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Investigating the nexus between FDI, governance quality and green economic growth in various Asian economies

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Abstract: This study explores the complex and dynamic relationships between foreign direct investment (FDI), governance quality, and green economic growth across selected Asian economies during the 2005-2022 period through a Pooled Mean Group (PMG) estimator in a dynamic panel framework. The empirical evidence depicts that there is the halo pollution theory in high and upper middle-income groups of countries, while the haven pollution theory exists in low and lower middle-income groups of countries. Moreover, labor force participation, governance, and financial openness may accelerate green economic growth in both panels of Asian countries, while any increase in the inflation rate and fossil fuel consumption may lead to a lower speed of green growth in both panels of Asian countries. As policy implications, high or upper-middle-income countries in Asia should try to reduce their dependence on fossil fuels, adopt effective strategies in the field of financial openness, improve green employment, and increase the green skills of the workforce, while low or lower-middle-income countries should strive to make R&D more efficient, improve governance indicators, and implement green investment incentive policies.

Keywords: *Asia, FDI, Governance, Green economic growth.*

1. Introduction

The past few decades have seen Asia emerge as a global hub for economic dynamism, largely fueled by substantial inflows of foreign direct investment (FDI). While FDI has undoubtedly contributed to job creation, industrial expansion, and GDP growth, its implications for environmental sustainability remain ambiguous. The environmental impact of FDI varies significantly across countries and sectors, raising critical questions about its role in achieving green economic growth and sustainable development. Green economic growth refers to a development trajectory that balances economic performance with environmental sustainability. It involves reducing carbon emissions, enhancing energy efficiency, promoting renewable energy, and fostering green innovation. However, the extent to which FDI can support this transformation depends not only on the nature of the investment but also on the governance environment of the host economies. Governance, broadly defined to include control of corruption, regulatory quality, and government effectiveness, plays a crucial role in directing economic activities toward sustainable outcomes. Good governance can attract environmentally responsible investors, enforce pollution control, and promote long-term planning. This study aims to investigate how governance interacts with FDI to influence green economic growth in Asian economies. The paper seeks to contribute to the existing literature in the following aspects: First, modeling an inclusive green growth indicator for Asian countries through a panel econometric technique to provide new insights and policies for different Asian regions to achieve green economic growth. Second, considering a panel of countries in different Asian regions based on their income level, as defined by the World Bank country classifications for 2023-2024, can lead to more comprehensive findings and comparisons among Asian regions. Additionally, analyzing the causality linkages among the inclusive

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green growth indicator, green energy consumption, governance, and economic openness can help develop practical policy patterns for Asian countries. The research employs the following organization: Section 2 presents a brief literature review to highlight the literature gap that the study aims to fill. The next section describes the data and methodology. Section 4 reports empirical findings, and finally, Section 5 discusses conclusions and practical policies.

2. Literature Review

This section aims to clarify the literature gap by presenting earlier studies. The relationship between FDI and green economic growth is complex. However, it can be primarily classified into two main streams based on the existence of the pollution halo hypothesis (PH) or the pollution haven hypothesis (PHH).

A group of earlier studies revealed that through green capital accumulation in the recipient country of FDI, this type of investment is expected to help the country combat the threat of climate change and environmental pollution through greening economic structures. This statement is described by the theory of the PH [1], which emphasizes the importance of FDI in transferring green technologies, promoting green economic growth that causes lower CO2 emissions. Liu et al. [2] studied the impacts of FDI on China's environment. They found that FDI inflows can help China boost green economic growth, which lowers pollutant emissions. This finding is in line with Gao and Zhang [3] and Liu et al. [4], who approved the positive role of FDI inflows to the environmental quality of China. In another study, Wang et al. [5] argued that by enhancing marketization and innovation capacity, FDI has a significant green spillover effect in the host country of FDI. Using disaggregated emissions data, Opoku et al. [6] found that FDI can increase the level of green economic development in countries, leading to a reduction in carbon dioxide emissions. Lin and Zhou [7] tried to model green economic growth in China, and the results provided evidence of the impact of FDI on the improvement of the green economic growth level of the country.

