]
lnTO	−0.194*** [−5.22]	0.012*** [4.46]	0.194*** [7.30]	−0.351*** [−6.39]	0.094*** [14.27]	0.487*** [16.07]
INF	0.000 [0.57]	−0.000 [−1.58]	−0.001** [−2.41]	0.001 [0.53]	−0.000 [−0.46]	−0.003*** [−2.98]
GDPG	0.005*** [3.49]	0.000 [0.33]	−0.001 [−1.26]	−0.016 [−1.52]	−0.002** [−2.48]	−0.001** [−2.45]
GMM		(1) lnCO2	(2) HDI	(3) GQ		
L.lnCO2		0.616*** [9.60]				
L.HDI			0.959*** [106.05]			
L.GQ						1.243*** [14.78]
lnFGF		0.091*** [2.94]	0.002*** [4.87]			0.056** [2.10]
lnTO		−0.250*** [−2.87]	0.005*** [4.56]			−0.087** [−2.48]
INF		−0.000 [−0.69]	−0.000 [−0.09]			0.000 [1.31]
GDPG		0.016** [2.03]	0.000*** [3.25]			−0.002 [−0.72]
cons		1.593*** [2.98]	−0.005 [−0.79]			0.065 [0.33]
N		1,020	1,020			1,020
Arellano–bond test for AR(1)		0.000	0.000			0.000
Arellano–bond test for AR(2)		0.534	0.076			0.309
Sargan test		0.035	0.088			0.766
Hansen test		0.100	0.229			0.766
Note(s): <i>t</i> -statistics in brackets; * <i>p</i> < 0.1, ** <i>p</i> < 0.05, *** <i>p</i> < 0.01, ^a For the descriptive statistics and correlation matrix, see Table A1 and Table A2 in Appendix A						
Source(s): Authors' calculations						

and *lnTO* are significant, showing that fossil fuel usage increases emissions, while trade openness reduces them. *GDPG* has a positive but smaller effect. In model (2), *L.HDI* shows significant persistence, with both *lnFGF* and *lnTO* positively influencing HDI, emphasizing the role of energy consumption and trade in human development. Model (3) shows significant autoregressive effects for *L.GQ*. *lnFGF* and *lnTO* significantly affects governance quality, with mixed results from energy use and trade. *INF* and *GDPG* lack significance in this model, suggesting limited impact on governance in the short term. Diagnostic tests support the model's validity, with Arellano-Bond tests confirming no second-order autocorrelation and Sargan and Hansen tests validating the instrument set.

5.2 Robustness checks

5.2.1 Alternative measurements of ESG sustainability. To test the robustness [1] of the results, alternative ESG sustainability indicators are used in [Table 3](#). For environmental sustainability,

Table 3. FGLS, PCSE and GMM estimation results for alternative measures of ESG metrics

Variables	FGLS			PCSE		
	(1) CO2GDP	(2) SERVICE	(3) PS	(1) CO2GDP	(2) SERVICE	(3) PS
lnFGF	−0.000 [−0.40]	0.052 [1.31]	0.00660* [1.70]	0.015*** [5.89]	0.282*** [4.12]	0.005 [0.67]
lnTO	0.010*** [3.58]	0.134 [0.38]	0.214*** [5.59]	0.083*** [13.57]	0.131 [0.53]	0.749*** [15.31]
INF	0.000 [0.42]	−0.004 [−0.70]	−0.000** [−2.13]	0.000* [1.88]	−0.005 [−0.50]	−0.002** [−2.07]
GDPG	−0.000 [−0.96]	0.000 [0.04]	−0.002* [−1.83]	−0.001* [−1.76]	0.0447 [1.51]	−0.007 [−1.26]
GMM	(1) CO2GDP		(2) SERVICE		(3) PS	
L.CO2GDP	1.811*** [3.46]					
L.SERVICE			0.845*** [6.04]			
L.PS					0.925*** [12.69]	
lnFGF	0.021** [2.23]		0.611*** [3.90]		−0.159*** [−4.18]	
lnTO	−0.048 [−1.10]		0.021 [0.09]		0.030 [0.51]	
INF	−0.000 [−0.75]		0.005** [2.32]		−0.002*** [−3.81]	
GDPG	−0.000 [−0.19]		−0.002 [−0.19]		−0.019*** [−5.54]	
N	1,020		1,020		1,020	
Arellano-bond test for AR(1)	0.001		0.000		0.000	
Arellano-bond test for AR(2)	0.996		0.947		0.977	
Sargan test	0.447		0.686		0.874	
Hansen test	0.734		0.696		0.488	

Note(s): *t*-statistics in brackets; **p* < 0.1, ***p* < 0.05, ****p* < 0.01

Source(s): Authors' calculations

carbon dioxide emissions per unit of GDP (*CO2GDP*), measured in kilograms per constant 2017 U.S. dollars using purchasing power parity, offer a refined view of the link between economic activity and emissions intensity (Grossman and Krueger, 1991). For social sustainability, the share of government spending on essential services (*SERVICE*), including education, health and social protection, serves as a proxy for commitment to social welfare, supporting equity and human capital development. For governance, political stability (*PS*) reflects the resilience of a country's political environment, which critically shapes its ability to implement and sustain green finance policies (Kaufmann et al., 2009).

