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Greenfield investments as a source of sustainable green finance?
On the relationships between greenfield investments, environmental
performance, and asian economic growth

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ADB Working Paper Series

GREENFIELD INVESTMENTS AS A SOURCE OF SUSTAINABLE GREEN FINANCE? ON THE RELATIONSHIPS BETWEEN GREENFIELD INVESTMENTS, ENVIRONMENTAL PERFORMANCE, AND ASIAN ECONOMIC GROWTH

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Abstract

Can economic growth continue without degrading the quality of the environment? This question has led to a lot of inconclusive findings among researchers. This study examines the impact of greenfield investment, human capital, economic activities, and the role of institutions on the environment among Asian countries for the period 2000–2018. The Environmental Performance Index (EPI) developed by Yale University is used as a proxy for gauging environmental performance. The econometric technique is based on panel data econometrics that accounts for cross-sectional dependence, possible endogeneity, and existing heterogeneities. The statistical techniques differentiate between short- and long-term causality. We find that greenfield investment with a strong institution improves environmental performance, suggesting that the pollution haven hypothesis in Asian regions can be moderated by good regulation when good institutional factors are in place. Thus, greenfield investments in the presence of supporting institutions can be a viable source of green finance. In addition, our results also support the Environmental Kuznets Curve hypothesis for these economies as economic growth positively and significantly impacts environmental performance. The environmental performance of the Asian region is negatively impacted by human capital development.

Keywords: investments, environment, economic growth, institutions

JEL Classification: F65, Q56, O16

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1. INTRODUCTION

The global transition to greener economies has accelerated the demand for green financing. Green financing enables better management of environmental and social risks while fostering opportunities that bring a rate of return coupled with environmental benefits and deliver greater accountability (Sachs et al. 2019). Therefore, in the context of increasing green financing requirements, greenfield investments can offer a novel avenue toward green financing by improving environmental performance. However, few studies have studied the causal relationship between greenfield investments and environmental performance, even though there are studies attempting to understand the causality relationships between economic growth, environmental qualities, and foreign direct investment (FDI) (Abdouli and Hammami 2017; Jiang 2015; Liu et al. 2018; Nasreen, Anwar, and Ozturk 2017; Pablo-Romero and De Jesús 2016; Sapkota and Bastola 2017; Shahbaz et al. 2015; Shittu, Musibau, and Hassan 2018).

The aim of our study is to unravel the dynamic relationship between greenfield investment, environmental performance, institutional quality, and economic growth for a group of 40 Asian economies between 1990 and 2018. Panel data econometrics is employed for this purpose. The significance of this study is that the findings provide decisional guidance for policy makers and practitioners regarding greenfield investments, environmental sustainability, creating strong institutional quality, economic growth, and emissions reduction in Asian economies.

The contribution of this study to the existing stock of literature is fourfold. First, this paper focuses on the dynamic relationship between the environment and FDI, although there are ample studies exploring the nondynamic causality relationships between greenfield investments, environmental sustainability, institutional quality, and economic growth. Our study extends and enriches the literature on the dynamic relationship between the environment and FDI while relying on disaggregated FDI data (brownfield investment (mergers and acquisition [M&A]) and greenfield investment). Second, our study also uses the recently developed Environmental Performance Index by Yale University as a proxy for environmental degradation. The EPI robustly combines both environmental health and ecological vitality. Earlier studies mostly consider only CO₂ emissions, which is a subset of ecological vitality that neglects broader environmental health such as the quality of water and air, to mention just two. Third, as in Bellaid and Zrelli (2019), our study uses novel panel data econometric techniques that account for cross-sectional dependence and slope homogeneity based on second-generation estimators. This is achieved by performing four major steps, as also described in Bellaid and Zrelli (2019). First, the choice of an appropriate unit root test is determined by undertaking a cross-sectional dependence test. Second, Westerlund's (2007) cointegration test is applied as it allows for cross-sectional dependence. Third, the estimation of long-term estimators by accounting for cross-sectional dependence is achieved by applying Pesaran's Common Correlated Effects Mean Group (CCEMG) estimator. Fourth, the sources of causality and the distinction between short-term and long-term relationships that are robust to outliers and the choice of lag orders are achieved by applying the pooled mean group (PMG) estimator proposed by Pesaran (2004). It is important to note that there are very few studies using second-generation estimators (e.g., AMG and CCEMG) to investigate economic relationships such as the emission-growth-renewables nexus (Dong et al. 2018; Bellaid and Zrelli 2019). The PMG panel ARDL estimation approach allows for both long-run and short-run causality inferences to be drawn regardless of the integration order of time series (integration of order one or zero (I(1) or I(0)) while accounting for cross-sectional heterogeneity.