The second literature stream is based on the PHH context, which believes that FDI is the main culprit for environmental pollution and the interruption of green growth. Shahbaz et al. [8] expressed that the income level of countries determines the relationship between FDI and environmental quality. The major empirical findings depicted the PHH for middle-income panels. Doytch and Uctum [9] believed that the income level is an important factor in the field of the FDI-environment relationship. They depicted that for low- and middle-income countries, FDI cannot support the green economic growth progress. Sarkodie and Strezov [10] studied the relationship between FDI and environmental quality in some developing economies. They found that there is a PHH for China, Iran, and India. In another study, Benzerrouk et al. [11] analyzed the FDI-CO2 relationship in developing and developed countries. The empirical findings showed that there is a positive relationship between these two variables for the developed economies, while Adeel-Farooq et al. [12] concluded that FDI inflows are harmful only to environmental quality in low- and lower-middle-income countries.

The aforementioned literature review suggests that the relationship between FDI and green economic growth is controversial. Furthermore, there has not been any in-depth study focusing on the FDI-green growth relationship in Asian economies. Therefore, the paper tries to fill this literature gap by considering the two panels of Asian nations based on their income levels. Moreover, the inclusive green economic growth index proposed by Jha et al. [13] is calculated for Asian nations over the research time period and added to the empirical model as a dependent variable. This index contains different variables of economic growth, social equity, and environmental sustainability, leading to better results for making policies for green economic recovery in various Asian countries.

3. Data and Methodology

To explore how FDI can affect green economic growth, a simple neo-classical economic growth model is considered in this paper. This growth model, shown in Eq. (1), contains capital (represented by

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FDI inflows), labor force (proxied by labor force participation), and energy consumption (indicated by fossil fuel consumption):

$$IGG_{it} = f(K_{it}, LP_{it}, EC_{it}) \quad (1)$$

Where IGG is the inclusive green growth index, while K, LP and EC denote FDI inflows, labor force participation and fossil fuel energy consumption, respectively. Since the earlier studies, such as de Oliveira et al. [14], Hua et al. [15], Abille et al. [16] and An and Yeh [17], have approved the significant impact of governance and financial openness on green growth, these two variables are added to our empirical model. Moreover, the inflation rate and R&D expenditure are considered control variables in the model. Therefore, Eq. (1), with the newly added variables, can be written as Eq. (2) in an econometric form:

$$IGG_{it} = \alpha_0 + \alpha_1.FDI_{it} + \alpha_2.LP_{it} + \alpha_3.EC_{it} + \alpha_4.GOV_{it} + \alpha_5.FOPN_{it} + \alpha_6.INF_{it} + \alpha_7.RD_{it} + \varepsilon_{it} \quad (2)$$

Regarding the case study, two groups of Asian nations based on income levels (Panel 1: high and higher middle-income group, Panel 2: low and lower middle-income group) are selected. The measurement of the determination of income levels of Asian countries is based on the World Bank country classifications by income level: 2023-2024 (http://databank.worldbank.org/data/download/site-content/CLASS.xlsx). The list of each group of Asian countries is reported in Appendix 1. Table 1 represents the initial information of variables:

Table 1.
Variable descriptions.

