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Does environmental entrepreneurship play a role in sustainable green development? Evidence from emerging Asian economies

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ABSTRACT

Environmental entrepreneurship and green growth are emerging concerns of policymakers around the globe. We aim to find the role of environmental entrepreneurship in attaining sustainable green development in emerging Asian economies such as China, India, Indonesia, Korea, Malaysia, Pakistan, the Philippines, Thailand, Malaysia, and Singapore. Two different proxies of environmental entrepreneurship are used in this analysis including electricity production from renewable energy and nuclear & renewables energy production. For empirical estimation, we have applied ARDL-PMG. The findings from the panel-ARDL PMG confirmed the positive impact of electricity production from renewable sources on green economic growth both in the long and short-run. Similarly, renewable energy production also causes green economic growth to rise in the short and long run. Trade is another element that can help promote green economic growth. Green entrepreneurship policies have been suggested for improving sustainable development.

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1. Introduction

Since the introduction of sustainable development goals (SDGs) by the United Nations (UN) in 2015, sustainable development has become the primary target of every nation and the central focus of every discussion. Sustainable development is quite a broad term that is not limited to achieving only long-term economic growth but also includes preserving the environment for current and future generations and reshaping the social and economic outlook of the society by bringing gender and economic equality. Given the limited amount of resources and rising population, sustainable development goals are not easy to achieve (Brahmbhatt et al., 2017). The

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continuous consideration provided to sustainability is to control the undue emanations of carbon dioxide, which will eventually alleviate climate change, control further damages to ozone, and stop the annihilation of biodiversity consequential in the accomplishment of sustainability. Therefore, environmental researchers and empirics are trying to find the factors that can help attain the targets of sustainable development. In recent times, environmental entrepreneurship has emerged as an important factor that has become an important contributor to achieve the targets of sustainable development. The mindset of the entrepreneurs has changed, particularly in advanced economies, and they have started looking at the environmental consequences of their entrepreneurial activities (Gu & Zheng, 2021). Hence, the focus has shifted to environment-centered entrepreneurship, which will not only solve the problems of degrading environment and climate change but also help attain long-run green economic growth (Creech et al., 2014; Reynolds, 2018). As a result, the significance of environmental entrepreneurship has increased manifold in conserving nature and its resources and solving other environment-related problems.

In recent times, a theory called the triple bottom line theory has emerged, which is a sustainable development theory and can account for the social, economic, and environmental values of a firm. The significance of the theory has been recognized in assessing sustainable corporate development and motivation analysis. According to Dhahri and Omri (2018), the association between entrepreneurship and the three essentials of a firm's sustainable development is confirmed both in the short and long term. By combining all three pillars of bottom line theory we can explain how firms take part in green and clean activities and what are the incentives available for them to become a part of such activities. Moreover, the theory also explains that entrepreneurs require essential entrepreneurial skills to perform sustainable activities. The research on entrepreneurship has gathered pace in recent years and grabbed the attention of many empirics. Among the diverse issues in entrepreneurship works, the studies on sustainable entrepreneurship emphases on commercial actions that are expected to preserve a 'sustainable' civilization and environment. The theory suggests that increasing the economic value of the firm is not enough rather the entrepreneurs should also focus on increasing the firm's social and environmental values. In this context, environmental entrepreneurship has become an important form of entrepreneurship through which firms and businesses can not only preserve the environment but can also attain sustainable green economic growth (Thompson et al., 2011; Usman et al., 2021; Chen et al., 2022).

Several studies in the past have highlighted that entrepreneurship may lead to sustainable development because entrepreneurship helps solve environment-related problems and also helps attain long-term green economic growth (Hall et al., 2010). As far as the studies on environmental entrepreneurship are concerned, most of the studies have confirmed that there are opportunities and creation in the process of environmental entrepreneurship that helps to improve environmental quality and achieve green economic growth (York et al., 2016; Omri, 2018). However, the flip side of the story is that increased dirty economic growth promotes entrepreneurial activities in the economy that may lead to the rise in energy demand and hurt the environment. Evidence suggests that nations don't have access to green products, and

their investments in environment-related projects are not enough to support a sustainable environment. Consistent with this view, resources should be used prudently and efficiently so that environmental entrepreneurship can complement the environment-related policies and regulations that will ultimately reduce the burden on the environment (Adedoyin et al., 2021).