The fourth contribution is that the nexus relationships between greenfield investment, human capital, economic activities, and the role of institutions and the environment has scarcely been studied in the Asian economies. This presents a major gap considering the broader stock of literature analyzing the causal linkages between greenfield investments, environmental sustainability, institutional quality, and economic growth. This study fills this gap by focusing on developing economic regions like Asia. The paper aims to provide answers to several research questions: (1) What is the role of greenfield investments in mitigating malaise among Asian economies?; (2) Is there a possibility of replacing greenfield investments with brownfield investments such as mergers and acquisitions (M&A) in the economic growth process in Asia?; (3) How can weak institutions contribute to increasing environmental degradation as well as economic unsustainability?; and (4) What are the spillover effects of improvements in environmental quality in Asian countries? The findings of this paper answer these research questions by highlighting the sources and directions of the causal dynamic relationships between greenfield investments, environmental sustainability, institutions, and economic growth. Policy makers and development practitioners can benefit from the study's findings in enabling the design and implementation of ongoing economic, greenfield investment, environment sustainability, and institutional quality policies in the Asian region.

The study can also provide ideas on the design and implementation of future economic, greenfield investment, environment sustainability, and institutional quality policies in the region.

The remainder of the paper is structured as follows. Section 2 sets the geographic focus by providing the Asian context. Section 3 is a brief summary review of the relevant literature. The data and econometric model are described in Section 4. The empirical findings are reported in Section 5. Section 6 concludes the paper by providing relevant policy implications.

2. THE ASIAN CONTEXT

Developing Asia is prone to several energy and environmental problems. Therefore, the Asian economies have attempted to adopt different policies toward combating the adverse impacts of climate change as well as policies geared toward improving energy security. These policies, for instance, include prompting green energy investments, financing energy efficiency improvements, and deploying low-carbon technologies.

Evidently, in 2014, the developing countries had a total foreign direct investment (FDI) flow of \$681 billion. In particular, the developing regions of Asia comprising East Asia and Southeast Asia collectively experienced about a 10% rise in the inflow of FDI. Similarly, the South Asia region accrued a 16% increase in FDI from that in 2013. The huge inflow of foreign capital is primarily invested in developing the manufacturing sector (Nadeem 2019). The FDI inflow can promote economic growth, develop human capital, and create employment by transferring management skills, knowledge, and innovative technologies (Ahmad, Draz, and Yang 2018; Anyanwu 2014; Tülüce and Doğan 2014). Globally, among the developing economies, Asia has been relatively more attractive for FDI inflow than other developing regions since 1990. The influx of foreign capital inflows has largely boosted the economic growth of the Asian region, including East Asia, Southeast Asia, and South Asia (Quazi 2014; Ullah et al. 2018). For example, East Asia, Southeast Asia, and South Asia experienced a sharp growth in the inflow of FDI from 1990 to 2014 (Athukorala 2014). The amount of FDI increased to \$2,886 million, \$1,707

million, and \$352 million in 2014 from \$240 million, \$616 million, and \$6,795 million in 1990 for East Asia, Southeast Asia, and South Asia, respectively.

Although FDI serves as a tool for economic growth and employment generation, an associated challenge is a decline or worsening of the environmental performance of the host countries, which emanates from the transfer of polluted industries, the higher rate of industrialization, the increased demand for energy, rising urbanization, and economic growth (Osabuohien, Efobi, and Gitau 2015; Sibanda and Ndlela 2019). According to the theories of sustainability, inflow of investments and trade leads to a decline in environmental quality as a consequence of overutilization of natural resources (Bende-Nabende 2017). Furthermore, the pollution haven hypothesis (PHH) also asserted that in order to reduce production costs, locations with less stringent environmental regulations are usually preferred for investment by multinationals (MNCs) from developed countries. This is because stringent environmental regulations such as imposing extra taxes or controls on the industrial input usage leads to increased production costs. Through the investment activities of MNCs from developed countries, pollutants are generated and released into the host developing countries from the exploitation of natural resources (Aguilera-Caracuel et al. 2012). However, the Porter or pollution halo hypothesis (Porter 1991) suggests that the competitiveness among MNCs is increased owing to stringent environmental regulations that drive them toward the evolvement of environmentally efficient technologies. Consequently, these MNCs are able to impact the environment positively through the development and use of pro-environmental technologies (Chakrabarty and Wang 2013).