Variable	Definition	Unit	Sources
Inclusive green growth index	An index with three dimensions of economic growth, social equity, and environmental sustainability.	-	Calculation based on the raw data of the World Bank, British Petroleum, UNDP, and local statistical bureaus of countries.
Foreign Direct Investment	Net inflows of FDI	BoP, current US $	World Bank (https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD)
Labor force participation	Percentage of total population ages 15+	%	World Bank (https://data.worldbank.org/indicator/SL.TLF.CACT.ZS)
Fossil fuel consumption	Consumption of crude oil, coal, and gas	Exajoules	BP Statistical Review of World Energy 2020 (https://nangs.org/analytics/download/5340_d5fac840e1f9574dcd0117dafe3b59bc)
Governance	An index comprises voice and accountability, political stability, absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption.	-	Worldwide Governance Indicators (WGI) in World Bank (https://info.worldbank.org/governance/wgi/Home/downLoadFile?fileName=wgidataset.xlsx)
Financial openness	Chinn-Ito Index (KAOPEN) derived from data in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).	-	https://www.theglobaleconomy.com/rankings/financial_openness/
Inflation rate	Inflation, consumer prices	%	World Bank (https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG)
R&D expenditure	Research and development expenditure	% of GDP	World Bank (https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS)

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To estimate the coefficients of variables, the empirical model is constructed based on the principles of the panel ARDL (Autoregressive Distributed Lag) framework, as expressed in Eq. (3):

$$IGG_{i,t} = \sum_{j=1}^{p} \alpha_{ij}\ IGG_{i,t-j} + \sum_{j=0}^{q} \delta_{ij}'\ X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

In Eq. (3), i and t denote country and time period, respectively. X stands for the vector of independent variables (FDI, labor force participation, inflation rate, R&D expenditure, financial openness, governance, and fossil fuel consumption). $\mu_i and\ \varepsilon_{it}$ are fixed effects and the residual term, respectively.

Moreover, two estimators of the Pooled Mean Group (PMG) and the Mean Group (MG) are employed to evaluate the signs and magnitudes of coefficients. These two estimators are highly suitable for exploring short-run and long-run impacts of variables within a panel framework. As preliminary tests before estimations, a cross-sectional dependency test is conducted. If cross-sectional dependency among variables exists, the appropriate panel unit root test, CIPS (Cross-Sectional Augmented IPS), is employed. Subsequently, the existence of cointegration is examined using Pedroni's cointegration test.

4. Estimation Results

4.1. Preliminary Tests

Prior to conducting estimations, it is necessary to perform preliminary tests to identify the most appropriate estimator. The first test is the Pesaran Cross-Dependence (CD) test, and the results of this test are reported in Table 2 as follows:

Table 2.
Cross-sectional dependency test.

Group	Pesaran CD test	variable							
		IGG	FDI	LP	EC	GOV	FOPN	INF	RD
Panel 1	CD test	25.31	13.42	31.64	27.50	14.39	18.95	36.04	14.96
	Prob.	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.05
Panel 2	CD test	35.49	29.84	19.04	16.94	40.92	22.78	34.53	29.04
	Prob.	0.04	0.00	0.00	0.03	0.00	0.03	0.00	0.03

Note: IGG, FDI, LP, EC, GOV, FOPN, INF and RC denote the inclusive green growth index, foreign direct investment, fossil fuel consumption, governance, financial openness, inflation rate and R&D expenditure, respectively.

According to Table 2, the null hypothesis of this test (the presence of cross-dependence among countries) can be rejected; therefore, it can be concluded that there is cross-dependence between the countries in the two panels of Asian economies. Next, the panel unit root test based on the existence of cross-sectional dependency is conducted. The CIPS test, as a second-generation panel unit root test for all variables of the two panels, is represented in Table 3.

Table 3.
CIPS test results.

Group	CIPS test	variable							
		IGG	FDI	LP	EC	GOV	FOPN	INF	RD
Panel 1	level	-2.86**	-1.37	-1.95	0.63	-1.30	-1.94*	-1.24	-2.48*
	d(var)	-1.89**	-2.66**	-2.10*	-1.80**	-2.59**	-2.84**	-2.33**	-1.67*
Panel 2	level	-1.32	-2.55*	-0.70	-1.38	-1.34	-1.35	-1.78	-0.64
	d(var)	-2.31**	-1.93**	-1.68*	-2.43**	-2.25**	-2.40*	-2.10**	-1.79**

Note: IGG, FDI, LP, EC, GOV, FOPN, INF, and R&D expenditure denote the inclusive green growth index, foreign direct investment, fossil fuel consumption, governance, financial openness, inflation rate, and R&D expenditure, respectively. * and ** indicate significance levels at 1% and 5%, respectively.