Environmental entrepreneurship is an emerging area of research, and it has become a hot topic among empirics and policymakers as a potential candidate to fight against global warming and climate change (Sun et al., 2020). In the development of enterprises and businesses, the leading role is performed by the entrepreneurs, which they can be called transmitters of entrepreneurship. Enterprises that can help achieve the sustainable development goal are the need of the hour. In this context, entrepreneurs become the key figures as they can lead their enterprises toward the path of adopting clean green technologies that will reduce the burden on the environment without hampering the rate of green economic growth (Ullah et al., 2021; Wei & Ullah, 2022). With the rising concern about the degrading environment among the people of the society, the environment has become a commodity that is important and scarce. The environment is affected by economic actions, whereas economic activities are affected by environmental changes. Liu et al. (2016) confirmed the relationship between the growth rate of the economy and carbon releases. They observed that rising economic growth in China is linked with rising emissions; however, the rising emissions hinder economic growth. Conversely, Fan and Hossain (2018) confirmed that economic growth proves a catalyst for carbon emissions, and pollution emissions promote economic growth. Hickel and Kallis (2020) pointed out that there is a balancing relationship between the economy's growth rate and environmental quality, which means that both of them jointly work to achieve sustainable development. In other words, we can say that both economic growth and environmental quality complement each other in attaining goals of sustainable development. While literature observed that entrepreneurship improves the green infrastructure and plays an important role in the green transition in the economy (Hu et al., 2021; Ying et al., 2021; Li & Ullah, 2022).

In the 21st century, the efficacy of environmental entrepreneurship in mitigating the effects of environmental pollution, particularly in the emerging Asian economies, has become much more pertinent. Asia is the largest continent in the world, and the most polluted one as well. In 2020, the Asian continent alone produced 16.75 billion metric tons of CO_2 emissions, which were more than the total combined emissions of all other continents (Tiseo, 2021). Emerging economies of Asia are the fastest growing economies in the world and the largest contributors to CO_2 emissions in the world. Among them, China alone contributed to 31% of the global CO_2 emissions in 2020. As already discussed, environmental entrepreneurship, in recent years, has become an effective tool to fight against climate change and global warming. Therefore, it is very pertinent to analyze the impact of environmental entrepreneurship on green growth in emerging Asian economies. To the best of our knowledge, this is the first-ever effort in this direction. Next, we discuss the data and methods in section two. Results are provided in section three, and we conclude the study in section four.

2. Model and methods

Green growth and its determinants have become an area of great interest in empirical research over the last few decades. During this time a large number of factors have been tested that can help to attain green economic growth. However, environmental entrepreneurship has not been the focus of researchers and policymakers: eventually, the factors e.g. green products and technologies that have become a driver of economic growth are to be introduced by entrepreneurs that have a firm belief in green environment and growth (Christensen, 1997; Willis et al., 2007). Environmental entrepreneurs are important players in transforming the dreams of green economic growth into reality.

Despite the importance of green entrepreneurship, the literature on green entrepreneurship is not that vast, and there is a lack of foundation on which we can develop our empirical model. This is due to the fact that it is hard to draw a line between green and non-green entrepreneurship. In the decade of 1990s, literature on green entrepreneurship started to grow. The terms 'environmental entrepreneur', 'green entrepreneur', 'eco-entrepreneur', and 'ecopreneur' were first developed by Bennett (1991). Since then most studies have considered renewable energy as the leading product of environmental entrepreneurship (Dean & McMullen, 2007; Gast et al., 2017). In the literature, few studies such as Sun et al. (2020) and Nakamura and Managi (2020) have scrutinized the link between environmental entrepreneurship and economic growth. We have made small changes in their model, for example, the economic growth variable is replaced by green growth, and tried to explore whether environmental entrepreneurship promotes green growth. Following Nakamura and Managi (2020) and Sun et al. (2020), we have developed the following model:

$$\mathrm{GEG}_{it} = \varphi_0 + \varphi_1 \mathrm{EE}_{it} + \varphi_2 \mathrm{Internet}_{it} + \varphi_3 \mathrm{Patent}_{it} + \varphi_4 \mathrm{Trade}_{it} + \varphi_4 \mathrm{FD}_{it} + \varepsilon_{it} \quad (1)$$