The relationship between *SERVICE* and *CO2GDP* is significant in the PCSE model, indicating that increased investment in sectors like education and health can help mitigate environmental impacts of economic growth (coefficient = 0.282). However, the FGLS estimation shows weaker results, with government spending having a limited effect on *CO2GDP*. GMM results emphasize long-term dynamics, with lagged values of *CO2GDP* and *SERVICE* significantly influencing future outcomes, highlighting the persistence of sustainability indicators. The negative relationship between *INF* and *PS* suggests that rising prices destabilize political environments, supporting macroeconomic impacts on governance.

5.2.2 The moderating effects of trade openness and institutional quality. Trade openness influences how FGF translates into ESG gains by strengthening external discipline and accelerating technology diffusion. In more open economies, FGF-funded projects are more likely to comply with international disclosure norms, procurement standards and environmental safeguards required by global buyers and financiers, which enhances environmental performance and governance quality. Openness also supports social outcomes through skill upgrading and improved workplace practices. To test this mechanism, we estimate [H4](#) by interacting FGF with trade openness and present the moderation results in [Table 4](#).

Institutional quality likewise plays a central role in determining the effectiveness of FGF. We evaluate [H5](#) by incorporating institutional-quality indicators into the extended model. Following the World Governance Indicators of the World Bank, institutional quality is assessed across six dimensions: voice and accountability (VA), political stability and absence of violence (PV), government effectiveness (GE), regulatory quality (RQ), rule of law (RL) and control of corruption (CC). The corresponding estimates are also reported in [Table 4](#).

The moderating role of trade openness is statistically significant. The interaction between FGF and trade openness is negative and significant at the 1% level in the CO₂ regressions, implying that openness strengthens the emissions-reducing effect of FGF, in line with [H4](#). By contrast, this interaction term attenuates the social gains from FGF: the marginal effect of FGF on social sustainability declines with greater openness. A plausible mechanism is that export-competition and buyer compliance regimes prioritize environmental performance over social upgrading in the short run; simultaneously, compositional shifts toward capital- or resource-intensive segments and thin domestic value capture can suppress wage growth, formalization and worker protections unless flanked by active labor and skills policies. Regrading institutional quality, the analytical results clearly demonstrate that under the auspices of *GE*, *CC*, *RQ* and *RL*, *FGF* emerges as a pivotal element in fostering the growth of environmental and social sustainability. This empirical evidence confirms that specific attributes of institutional frameworks play a vital role in mitigating the nexus between FGF and ESG metrics.

6. Discussion

6.1 Results discussion

The connection between foreign green funding and CO₂ emissions in developing nations reveals a positive relationship, indicating that a 1% increase in foreign greenfield FDI inflows is associated with up to a 0.613% increase in CO₂ emissions at a 1% level of significance. This can be explained by the early stages of greenfield investment, which often require significant construction, industrial and logistical resources, leading to higher emissions initially despite the long-term environmental goals of green finance. This aligns with the Green Solow model and EKC hypothesis, where developing countries at the early stages of foreign green investment may experience emissions-intensive activities due to infrastructure and manufacturing expansion. In contrast, the negative correlation between trade openness and CO₂ emissions supports the view that trade liberalization facilitates access to cleaner technologies and international environmental standards. The “technique effect” ([Antweiler et al., 2001](#)) suggests that trade encourages the adoption of energy-efficient technologies, which may reduce emissions despite increased industrial activity. Additionally, trade openness often pressures countries to adhere to stricter environmental norms, particularly when exporting to environmentally conscious markets, promoting cleaner industrial practices.