More recently, multidimensional environmental challenges have evolved as a result of rapid capital flows and through human actions such as increased use of fossil fuels and non-renewable energy, as well as urbanization coupled with economic growth across regions (Lieder and Rashid 2016). Therefore, the world has been experiencing heightened environmental challenges for three successive decades now. The surface temperature of the world increased by 0.89 degrees centigrade between 1901 and 2012, and this phenomenon has resulted in climate change endangering the global food supply, impeding economic growth, and debasing the welfare of humans in general (McMichael 2013).

The International Energy Agency (IEA 2016) also revealed an increase of 150% in the total global primary energy supply between 1971 and 2014. Approximately 82% of this primary energy is produced from fossil fuels, and the increase in fossil fuel consumption led to an increase in per capita carbon dioxide (CO₂) emissions of 16% from 1990 to 2014 (IEA 2016). The joint contribution of the energy and industrial sector to the overall global CO₂ emissions amounted to 70%. The use of fossil fuels for energy generation alone contributed about 32 GT of CO₂ emissions in 2014 (Nejat et al. 2015). Consequently, both environmental quality and human health have been negatively affected by anthropogenic activities. The World Health Organization (WHO) (2016) has shown that atmospheric air pollution is the root cause of over 300 million deaths annually. Similarly, the pollution of water bodies also serves as a main cause of infant mortality at the global level (Lelieveld et al. 2015).

The issue of urbanization poses a major threat to environmental sustainability. Urbanization has the impending consequences of overdemand for water supply, a high rate of air pollution, a shortage of sanitation facilities, and hiking of the energy demand leading to greater deterioration in environmental quality (Blum 2016). It is projected that by 2050, the proportion of the total world population that are urban dwellers will increase to 66%, in contrast to 54.5% in 2014, and only 30% in 1950 (Cheng and Tong 2017).

Asia is considered to have one of the most vulnerable environments among the regions of the world. Air and water pollution, land degradation, deforestation, and biodiversity loss are some of the environmental challenges prevalent in the region (Jha and Whalley 2001; Reynolds et al. 2001). Two countries, namely the People's Republic of China (PRC) and India, are the highest CO₂ emitters within the region. For instance, the respective emissions by the PRC and India in 2014 amounted to 30% and 6.5% of the total global carbon emissions (Phoumin et al. 2018). Furthermore, from 1990 to 2010 the aggregate emissions from Southeast Asia alone were more than the emissions from any other regions in the world. From 1990 to 2014, the per capita carbon emissions of the PRC, India, Indonesia, and Thailand rose by 333%, 259%, 184%, and 147%, respectively (Phoumin et al. 2018). Increased CO₂ emissions in these regions of Asia have translated into detrimental impacts on their environmental quality. Some Southeast Asian countries, such as Indonesia, Malaysia, Viet Nam, and the Philippines, are ravaged by a serious loss of biodiversity, a downfall in agricultural production, a decline in sanitation and well-being, and an increase in deforestation signaling adverse climate change impacts. It is projected that the region will experience an 11% decline in economic output due to these environmental damages by 2100 if no sustainable intervention policies are implemented (Asuncion and Lee 2017; Ruben and Lee 2017).

South Asia, with its population of 1.5 billion, is plagued by issues of multidimensional socioeconomic threat as a result of environmental degradation. A large proportion of the population suffers from inadequate basic amenities such as fresh water, air, and food, as well as sanitation (Facon and Wojciechowska 2015; Oteng-Ababio 2017). It is projected by 2050 that the region will lose about 1.8% of GDP due to environmental damages. South Asia also has some of the most polluted cities in the world (Adeel-Farooq, Abu Bakar, and Olajide Raji 2018). The PRC is the most highly polluted country in the East Asia region, accounting for two-thirds of carbon emissions globally. This has been the direct cause of environmental degradation and consequently 1.6 million deaths in the PRC annually. The rapid influx of FDI and economic growth overburdens the environment with pollution (Lu et al. 2017).

Figure 1 shows the underlying regional trend in Asia with regard to FDI inflows in 2017 and 2018. The relationship between greenfield investments and environmental quality in this region is expected to generate many advantages, such as new job opportunities, subduing the rising CO₂ emissions, lowering the transactional costs of firms, sustaining long-term economic growth, and enhancing good institutional qualities among Asian countries.