Where green economic growth (GEG) is dependent on environmental entrepreneurship (EE), internet users (internet), technology innovation (Patent), trade openness (Trade), financial development (FD), and randomly distributed error term (ε_{it}). However, this is a long-run equation that only estimates the long-run results. To know the short-run estimates we need to convert equation (1) into error correction format as specified under:

$$\begin{aligned}\Delta \mathrm{GEG}_{it} = {} & \alpha_0 + \sum_{i=1}^{p} \pi_i \mathrm{GEG}_{it-i} + \sum_{i=0}^{p} \psi_i \Delta \mathrm{EE}_{it-i} + \sum_{i=0}^{p} \mu_i \Delta \mathrm{Internet}_{it-i} \\ & + \sum_{i=0}^{p} \theta_i \mathrm{Patent}_{it-i} + \sum_{i=0}^{p} \lambda_i \mathrm{Trade}_{it-i} + \sum_{i=0}^{p} \beta_i \mathrm{FD}_{it-i} + \omega_1 \mathrm{GEG}_{it-1} \\ & + \omega_2 \mathrm{EE}_{it-1} + \omega_3 \mathrm{Internet}_{it-1} + \omega_4 \mathrm{Patent}_{it-1} + \omega_5 \mathrm{Trade}_{it-1} + \omega_6 \mathrm{FD}_{it-1} \\ & + \lambda . \mathrm{ECM}_{it-1} + \varepsilon_{it}\end{aligned} \quad (2)$$

Equation (2) has now been called Panel ARDL of Pesaran et al. (1999) and Pesaran and Shin (1995). This method has various advantages over other methods.

Firstly, it can provide both short and long-run estimates simultaneously. The difference variables represent the short-run results and the coefficients of $\omega_2 - \omega_6$ after normalizing on ω_1 signify the long-run results. The originality of the long-run results rests on the F-test: a test of co-integration that confirms the significance of lagged-level variables jointly. Pesaran et al. (1995, 1999) developed critical values for this test. Secondly, this technique provides efficient estimates in the case of a small sample size. Thirdly, this technique also considers the integrating properties of the variables; hence, in this method, we can add the variable that is stationary at level, first-difference, or a mixture of both. Last but not least, this equation can also handle the problems of endogeneity and serial correlation which are serious issues in panel data analysis. In the end, we have also used the CS-ARDL method to confirm the robustness of our results.

3. Data

The study explores the role of environmental entrepreneurship on sustainable green development for emerging Asian economies from the time period 1990 to 2019. Emerging economies of Asia are selected for the analysis. The study took the sample of 10 Asian emerging economies for empirical nexus. Sustainable green development is denoted by green economic growth (i.e. environmentally adjusted multifactor productivity). Following the standard literature (Sun et al. (2020), environmental entrepreneurship is measured by two proxies namely electricity production from renewable sources in total percentage (excluding hydroelectric sources) and renewable energy production (nuclear, renewables, and other production in quad Btu). In line with earlier literature, such as Sun et al. (2020), Omri and Afi (2020), technology progress, trade openness, and financial development control variables associated with green economic development. The study is incorporating the internet (individuals using internets as percent of total population), technology (patent applicants both residents and non-residents), trade openness (total trade as a percent of GDP), and financial development (domestic credit to the private sector by banks in percent of GDP) as control variables in regression analysis. Definitions and data sources are given in Table 1. The data for analysis is extracted from the OECD and the World Bank.

4. Empirical results and discussion

Before performing regression analysis it is obligatory to check the cross-sectional dependence and unit root properties of variables in the model. In this way, the empirical findings will be more beneficial for policymakers in designing environmental and energy policies to enhance the quality of the environment for sustainable green economic growth. Cross-sectional dependence occurs when the error terms of economies are correlated. It is well-known fact that due to openness and globalization, any kind of variation in one economy may influence other economies as well located in the same continent and region. Our study used a cross-sectional dependence test developed by Pesaran (2007) for analysis. The output of Pesaran's test is presented in Table 2. The reported results confirm that the issue of cross-sectional

Table 1. Definitions and data sources.