The results of the panel unit root test indicate that the variables in each panel of countries become integrated at orders 0 and 1. The findings from the panel unit root test permit the application of Pedroni's cointegration test to determine whether a long-run relationship exists among the variables.

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According to the results reported in Table 4, the null hypothesis of no cointegration can be rejected in two panels of Asian countries, suggesting that the variables in both panels are cointegrated.

Table 4.
Results of the panel co-integration test.

Panel 1:			
Panel v stat.	7.203 (0.00)	Group rho stat.	4.05 (1.00)
Panel rho stat.	2.75 (0.99)	Group PP stat.	-3.66 (0.00)
Panel PP stat.	-0.48 (0.01)	Group ADF stat.	-2.07 (0.02)
Panel ADF stat.	-1.84 (0.04)	-	-
Panel 2:			
Panel v stat.	5.33 (0.02)	Group rho stat.	3.80 (0.99)
Panel rho stat.	3.17 (1.00)	Group PP stat.	-2.57 (0.02)
Panel PP stat.	-0.26 (0.00)	Group ADF stat.	-2.89 (0.01)
Panel ADF stat.	-1.65 (0.01)	-	-

4.2. Estimation Findings

To estimate the short-run and long-run coefficients of variables, the PMG estimator is employed. The results for two panels of countries are presented in Table 5 as follows:

Table 5.
Results of PMG estimation.

Explanatory variable	**Panel 1**	**Panel 2**
Long-run coefficients		
Foreign Direct Investment	0.16* (0.04)	-0.04* (0.00)
Labor force participation	0.011** (0.08)	0.03** (0.05)
Fossil fuel consumption	-0.24*(0.00)	-0.42* (0.03)
Governance	0.04** (0.06)	0.15* (0.00)
Financial openness	0.31* (0.00)	0.19** (0.05)
Inflation rate	-0.03* (0.01)	-0.14* (0.00)
R&D expenditure	0.11* (0.00)	0.03* (0.01)
Error correction term	-0.62* (0.04)	-0.51*** (0.10)
Short-run coefficients		
Δ Foreign Direct Investment	0.04* (0.00)	-0.13** (0.07)
Δ Labor force participation	0.03** (0.09)	0.00* (0.00)
Δ Fossil fuel consumption	-0.09** (0.05)	-0.03*** (0.10)
Δ Governance	0.05* (0.00)	0.14* (0,03)
Δ Financial openness	0.011** (0.06)	0.07* (0.00)
Δ Inflation rate	-0.13* (0.00)	-0.09** (0.07)
Δ R&D expenditure	0.01* (0.00)	0.05 (0.19)
Constant	4.07** (0.05)	5.49* (0.00)
Observations	266	252
Log likelihood	613.492	743.950
Hausman test:	$\chi^2(7) = 2.13\ (0.56)$	$\chi^2(7) = 4.33(0.19)$

Note: numbers in () are p-value. *, **, and *** denote significance at the levels of 5%, 10% and 1%, respectively.

According to the estimated coefficients of variables, the first important point is that for both panels of countries, there exists a stable long-term relationship between variables, as the error correction term (ECT)'s coefficients for both panels are negative and statistically significant. The estimated coefficients of ECT, reported in Table 5, reveal that if 1% deviation from the long-term equilibrium occurs in our models, 0.62% and 0.51% of the distortion in the long-term equilibrium will be adjusted in each period. Therefore, both models have a stable equilibrium in the long term. Furthermore, the homogeneity restriction among countries of the two panels has been checked by the Hausman test, and the results of this test show the efficiency of the PMG rather than the MG estimator.