The relationship between foreign green financing and HDI shows a strong positive correlation, suggesting that a 1% increase in the green flow of greenfield FDI typically leads to about 0.0192-point improvements in HDI at a 1% level of significance. Greenfield investments benefit host nations’ social infrastructure by creating jobs, enhancing skill development and providing access to advanced technologies. Foreign companies also foster

Table 4. Analysis of moderating effects of trade openness and institutional quality on the link between FGF and ESG metrics

Variables	(1) VA	(2) PV	(3) GE	(4) RQ	(5) RL	(6) CC
<i>Environmental sustainability (lnCO2)</i>						
lnFGF	1.631*** [10.52]	1.499*** [9.42]	1.495*** [10.89]	1.630*** [12.00]	1.525*** [11.47]	1.533*** [10.72]
FGFxTO	−0.243*** [−8.57]	−0.211*** [−5.79]	−0.337*** [−11.48]	−0.330*** [−12.14]	−0.308*** [−11.36]	−0.294*** [−10.00]
InstQ	−0.011* [−1.68]	−0.007 [−1.16]	−0.059*** [−7.97]	−0.058*** [−9.26]	−0.060*** [−8.20]	−0.057*** [−7.66]
FGFxInstQ	0.000 [0.11]	−0.000 [−0.14]	0.011*** [11.70]	0.009*** [10.11]	0.010*** [9.74]	0.009*** [8.56]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
<i>Social sustainability (HDI)</i>						
lnFGF	0.065*** [6.45]	0.079*** [7.70]	0.057*** [6.20]	0.059*** [7.11]	0.066*** [6.56]	0.071*** [6.46]
FGFxTO	−0.010*** [−5.05]	−0.015*** [−6.54]	−0.014*** [−6.28]	−0.014*** [−7.06]	−0.016*** [−6.61]	−0.017*** [−6.45]
InstQ	0.002*** [3.68]	0.001*** [2.67]	0.002*** [6.36]	0.001* [1.67]	0.001 [1.53]	−0.000 [−0.72]
FGFxInstQ	−0.000 [−1.63]	0.000* [1.78]	0.000*** [4.71]	0.000*** [4.40]	0.000*** [4.98]	0.000*** [5.71]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
<i>Governmental sustainability (GQ)</i>						
lnFGF	0.064 [1.38]	0.092** [2.25]	0.011 [1.08]	−0.001 [−0.03]	0.084*** [2.93]	0.116*** [4.11]
FGFxTO	0.029** [2.22]	0.014 [1.16]	−0.003 [−1.24]	0.015 [1.62]	−0.010 [−1.40]	−0.013** [−2.13]
InstQ	0.029*** [11.49]	0.024*** [11.17]	0.030*** [77.50]	0.028*** [18.91]	0.026*** [23.97]	0.024*** [17.90]
FGFxInstQ	−0.002*** [−6.22]	−0.001*** [−3.80]	−0.000 [−0.42]	−0.000** [−2.07]	−0.000 [−0.40]	−0.000 [−0.63]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	1,105	1,105	1,105	1,105	1,105	1,105

Note(s): *t*-statistics in brackets; **p* < 0.1, ***p* < 0.05, ****p* < 0.01; Control variables include trade openness, inflation rate and GDP growth rate

Source(s): Authors' calculations

local job creation and economic growth through supply chain links, knowledge transfer and increased competitiveness. Trade openness further supports HDI by enabling access to global markets, promoting economic growth and alleviating poverty through a broader range of goods, services and employment opportunities (Dollar and Kraay, 2003). It also helps import advanced medical and educational resources, improving human development standards. However, the modest negative correlation between GDP growth and HDI suggests a complex dynamic, where rapid economic growth does not always translate into immediate HDI gains. This “growth without development” phenomenon can exacerbate income inequality and strain social services, particularly in emerging economies where urbanization and industrialization outpace the government’s capacity to provide adequate public services such as healthcare and education (Aghion *et al.*, 1999).

In the governance model, foreign green financing is positively associated with government quality, where a 1% increase in FGF can lead to a 0.111-point surge for the governance quality indicator, suggesting that the green flow of FDI can enhance governance frameworks in developing countries. This aligns with the idea that foreign investments bring capital along

with international standards of corporate governance, transparency and accountability. [Busse and Gröning \(2011\)](#) argue that FGF strengthens institutions by promoting higher governance standards, as international investors demand regulatory improvements to protect their investments. Additionally, foreign investors in greenfield projects may engage in corporate social responsibility initiatives, fostering a culture of accountability and strengthening local governance. Trade openness also positively influences governance quality, supporting the view that global economic integration encourages better governance. However, inflation and GDP growth volatility negatively affect governance quality, as economic instability creates uncertainty, depletes government resources and shifts focus from long-term regulatory improvements to crisis management ([Acemoglu et al., 2003](#)).

6.2 Implication for Vietnam

For Vietnam, the evidence points to a balanced but demanding agenda. FGF tends to raise human development and strengthen governance, while trade openness helps lower emissions through access to cleaner technology. At the same time, large greenfield projects can lift emissions in the near term as construction and logistics ramp up. An effective strategy therefore directs incoming capital toward low-carbon activities under clear rules, deepens institutional capacity to screen and monitor projects and builds domestic capability to absorb advanced technologies.