Variables	Symbol	Definitions	Sources
Green economic growth	GEG	Environmentally Adjusted Multifactor Productivity	OECD
Electricity production from renewable	EEE	Electricity production from renewable sources, excluding hydroelectric (% of total)	World Bank
Renewable energy production	EER	Nuclear, renewables, and other production (quad Btu)	OECD
Internet	Internet	Individuals using the Internet (% of population)	World Bank
Technology	Patent	Patent applications, total (residents and non-residents)	World Bank
Trade openness	Trade	Trade (% of GDP)	World Bank
Financial development	FD	Domestic credit to private sector by banks (% of GDP)	World Bank

Source: World Bank and OECD.

Table 2. CD tests.

	GEG	EEE	Internet	Trade	FD
Pesaran's test	5.204***	1.074	4.156***	3.599***	−0.419
Prob.	0.000	0.282	0.000	0.000	0.675
off-diagonal elements	0.230	0.534	0.488	0.289	0.436
	GEG	**EER**	**Internet**	**Trade**	**FD**
Pesaran's test	5.038***	−0.310	6.156***	3.987***	−1.016
Prob.	0.000	0.756	0.000	0.000	0.309
off-diagonal elements	0.233	0.768	0.496	0.449	0.452

Source: Authors' Calculations.

dependence is found in our models. In the next step, we have employed LLC and IPS unit root tests. Table 3 displays the findings of unit root tests. We note that there is mix order of integration among variables. Few variables are found stationary at level i.e. I(0) and others are stationary at their first difference i.e. I(1). The finding of the unit root tests motivates us to apply the ARDL-PMG regressions technique for investigating the nexus between environmental entrepreneurs and green economic growth. After confirming the unit root properties and cross-sectional dependence, the next step is to check the cointegration relationship among the variables of the models. Thus, our study employed the Westerlund cointegration and Kao-cointegration tests for this task. The results of panel cointegration tests are given in Table 4. The results of the panel cointegration test confirm the presence of long-run cointegration association among variables of the models.

The findings of ARDL-PMG models are reported in Table 5. The study captured the environmental entrepreneur's effect by using two proxies EEE and EER and the study also estimated each focus variable on internet and patent variable separately. In this regard, the study estimated four separate models. In model 1, column 1, EEE effect is measured on green economic growth with the impact of the internet. In model 2, column 2, EEE effect on green economic growth is captured by including the patent role. In model 3, column 3, EER effect on green economic growth is extracted by including the role of the internet. In the last model, column 4, EER impact is captured on green economic growth with the inclusion of patent role.

The long-run coefficient estimates of ARDL-PMG models reveal that EEE produces a significant and positive impact on green economic growth in model 1 and EER

Table 3. Unit root tests.

	IPS			ADF		
	I(0)	I(1)	Decision	I(0)	I(1)	Decision
GEG	−6.187***		I(0)	−4.922***		I(0)
EEE	−0.543	−7.151***	I(1)	1.452	−6.125***	I(1)
EER	0.625	−6.756***	I(1)	1.012	−3.654***	I(1)
Internet	1.791	−1.990*	I(1)	1.542	−1.652*	I(1)
Patent	0.094	−7.270***	I(1)	0.235	−6.524***	I(1)
Trade	−2.225**		I(0)	−1.524*		I(0)
FD	−3.421***		I(0)	−1.554*		I(0)

Note: ***p < 0.01; **p < 0.05; and *p < 0.1.
Source: Authors' Calculations.

Table 4. Panel cointegration tests.

		Model 1			Model 2		
	Statistic	Value	Z-value	P-value	Value	Z-value	P-value
Westerlund cointegration	Gt	−3.740***	3.147	0.001	−4.206***	4.563	0.000
	Ga	−7.183	2.747	0.997	−13.01	0.827	0.796
	Pt	−10.75***	4.500	0.000	−12.68***	6.558	0.000
	Pa	−9.202	1.030	0.849	−16.84	1.625	0.052
Kao- cointegration		−3.347***			−3.545***		

Source: Authors' Calculations.