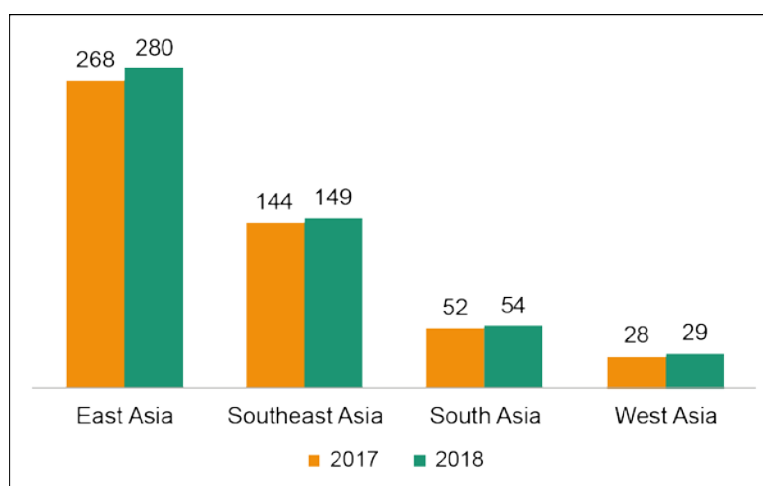
2.1 Institutional Quality, FDI, and Environmental Performance Scenario in Asia

The global flow in FDI in 2018 was \$1.3 trillion. This was a decline of 13% from 2017. The FDI flows to developed economies declined by 27% in 2018, with the overall amount nosediving to the lowest point witnessed since 2004. A tenable reason was the decline of inflows from some large host countries, including the United Kingdom and the United States with declined inflows of about 50% (down to \$200 billion) and 9% (down to \$252 billion), respectively (UNCTAD 2019). However, inflows to developing countries increased by 4%, making it the region with the largest inflow. The developing Asian region hosted 39% of global inflows in 2018 (and 33% in 2017) and was the world's largest FDI receiving region, up from 33% in 2017 (UNCTAD 2019). The large inflows of FDI can be regarded as the engine of its economic growth since 1990s. The East Asian region experienced a 4% increase, amounting to \$280 billion, in 2018, with the PRC

swallowing almost 50% of the inflows. Thus, the PRC remains the largest developing economy recipient. For example, foreign investments accounted for over 60,000 new greenfield investments in 2018 in the PRC (UNCTAD 2019).

The Southeast Asian countries (such as Singapore, Indonesia, Viet Nam, and Thailand) experienced a rise in the level of investment of up to 3% to a value of \$149 billion. Strong investment in manufacturing and service sectors, including digital economy, finance, retail, and wholesale trade, was the driver of this growth. However, countries like Malaysia and the Philippines experienced a drop in FDI inflows. There was a general increase in FDI inflows of 3.5% (to a value of \$54 billion) and 3%, respectively, in South Asia and West Asia. Notable increases are the inflows to Turkey and Saudi Arabia, which rose for the first time in 10 years from a persistent decline (UNCTAD 2019).

Figure 1: Developing Asia: FDI Inflows by Subregion, 2017 and 2018
(billions of dollars)



Source: United Nations Conference on Trade and Development (UNCTAD 2019).

3. SUMMARY OF RELEVANT LITERATURE

The body of literature establishing the linkages between the environment, foreign capital such as FDI (greenfield investment and merger and acquisition), institutional qualities (such as corruption control, the effectiveness of government, rule of law, governance, etc.), and economic growth is large. The free flows of FDI remain a hallmark of the ongoing globalization and globalizing economies. Economic growth around the world is being catapulted by economies being open toward attracting FDI and creating appropriate conditions to attract foreign capital. Past studies such as Mavragani, Nikolaou, and Tsagarakis (2016) and Zhu et al. (2016) show that there exists a strong relationship between economic growth, the openness of the economy, the effectiveness of governance, and environmental performance. Productivity improvements, the diffusion of technology, and the creation of employment are the channels through which FDI encourages economic growth (Abu Bakar and Afolabi 2017). However, Baek and Koo (2008) and Kareem et al. (2014) argued that FDI also contributes to environmental degradation by increasing energy demand and encouraging overexploitation of scarce resources. Increasing greenhouse gas emissions, deforestation, and biodiversity loss are the major environmental problems in which FDI has played a major role by spurring the growth in economic and industrial activities (Mavragani, Nikolaou, and Tsagarakis 2016).