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Regarding the explanatory variables' impacts on the green growth index, the interpretation of coefficients can be done for two separate time ranges: short-term and long-term.

In the long-term:

The empirical evidence supports the presence of a positive impact of FDI on the green growth index in high and upper middle-income groups of Asian countries, while the green growth index is not positively affected by FDI inflows in panel 1 of Asian countries. This finding supports the existence of the Halo pollution theory for the group of Asian countries with high and upper-middle-income, whereas the Haven pollution theory exists in the low and lower-middle-income countries in Asia. The finding is consistent with Doytch [18], who found out halo pollution theory for financial services FDI in high-income countries.

Labor force participation may accelerate green growth in both panels of Asian countries. However, the magnitude of the positive impact is larger in the case of panel 1. Following Karakul [19] and Fankhauser et al. [20], in economies with an appropriate level of income, it is easier to educate the labor force for a green economy and green jobs. Therefore, a high ratio of labor force participation leads to a more significant green-skilled labor force in these nations, which promotes green economic growth.

A 1% increase in the consumption of fossil fuels may lead to a reduction in the green growth index of panels 1 and 2 of Asian nations by approximately 0.24% and 0.42%, respectively. This finding is in line with Martins et al. [21], who expressed that fossil fuel consumption increases carbon dioxide emissions, environmental pollution, and decreases green growth progress.

In the long term, governance has a positive impact on the green growth index of both panels of Asian countries. In line with de Oliveira et al. [14] a good governance can connect a green economic structure to legislation, culture, and social mechanisms in a country. The magnitudes of coefficients depict that the green growth index is more sensitive to this variable in low and lower-middle-income Asian countries that generally suffer from a weak governance situation.

The positive and significant coefficient of financial openness shows that this variable can motivate green growth progress in both panels of countries in Asia. A 1% increase in the level of financial openness can increase the green growth index of panels 1 and 2 of countries by nearly 0.31% and 0.19%. The magnitude of impact of this variable is larger for the case of countries with high incomes due to their stronger ties with the global economy and interactions with global financial systems. However, the finding is in contrast with You et al. [22], who found no significant relationship between financial openness and environmental pollution.

The inflation rate has a negative impact on the green growth index in both panels of Asian countries. This finding is not consistent with the previous findings of Deka and Dube [23] who depicted that there is no relationship between the inflation rate and green energy development (as part of green growth) in the long term for the case of Mexico, whereas it is consistence with Nawaz et al. [24] who believes that any increase in the general price level of commodities means an increase in the financing cost for investors in green projects, leading to a lower return on investment and reduced attraction of green projects for investors.

Finally, the R&D expenditure coefficient was estimated positively and was statistically significant, highlighting the role of research and development progress in promoting the green growth of Asian economies. It is in line with the conclusions of Alvarado et al. [25], who depicted the positive role of R&D to mitigate air degradation.

In the short-term:

The signs of coefficients in the short term are similar to those in long-term estimations. Therefore, it can be stated that even in the short term, the halo pollution theory applies in panel 1 of countries, while the haven pollution theory exists in the low and lower-middle-income groups of countries. Additionally, labor force participation, governance, and financial openness are motivators for inclusive green growth in Asian countries across both panels, whereas inflation rate and fossil fuel consumption

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negatively impact the progress of green growth in Asian countries. Interestingly, the coefficient of R&D expenditure for the panel of low and lower-middle-income Asian countries is statistically insignificant; however, the coefficient of this variable aligns with the estimated result for the variable in the long term. Dobrzanski and Bobowski [26] argue that R&D expenditure does not have similar efficiency among countries due to different innovation capacities and high-skilled labor forces among countries. Furthermore, Sinimole and Saini [27] express that among Asian countries, only the economies with appropriate ease of doing business, industry collaboration, and private partnership have efficient R&D progress.

At the final stage of empirical findings, the Dumitrescu and Hurlin [28] panel causality test to determine the direction of the relationship between green growth, FDI, governance, and financial openness in two separate panels of Asian countries.