Table 5. ARDL-PMG estimates of green growth.

	(1)		(2)		(3)		(4)	
Variable	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat
Long-run								
EEE	0.168*	1.676	0.114	1.016				
EER					0.108**	2.063	0.114**	2.152
INTERNET	0.011*	1.727			0.017*	1.877		
PATENT			0.265	0.813			0.255	0.556
TRADE	0.036*	1.833	0.029**	2.016	0.031*	1.910	0.024*	1.743
FD	0.420	0.969	0.257	0.135	0.436	0.941	0.283	0.662
Short-run								
D(EEE)	1.407	1.089	1.416*	1.874				
D(EEE(−1))	1.203**	2.214	1.022	0.985				
D(EER)					2.593**	2.067	2.272**	2.058
D(EER(−1))					2.012	1.012	1.033	0.987
D(INTERNET)	0.099***	3.125			0.097**	2.370		
D(INTERNET (−1))	0.001	1.022			1.021	1.021		
D(PATENT)			5.228**	2.122			5.880**	2.216
D(PATENT(−1))			2.012	1.012			1.023**	2.356
D(TRADE)	0.018	0.193	0.001	0.007	0.001	0.016	0.007	0.085
D(Trade(−1))	0.009	1.022	0.002	1.022	0.002	1.023	0.023	1.023
D(FD)	1.346	0.600	3.558*	1.715	2.188	0.947	4.405**	2.172
D(FD(−1))	1.023	0.985			1.023	0.356	1.023	0.256
C	5.307***	8.169	6.788***	9.129	5.323***	9.345	7.092***	9.271
Diagnostics								
Log likelihood	−399.7		−386.7		−393.7		−379.2	
ECM(-1)	−0.791***	−6.060	−0.763***	−6.036	−0.804***	−7.536	−0.807***	−6.892
Hausman test	1.023		0.325		1.023		1.023	

Note: ***p < 0.01; **p < 0.05; and *p < 0.1.
Source: Authors' Calculations.

infers a significant and positive impact on green economic growth in both models, revealing that environmental entrepreneurship tends to enhance green economic

growth. Environmental entrepreneurship helps to adopt green technological innovation, thus endorsing their practices in innovation to enhance the quality of the environment. Environmental entrepreneurship inspires businesspersons to adopt corporate environmental and social responsibilities (Zhao et al., 2010). Environmental entrepreneurs do green production practices by using eco-friendly green technologies in each sector of the economy (Sun et al., 2020). Environmental entrepreneurship inspires entrepreneurs to make an investment in R&D and encourages technological innovation, consequently escalating green growth. This finding is also consistent with Kuang and Cheng (2010), who noted that environmental entrepreneurship can increase the capability of the green economy in each economy. This finding is also reliable with Sarkar (2013), who also noted that green entrepreneurship can effectively reduce environmental pollution and its positive impacts on sustainable green development.

This finding is also backed by Omri and Afi (2020), who infers that environmental entrepreneurship contributes to economic growth by reducing the environmental pollution. Hall et al. (2010) suggested that entrepreneurship can be adopted as a measure to solve environmental problems that promote economic growth. Findings observed that entrepreneurship ensures transformation towards sustainable products and processes, which solve several social and environmental issues. This finding is also supported by Shepherd and Patzelt (2011), who noted that entrepreneurship contributes significantly to preserving the ecosystem, mitigating environmental degradation and climate change, and augmenting green growth. This finding is in accordance with Dhahri et al. (2021), who noted that environmental entrepreneurship is a key element in achieving sustainable development goals.

Environmental entrepreneurship with social accountability is persuaded to attain a win-win position of economic benefits and environmental protection. A possible reason is that environmental entrepreneurship can easily promote and upgrade the industrial structure and enhance the expansion of enterprises in a cleaner and greener direction. The enterprise dynamically endorses the revolution of its structure, therefore attaining green growth. Environmental entrepreneurship may augment sustainable green growth. Environmental entrepreneurship is also signified as 'green entrepreneurship' because they are associated with cleaner technologies and products that have great prospective to condense environmental pollution.