The debates on FDI mirror a trade-off between governments and investors pursuing their economic interests over the welfare of the society and the global environment (Mabey and McNally 1999). As this happens, economic growth does not necessarily occur with appropriate regulation and responsibility (Yerrabati and Hawkes 2016). The lack of adequate regulation implies that sustainable development takes a back seat. Hence, the institutional quality in the destination countries is of paramount importance to engender the positive spillover impacts of FDI. The quality of institutions, including institutional endowment and institutional governance, matters for economic growth (North 1994). As a result, there are some studies studying the impact of the role of institutional quality and FDI inflows in the host country (Ali, Fiess, and MacDonald 2010; Brahim and Rachdi 2014; Jude and Leveigue 2015). High-quality institutions have attributes like rule of law, no corruption, good government, and proper regulations, and this facilitates harmony between local companies and firms from abroad by holding all parties accountable toward sustainable production. On the other hand, bad institutions are costly to the society as they increase transaction costs and generate greater risks, which will eventually lower long-term investments and commitment to environmentally sustainable policies.

Table 1 below summarizes the literature on the relationships between FDI, environmental quality, and economic growth. It is clear from Table 1 that there is no conclusive evidence on the relationships between economic growth, FDI (greenfield and M&A), and environmental performance to date despite the increasing volume of research in this area. The findings are diverse on the magnitude and direction of impacts, which implies that there is no consensus on the direction of causality. Our study aims to fill this knowledge deficit and contribute to the existing literature in this emerging research area by making the following contributions. We first investigate the relationships between greenfield investment, brownfield investment, environmental performance, institutional qualities, and economic growth in Asian economies. We then undertake a causality analysis based on panel unit roots, panel cointegration and estimation, and panel causality tests. Our tests and estimation procedures account for cross-sectional dependence, cross-sectional heterogeneity, and slope homogeneity.

Table 1: Summary of Nexus Studies on the Empirical Relationships between Environmental Quality and Economic Growth

Author	Year	Country and Period	Dependent Variable	Methodology	Results
Adeel-Farooq, Abu Bakar, and Raji	2018	Asia 2003–2014	Environmental Performance Index (EPI)	Robust least squares, fixed effects, random effects	Greenfield investment – EPI GDP + EPI
Kahouli	2018	Mediterranean countries (MCs)/ (1990–2016)	CO ₂ emissions	SUR, 3SLS, and GMM	Electricity consumption ↔ CO ₂ , R&D stocks ↔ CO ₂ , and GDP ↔ CO ₂
Posu	2014	Nigeria/1970–2012	CO ₂	Causality test	Trade intensity, per capita gross GDP, and FDI → environmental quality; and per capita GDP → FDI
Omri	2013	MENA/(1990–2011)	CO ₂	GMM estimators	Energy Consumption → CO ₂ , CO ₂ ↔ GDP
Katrakilidis, Kyritsis, and Patsika,	2016	Greece/1960–2012	CO ₂	ARDL approach to cointegration	Income → CO ₂ and infant mortality. Infant mortality negatively affects economic growth

continued on next page

Table 1 *continued*

Author	Year	Country and Period	Dependent Variable	Methodology	Results
Özcan	2013	12 Middle East countries/(1990–2008)	CO ₂	Panel unit root, cointegration, and causality tests	GDP→EC (short-term) GDP→CO ₂ (long-term) EC→CO ₂ (long-term)
Acharyya	2009	India/1980–2003	CO ₂	OLS estimators	FDI (1ive)
Cowan et al.	2014	BRICs/(1990–2010)	CO ₂	Panel data econometrics based on causality tests	Russian Federation (GDP↔Electricity consumption), Brazil (no causality) Russian Federation (GDP↔CO ₂), South Africa (GDP→CO ₂), Brazil (CO ₂ →GDP) India (Energy consumption→CO ₂)
Hassaballa	2013	Developing countries/1970–2005	CO ₂	Fixed effect model/ GLS	FDI (Mixed)
Kasman and Duman	2015	15 European countries/ (1992–2010)	CO ₂	Panel cointegration and causality tests	EC→CO ₂ (short-term), GDP→EC (short-term), GDP↔EC (long-term), GDP↔CO ₂ (long-term), and EC↔CO ₂ (long-term)
Lan, Kakinaka, and Huang	2012	PRC/1996–2006	CO ₂	Random effect model/GLS	Energy consumption and GDP (positive), FDI and GDP depend on levels of human capital
Alshehry and Belloumi	2015	Saudi Arabia 1971–2010	CO ₂	Johansen multivariate cointegration technique	EC→CO ₂ EC→GDP GDP↔CO ₂
Haseeb, Hassan, and Azam	2016	BRICS/1990–2014	CO ₂	STRIPAT-model/FMOLS	RUT (-ive) Income(+ive) EC (-ive)
Halicioglu	2009	Turkey/(1960–2005)	CO ₂	Vector error correction model, ARDL	CO ₂ →GDP (unidirectional causality)
Azam and Khan	2015	SAARC/1982–2013	CO ₂	OLS	Urbanization (mixed results)
Payne	2012	US 1949–2009	CO ₂	TY procedure	No causality on REC
Ajmi et al.	2015	G7 countries/ 1960–2010	CO ₂	Granger causality	Mixed findings
Menyah and Wolde-Rufael	2010	South Africa 1965–2006	CO ₂	ARDL	CO ₂ ↔GDP NEC→CO ₂ GDP→REC
Ali, Law, and Zannah	2016	Nigeria/1971–2011	CO ₂	Autoregressive distributed lag (ARDL)	Economic growth(+ive) Energy consumption (+ive) Urbanization (insignificant)
Baek	2016	ASEAN/1981–2010	CO ₂	PMG (pooled mean group) estimation	FDI (positive), economic growth (positive), energy consumption (positive)
Shafiei and Salim	2014	OCDE countries 1980–2011	CO ₂	STIRPAT	CO ₂ →REC GDP→CO ₂ CO ₂ ↔NREC
Bélaïd and Youssef	2017	Algeria/1980–2012	CO ₂	ARDL and cointegration approach	Nonrenewable energy (+ive) Economic growth (+ive)
Sebri and Ben Salha	2014	BRICS countries 1971–2010	CO ₂	VECM, ARDL	CO ₂ →GDP GDP↔REC CO ₂ ↔REC (LT)
Chiu	2017	99 countries/ 1971–2010	CO ₂	Panel smooth transition regression	Real income (+ive) Energy (+ive)