As a result of the panel causality test shown in Table 6, in the case of panel 1 of countries, there is a bi-directional causality relationship between FDI-IGG, GOV-IGG, and FOPN-IGG, while for the low and lower middle income group of Asian countries, there is a uni-directional causality relationship running from IGG to FDI, from GOV to IGG, and from FOPN to IGG.

Table 6.
Results of panel causality test.

H0 hypothesis	**Panel 1 z-stat**	**Panel 2 z-stat**
ΔFDI does not homogeneously cause ΔIGG	1.743**	-1.0831
ΔIGG does not homogeneously cause ΔFDI	3.533*	2.704**
ΔGOV does not homogeneously cause ΔIGG	0.584**	0.392*
ΔIGG does not homogeneously cause ΔGOV	0.363**	0.043
ΔFOPN does not homogeneously cause ΔIGG	1.493**	0.844*
ΔIGG does not homogeneously cause ΔFOPN	0.580**	3.583

The given results of the panel causality test let us conclude that the efficiency of impacts of green growth on governance and financial openness in panel 2 of Asian countries is less than the efficiency in the high and upper middle income groups of Asian economies. It can only be addressed as an attraction to foreign investors to bring their capital to finance green projects in low and lower middle income groups of countries in Asia.

4.3. Robustness Check

To ascertain the validation of empirical findings, two different robustness check strategies are employed.

4.3.1. First Robustness Check's Strategy:

Two alternative estimators of the Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Squares (FMOLS) are employed to ensure the reliability of estimated coefficients. The estimated coefficients, reported in Table 7, for most of the variables, except R&D expenditure in the panel of low and lower middle income groups estimated by FMOLS, are consistent with the empirical estimated coefficients in Table 5. Therefore, the validation of empirical findings can be confirmed.

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Table 7.
Results of the first robustness check.

Explanatory variable	Panel 1	Panel 2
FMOLS estimation result:		
Foreign Direct Investment	0.09*	-0.21**
Labor force participation	0.17**	0.16*
Fossil fuel consumption	-0.05**	-0.13*
Governance	0.00**	.09**
Financial openness	0.03*	0.24**
Inflation rate	-0.13*	-0.07**
R&D expenditure	0.17***	0.07
DOLS estimation result:		
Foreign Direct Investment	0.11*	-0.43**
Labor force participation	0.04**	0.09*
Fossil fuel consumption	-0.18*	-0.03**
Governance	0.00*	0.16*
Financial openness	0.05*	0.35**
Inflation rate	-0.14*	-0.11*
R&D expenditure	0.09*	0.01***

Note: numbers in () are p-value. *, **, and *** denote significance at the levels of 5%, 10% and 1%, respectively.

4.3.2. Second Robustness Check's Strategy:

In the second robustness check's strategy, the inclusive green growth index is replaced. CO2 emissions and green energy consumption are considered as alternative indicators for green economic recovery of Asian nations, and then we re-estimate the long-term coefficients of FDI, financial openness, and governance to validate the dependent variable. Table 8 reports the results of the second robustness check. It can be concluded that FDI, governance, and financial openness can help panel 1 of Asian countries mitigate carbon dioxide emissions, while any improvement in FDI and financial openness may lead to higher emissions of carbon dioxide in low- and lower-middle-income Asian countries. The results are consistent with the estimated results for the dependent variable of green growth. Regarding green energy consumption, FDI, governance, and financial openness positively impact this variable in panel 1 of Asian countries, while FDI in panel 2 of Asian economies decelerates the consumption of renewable energy resources.

Table 8.
Results of the second robustness check.