For the empirical analysis, Vietnam-specific moderators can be introduced to identify where FGF delivers the largest ESG gains. An SBV green credit ratio, defined as the share of lending tagged as green, can be interacted with FGF to test whether stronger domestic intermediation reduces the emissions response and magnifies human development and governance effects. An ESG risk assessment adoption indicator for supervised institutions captures the governance transmission from prudential guidance into firm behavior. The renewable capacity share in the national power mix approximates the energy structure that conditions the environmental impact of new investment. A provincial index of environmental enforcement intensity, based on inspections, sanctions and compliance rates, reveals whether stricter enforcement bends the emissions curve. A measure of trade openness with green standards, such as the export share to partners enforcing environmental provisions and due diligence, tests for a technique effect that improves environmental performance as FGF rises.

On policy design, classification and disclosure provide the foundation. Developing and implementing a national Vietnam Green Taxonomy for sustainable activity classification anchors market practice and supervision. The State Bank of Vietnam can mandate ESG risk assessment and climate-related disclosure for supervised institutions on a phased timeline, integrate these frameworks into supervisory reviews and set portfolio-level targets for green credit. Access to finance expands through a green credit guarantee facility for small and medium enterprises financing energy efficiency, clean production and circular economy investments, with disbursement linked to independent measurement, reporting and verification.

Trade policy and capability support preserve the gains from openness. Export promotion and standards programs can embed environmental safeguards and provide technical assistance so that firms comply with partner market sustainability and due diligence requirements. Coordination between customs and standards agencies reduces compliance costs without weakening environmental integrity, with targeted support for small and medium exporters that face the largest capability gaps. Human capital policy aligns labor supply with green industry demand. Targeted vocational programs in electrical work, digital control systems, environmental management and maintenance for renewable and efficient equipment are most useful when delivered in locations receiving large foreign green projects. Scholarship and apprenticeship schemes linked to firms that commit to on-the-job training and local supplier development raise absorption capacity and spread benefits across regions. Credible institutions secure implementation. Environmental impact assessment gains from clearer

screening thresholds, stronger baseline data and independent review. Regulatory quality and transparency improve through open data on permits, inspections, sanctions and project performance. Procurement, licensing and land administration become more predictable with digital workflows that reduce discretion and time costs. Adherence to international standards for disclosure and verification lowers risk premia and strengthens Vietnam's capacity to attract and manage FGF while delivering environmental and social outcomes.

7. Conclusion

This paper highlights the transformative potential of foreign green financing for enhancing ESG sustainability in emerging markets, including Vietnam, particularly as firms become increasingly embedded in GVCs where sustainability standards shape upgrading opportunities. The positive link between foreign green finance and environmental sustainability underscores the need for Vietnam to mitigate short-term CO₂ emissions from industrial and infrastructure expansions driven by green flows of greenfield investments. To achieve sustainable growth, Vietnam must adopt stringent environmental standards, regulatory frameworks and incentives for clean technologies aligned with evolving GVC requirements. On the social side, foreign green finance can promote HDI through job creation, skills transfer and infrastructure improvements, but policies must ensure equitable development to prevent disparities. Enhanced transparency and accountability in governance are essential for strengthening Vietnam's institutional capacity as ESG compliance becomes increasingly central to GVC participation. The integration of ESG principles into the financial sector demonstrates Vietnam's commitment to fostering a resilient economy.

While this study offers some insights into capturing FGF impacts on ESG criteria, several limitations must be acknowledged. The reliance on secondary data, including announced greenfield FDI figures, may introduce reporting biases and may not fully reflect project completion or real impact. The assignment of fixed green proportion values across sectors, while grounded in established taxonomies, may oversimplify intra-sectoral variations and ignore contextual differences in project-level sustainability. Furthermore, the proxies used for ESG performance, such as CO₂ emissions and HDI, provide a partial and simplified view of complex sustainability dynamics. Quantitative focus excludes qualitative dimensions such as institutional quality, policy environments and cultural factors that shape the effectiveness of green investment. The study's limited temporal scope may also obscure long-term effects of FGF, and its findings may not be fully generalizable across all emerging markets due to varying economic and governance contexts. Future research could adopt mixed-method approaches, integrate broader and more dynamic ESG metrics, and explore sector variations.

Note

1. For the results of heterogeneous analysis across regions and income levels, see [Table B1-B2 in Appendix B](#)

Supplementary material

The supplementary material for this article can be found online.

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Corresponding author
Nhat Minh Trinh can be contacted at: minh.trinhnhat@fiingroup.vn