This finding is also provided favour by Gas et al. (2017), who suggested that the adoption of greenways in business can mitigate environmental problems. The advancement of environmental entrepreneurship and environment-related goods may terminate environmental degradation. Green entrepreneurship raises such businesses that have to minimize the pollution burden by enhancing green growth. Green entrepreneurs work in environmentally friendly customs due to their motivations and intrinsic values, and thus deliberately being ecologically aware in their business. Thus, green growth can be maintained by green entrepreneurs who promote green products and familiarize green technologies in the market.

In the long-run internet and trade result in increasing green economic growth, however, patent and financial development produce no impact on green economic growth as their coefficient estimates are statistically insignificant. In the short-run

Table 6. CS-ARDL estimates (Robustness).

	(1)		(2)		(3)		(4)	
Variable	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat
Long-run								
EEE	0.148*	1.681	0.109	0.016				
EER					0.118**	2.003	0.102*	1.785
INTERNET	0.021*	1.807			0.007	1.077		
PATENT			0.245	0.780			0.102	0.556
TRADE	0.041*	1.701	0.027**	2.045	0.034*	1.710	0.040*	1.800
FD	0.454	0.969	0.242	0.141	0.412	0.781	0.212	0.498
Short-run								
D(EEE)	0.907	1.089	1.016*	1.784				
D(EER)					1.091**	2.147	1.242***	3.114
D(INTERNET)	0.078***	3.125			0.057	1.203		
D(PATENT)			3.014**	2.122			3.001**	2.087
D(TRADE)	0.017	0.193	0.007	0.102	0.012	0.015	0.008	0.087
D(FD)	1.306	0.600	1.018	1.615	1.004	0.014	1.680***	4.012
C	4.307***	8.169	4.014***	4.044	3.014***	6.012	2.047***	7.689
ECM(-1)	−0.791***	6.060	−0.604***	5.542	−0.711***	7.536	−0.587***	4.825

Source: Authors' Calculations.

findings demonstrate that EEE positively affects green economic growth in the model and EER affects green economic growth in both models. In terms of control variables, in the short-run, internet, patent, and financial development have a significant and positive impact on green economic growth; but trade produces an insignificant impact on green economic growth. In order to check the validity of ARDL-PMG estimates, the study performs some important diagnostic tests such as Log-likelihood test, ECM; and Hausman test. The coefficient estimates of the Log-likelihood test confirm the goodness of fit of all models. There exists long-run cointegration among variables as shown by the findings of the ECM test in all four models.

The robustness of findings has been confirmed by employing another estimation method i.e. CS-ARDL estimation technique. In Table 6, the results of all four models are consistent in terms of signs and level of significance in most cases; however, variation occurs in terms of magnitude. The coefficient estimates of ECM terms in all four models are found to be statistically significant and negative, as required for confirming convergence towards stabilization. Table 7 presents the panel causality tests. The results indicate the presence of unidirectional causality between EEE and GEG, but do not unidirectional and bidirectional causality between EER and GEG. Moreover, there is bidirectional Granger causality running from FD to GEG.

5. Conclusion and implications

Over the last few decades, human-driven social and economic activities have gathered pace. On one side these activities have brought a revolution in the people's life by raising their living standards. On the other side, the balance of the eco-system is disturbed by a great deal which has caused the GHG emissions, particularly CO_2, to rise and environmental quality to deteriorate. Therefore, sustainable development has become the objective of almost every nation on the face of the earth. Sustainable development simply means that during the process of economic growth environment must be protected and the damages to the environment should be kept under control.

Table 7. Panel causality test.