EC (energy consumption), NREC (nonrenewable energy consumption), REC (renewable energy consumption), CO₂ (carbon dioxide emissions), and GDP (gross domestic product) → indicate (unidirectional causality), ↔ indicate (bidirectional causality or feedback hypothesis), (-ive) indicate negative impacts and (+ive) indicate positive impacts.

4. DATA, MODEL, AND ESTIMATION METHODOLOGY

4.1 Data Description and Preliminary Data Analysis

The empirical analysis of this study is based on the premises of annual time series data over the period 1990–2018 for 40 economies in Asia. The data on environmental performance proxy are computed by Yale University and include environmental health (encompassing air quality, water and sanitation, and heavy metals) in addition to ecosystem vitality (encompassing climate and energy, air pollution, water resources and agriculture, forests, fisheries).¹ The data on greenfield investments are obtained from UNCTAD. The data on per capita real GDP (constant 2010 US\$), human capital index, exchange rate, and interest rate are extracted from the Penn World Tables (PWT 9.0.).² However, institutional quality data are retrieved from the World Bank Worldwide Governance Indicators and include dimensions like voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and corruption control to form an index using principal component analysis (PCA) (WDI 2019).

Our analysis, therefore, made use of data for 40 Asian economies spanning from 2001 to 2017. A panel autoregressive distributed lag (ARDL) modeling approach was used to investigate the relationships between greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI),³ institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance index (EPI). The study relies on secondary data amassed from various sources, including the WDI (2019) and UNCTAD (2019).

Table 2 shows the descriptive statistics of the time series that this study uses to examine the impact of greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), and institutional quality index (INST) on environmental performance in 45 Asian countries. The study employed greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance to examine the role of greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), and institutional quality index (INST) on environmental performance in 45 Asian economies. The average (mean) values for environmental performance (EPI), Greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), and institutional quality index (INST) in 45 Asian countries are 2012.354, 1.13E+12, 14288.34, 150.3051, 0.314435, 2.87E+10, and 0.730281, respectively, for 45 Asian countries.

Table 3 shows the existence of a correlation relationship among the independent variables, namely greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), and institutional quality index (INST). However, the correlation values are low. Hence, we proceed assuming no problems of multicollinearity among the independent variables.

¹ These data are available at the following link: <https://epi.envirocenter.yale.edu>.

² These data are available at the following link: <https://www.rug.nl/ggdc/productivity/pwt/>.

³ The data on human capital development are retrieved from <http://hdr.undp.org/en/data>.