Explanatory variables	Panel 1	Panel 2
Dependent variable: CO_2 per capita		
Foreign Direct Investment	-0.03* (0.00)	0.16* (0.01)
Governance	-0.17** (0.06)	-0.09** (0.09)
Financial openness	-0.09* (0.01)	0.10* (0.07)
Dependent variable: renewable energy consumption		
Foreign Direct Investment	0.19* (0.03)	-0.00** (0.05)
Governance	0.21* (0.00)	0.08* (0.04)
Financial openness	0.16* (0.03)	0.01* (0.00)

Note: numbers in () are p-value. *, **, and *** denote significance at the levels of 5%, 10% and 1%, respectively.
FDI, CO_2, and RNC stand for foreign direct investment, carbon dioxide emissions, and renewable energy consumption, respectively.

5. Conclusions and Policy Implications

5.1. Concluding Remarks

Using data from 37 Asian countries, the main purpose of this paper is to model green economic growth to determine how major explanatory variables influence this dependent variable from 2005 to 2022. The coefficients of variables are evaluated in terms of two heterogeneous panels, Panel 1 and Panel 2. Empirical evidence indicates the presence of the halo pollution theory in Panel 1 countries,

while the haven pollution theory is observed in low and lower-middle-income groups. Additionally, labor force participation, governance, and financial openness may accelerate green growth in both panels of Asian countries. Conversely, increases in inflation rates and fossil fuel consumption may reduce the pace of green growth in both panels. The coefficient of R&D expenditure was estimated positively and statistically significant in the long term, emphasizing the role of research and development in promoting green growth in Asian economies. In the short term, the coefficient of this variable was estimated as insignificant for Panel 2 of Asian nations.

5.2. Practical Policy Implications

In order to make a sustainable green economic recovery during and after the pandemic in Asian economies, the policies of rich and poor countries in Asia must be different. High- or upper-middle-income countries in Asia should try to reduce their dependence on fossil fuels and increase the share of green energy in their total energy consumption basket in the short term. Also, due to the consequences of COVID-19, which has led to a reduction in economic liberalization and regional interactions between countries, it is suggested that they adopt effective strategies in the field of financial openness and cooperation, a joint committee. Another practical suggestion based on the findings of this study is planning in the field of green employment and increasing the green skills of the workforce. Moreover, these Asian countries are often better prepared legally, technically, and culturally to develop a digital economy that will help reduce fossil fuel consumption in the transportation sector. Since FDI and green growth in these Asian nations have positive impacts in the short-term and long-term, the establishment of motivations and stimulations to absorb foreign capital in green projects would be practical and fruitful.

On the other hand, low- or lower-middle-income countries should strive to make R&D more efficient in the area of green economic growth in the short term. Additionally, improving governance indicators can reduce the risk of green investment in these countries and increase the amount of foreign direct investment. Due to the existence of Haven pollution theory in both the short-term and long-term in these economies, the adoption of good governance patterns and investment incentive policies can lead to a positive impact of FDI on the green growth of these countries. Another important policy is greater financial convergence with rich Asian countries to reach sustainable development goal targets, especially in financing green projects, which can transfer green technology and knowledge from high-income to low-income countries in Asia.

5.3. Future Recommendations

The authors of the paper believe that this research provided new insights and practical policies for countries in Asia. However, the paper cannot evaluate the direct impact of COVID-19 on the green growth recovery of Asian economies. Future studies should consider the pandemic as an important explanatory variable, and an analysis of coefficients at the country level is highly recommended for future research.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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Appendix 1.
List of countries in groups of income levels.

High and upper-middle-income group	Low and lower-middle-income groups
United Arab Emirates, Bahrain, Brunei, China, Hong Kong, Jordan, Japan, Kazakhstan, Korea Rep., Kuwait, Lebanon, Maldives, Malaysia, Oman, Qatar, Saudi Arabia, Singapore, Thailand, Turkmenistan	Afghanistan, Bangladesh, Bhutan, Indonesia, India, Iran, Kyrgyz Republic, Cambodia, Laos, Sri Lanka, Myanmar, Mongolia, Nepal, Pakistan, Philippines, Tajikistan, Uzbekistan, Vietnam

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