Null hypothesis	W-Stat.	Prob.	Decision	Null hypothesis	W-Stat.	Prob.	Decision
EEE → GEG	3.866	0.070	Yes	EER → GEG	3.041	0.360	No
GEG → EEE	2.688	0.596	No	GEG → EER	1.100	0.231	No
INTERNET → GEG	3.228	0.263	No	INTERNET → GEG	3.228	0.263	No
GEG → INTERNET	2.833	0.491	No	GEG → INTERNET	2.833	0.491	No
TRADE → GEG	2.867	0.468	No	TRADE → GEG	2.867	0.468	No
GEG → TRADE	3.381	0.199	No	GEG → TRADE	3.381	0.199	No
FD → GEG	5.208	0.001	Yes	FD → GEG	5.208	0.001	Yes
GEG → FD	15.58	0.000	Yes	GEG → FD	15.58	0.000	Yes
INTERNET → EEE	5.055	0.002	Yes	INTERNET → EER	6.786	0.000	Yes
EEE → INTERNET	3.226	0.265	No	EER → INTERNET	3.830	0.076	Yes
TRADE → EEE	12.66	0.000	Yes	TRADE → EER	2.782	0.527	No
EEE → TRADE	2.841	0.486	No	EER → TRADE	5.407	0.001	Yes
FD → EEE	6.582	0.000	Yes	FD → EER	3.709	0.101	Yes
EEE → FD	6.033	0.000	Yes	EER → FD	7.523	0.000	Yes
TRADE → INTERNET	1.941	0.778	No	TRADE → INTERNET	1.941	0.778	No
INTERNET → TRADE	6.737	0.000	Yes	INTERNET → TRADE	6.737	0.000	Yes
FD → INTERNET	2.777	0.530	No	FD → INTERNET	2.777	0.530	No
INTERNET → FD	9.356	0.000	Yes	INTERNET → FD	9.356	0.000	Yes
FD → TRADE	2.871	0.465	No	FD → TRADE	2.871	0.465	No
TRADE → FD	14.39	0.000	Yes	TRADE → FD	14.39	0.000	Yes

Note: ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$.
Source: Authors' Calculations.

Consistent with this view, recent works on the determinants of environmental quality tried to find the factors that can be helpful in achieving the targets of economic growth without damaging the environment. One such factor is environmental entrepreneurship which has become the key focus of many empirics as a crucial contributor to sustainable development.

Hence, we aim to find the role of environmental entrepreneurship to attain sustainable green development in emerging Asian economies. Two different proxies of environmental entrepreneurship are used in this analysis including electricity production from renewable sources, excluding hydroelectric and nuclear, renewables, and other production. For empirical estimation, we have applied ARDL-PMG. The findings from the Panel-ARDL PMG confirmed the positive impact of electricity production from renewable sources on green economic growth both in the short and long run. Similarly, renewable energy production also causes green economic growth to rise in the short and long run. Trade is another element that can help promote green economic growth. The causal analysis confirms the feedback effects between green economic growth and financial development, electricity production from renewable and financial development, internet and renewable energy production.

Based on our findings, we can provide important policy insights. For green economic growth electricity production from renewable sources and renewable energy production turns out to be important factors. Therefore, the governments in these emerging Asian economies should focus on the promotion of renewable energy sources. Renewable energy sources provide an opportunity for entrepreneurs to produce products by using cleaner and greener energy sources that are more environmentally friendly and less detrimental to the environment. Renewable energy sources, on one side, improve energy security. On the other side, it helps to increase the overall production in the economy which would have a positive effect on economic growth and

environmental quality as well. Therefore, the foremost focus of the government in the emerging economy should be on the production and consumption of renewable energy and technological innovation. Policymakers should improve environmental laws and regulations, stimulate transparency, and delivers policies that encourage the entrance of new entrepreneurs into the renewable energy industry. Moreover, the formulation of appropriate institutions and reforms for good governance can support promoting sustainable growth and improving the overall economy.

This research encountered several limitations that provide new directions for future research as well. The present study provides empirical analysis in panel cases and completely ignores country-specific analysis. However, if future studies focus on country-specific analysis then more useful findings can be obtained. In this study, environmental entrepreneurship is measured through two proxies namely electricity production from renewable sources and renewable energy production. In future research, other measures of entrepreneurship could be considered, such as formal and informal entrepreneurship. Future studies can also explore the direct and indirect impact of environmental entrepreneurship on green sustainable development by adopting an asymmetric estimation approach, such as the NARDL method. Future studies can assess this nexus by considering other regions and economies as well.

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