Table 2: Descriptive Statistics

	EPI	GRNINVT	GDPPC	HCD	INST	EXCH	INTR
Mean	2,012.354	1.13E+12	14,288.34	150.3051	0.314435	2.87E+10	0.730281
Median	2012	1.59E+10	3659.092	87	0.256212	9.01E+08	0.7575
Maximum	2018	1.08E+13	56919.37	774	1.385559	2.91E+11	0.938
Minimum	1990	0	0	1	0.004226	-8.5E+07	0.408
Std. Dev.	3.801293	2.27E+12	18131.12	181.1279	0.278343	5.88E+10	0.134338
Skewness	-0.98901	2.337601	1.023857	1.994603	1.337934	2.748507	-0.93816
Kurtosis	7.501521	7.66278	2.460059	6.518911	4.824848	10.28383	3.083936
Jarque-Bera	193.4103	346.9756	35.6905	69.56222	83.92271	621.0657	28.22068
Probability	0	0	0	0	0	0	0.000001
Sum	386,372	2.16E+14	2,729,073	8,868	60.37146	5.14E+12	140.214
SumSq.Dev	2759.917	9.76E+26	6.25E+10	1902825	14.79765	6.15E+23	3.446919
Observations	192	192	192	192	192	192	192

Table 3: Correlation Table

	EPI	GRNINVT	GDPPC	HCD	INST	EXCH	INTR
EPI	1						
GRNINVT	0.135396	1					
GDPPC	-0.03436	-0.18605	1				
HCD	-0.1302	0.436245	-0.13422	1			
INST	0.07161	0.003145	0.477974	0.189239	1		
EXCH	0.108153	0.906856	-0.1842	0.495497	0.009251	1	
INTR	0.099853	-0.02194	0.140163	0.233038	0.540712	0.047115	1

4.2 Estimation Approach

The objective of this study is to explore the causality relationships between greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance index (EPI). Equation 3.2. below shows the estimated equation expressed in the logarithmic form:

$$[3.2] \ln EPI_{it} = \alpha_{it} + \ln GRNINT_{it} + \ln GDPPc_{it} + \ln HDI_{it} + \ln INST_{it} + \ln EXCH_{it} + \ln INTR_{it} + e_{it}$$

where EPI , $RNINT$, $GDPPc$, HDI , $INST$, $EXCH$, and $INTR$ denote environmental performance index, greenfield investment, GDP per capita, human capital index, institutional quality index, exchange rate, and interest rate, respectively. The error term is captured by e_{it} where 'i' refers to individual cross section (countries) and 't' represents the annual time dimension. We perform the following modelling steps as in Bellaid and Zrelli (2019) to explore the dynamics of the relationships between environmental performance index, greenfield investment, GDP per capita, human capital index, institutional quality index, exchange rate, and interest rate.

4.2.1. Cross-Sectional Dependence Tests

Cross-sectional dependence is a prominent feature in panel data settings, especially when the panel consists of dominant cross sections (or economies) on which other smaller economies rely. Thus, any panel causality analysis needs to test for cross-sectional dependence. The literature proposes various tests for detecting cross-sectional dependence (such as Friedman (1940), Frees (1995), Breusch and Pagan (1980), and Pesaran (2004)). The Lagrange Multiplier test (LM) based on Breusch and Pagan (1980) is commonly used when the data set has a larger T (time series dimension) than the number of cross sections (N). The test proposed by Pesaran (2004) is also popular for cross-sectional dependence to ensure robustness. In panel data models, cross-sectional dependence is embedded in the error terms (De Hoyos and Sarafidis 2006). Ignoring cross-sectional dependence can lead to spurious statistical inference as the unbiasedness and consistency properties of the panel estimators are violated (Phillips and Sul 2003; Baltagi 2005; Robertson and Symons 2000). On the other hand, cross-sectional dependence is inevitable in the context of globalizing economies as economic and financial integration among the sample countries increases. Following tests for cross-sectional dependence, the appropriate unit root tests are chosen to detect the order and find the direction of the integration.

4.2.2 Unit Root Tests

It is important to assess whether the variables are stationary and know the order of integration to validate the appropriate application long-run estimation in panel data (Levin and Lin 1992 1993; Quah 1994). For this purpose, we attempt to correct the shortcomings of previous studies that used a single panel unit root test, especially when a cross-sectional dependence problem exists. As a result, the second-generation panel unit root test has become popular (Pesaran 2007; Bai and Ng 2004; Moon and Perron 2004), while the commonly used first-generation tests include Choi (1992); Levin, Lin, and Chu (2002); and Maddala and Wu (1999). The advantage of the second-generation unit root tests over the first-generation tests is that the second-generation unit root tests look after cross-sectional independence (Smith et al. 2004; Pesaran and Yamagata 2008). The first-generation panel unit root tests unnecessarily tend to reject the null hypothesis in the presence of cross-sectional dependence, which the second-generation tests avoid, for example by using the cross-sectionally augmented ADF (CADF) statistic (Pesaran 2007).

4.2.3. Cointegration Tests

Cointegration tests make it possible to identify if the variables have a relationship in the long term. A pre-requisite for cointegration is that the time series should be integrated of the same order based on the unit root tests. The possibilities of a spurious long-term relationship are immense in the presence of cross-sectional dependence. Hence, we apply the recent and novel cointegration technique proposed by Westerlund and Edgerton (2008), which accounts for cross-sectional dependence.

4.2.4. Estimating Long-Term Relationship

The presence and nonaccounting of heteroskedasticity, cross-sectional dependence, and autocorrelation in panel models leads to misleading statistical inference while the estimators can be inconsistent (Phillips and Sul 2007). The common correlated effects (CCE) panel estimator proposed by Pesaran (2007) allows the presence of heteroskedasticity, cross-sectional dependence, and autocorrelation to be captured (Kapetanios, Pesaran, and Yamagata 2011; Chudik, Pesaran, and Tossetti 2011). The

CCE enables the exogenous regressors to be correlated with the unobserved components while maintaining the independency of idiosyncratic components across cross sections. As outlined in Chudik, Pesaran, and Tosetti (2011), the consistency of the CCE estimator still remains valid under conditions of autocorrelation, unit root behavior, and any contemporaneous dependence of the independent variables with the unobserved components. Therefore, this study applied the common correlated effects mean group (CCEMG) estimator, which is also robust to nonstationary common factors in estimating long-term relationships. The CCEMG estimator is based on Pesaran (2007).

4.2.5. Short-Term and Long-Term Granger Causality Test in Panel

A prerequisite to identifying the source and the nature of causality between the variables is the existence of a cointegrating relationship. We employed the two-step Engle-Granger causality procedure proposed by Engle and Granger (1987) to assert the causality relationships. The application of the pooled mean group (PMG) estimator not only allowed us to identify the sources of causality but also to classify them into short-term and long-term relationships (Pesaran, Shin, and Smith 1999). The PMG estimator accounts for parameter heterogeneity as short-term coefficients and their intercepts, the error correction term, and error variances can be heterogeneous across individual cross sections while restricting the homogeneity of long-term slope coefficients across the cross-sectional units (Calderón, Moral-Benito, and Servén 2015). The PMG estimator is also robust to the presence of outliers in the data and the choice of optimal lag orders based on the Akaike information criterion (AIC) (Pesaran and Smith 1995). We specify below the ARDL dynamic panel of order (pi, qi) that is estimated using the PMG estimator:

$$\begin{aligned}
 [3.3] EPI_{it} = & \alpha_{0i} + \sum_{l=1}^p \alpha_{1li} EPI_{i,t-l} + \sum_{l=0}^p \alpha_{2li} GRNINV_{i,t-l} + \sum_{l=0}^p \alpha_{3li} GDPPC_{i,t-l} \\
 & + \sum_{l=0}^p \alpha_{4li} HCD_{i,t-l} + \sum_{l=0}^p \alpha_{4li} INST_{i,t-l} + \sum_{l=0}^p \alpha_{5li} EXCH_{i,t-l} \\
 & + \sum_{l=0}^p \alpha_{6li} INTR_{i,t-l} + e_{1t}.
 \end{aligned}$$

$$\begin{aligned}
 [3.4] GRNINV_{it} = & \alpha_{0i} + \sum_{l=1}^p \alpha_{1li} GRNINV_{i,t-l} + \sum_{l=0}^p \alpha_{2li} EPI_{i,t-l} + \sum_{l=0}^p \alpha_{3li} GDPPC_{i,t-l} \\
 & + \sum_{l=0}^p \alpha_{4li} HCD_{i,t-l} + \sum_{l=0}^p \alpha_{4li} INST_{i,t-l} + \sum_{l=0}^p \alpha_{5li} EXCH_{i,t-l} \\
 & + \sum_{l=0}^p \alpha_{6li} INTR_{i,t-l} + e_{2t}.
 \end{aligned}$$

$$\begin{aligned}
[3.5]GDPPC_{it} = & \alpha_{0i} + \sum_{l=1}^p \alpha_{1li} GDPPC_{i,t-l} + \sum_{l=0}^p \alpha_{2li} EPI_{i,t-l} + \sum_{l=0}^p \alpha_{3li} GDPPC_{i,t-l} \\
& + \sum_{l=0}^p \alpha_{4li} HCD_{i,t-l} + \sum_{l=0}^p \alpha_{4li} INST_{i,t-l} + \sum_{l=0}^p \alpha_{5li} EXCH_{i,t-l} \\
& + \sum_{l=0}^p \alpha_{6li} INTR_{i,t-l} + e_{3t}.
\end{aligned}$$

$$\begin{aligned}
[3.6]HCD_{it} = & \alpha_{0i} + \sum_{l=1}^p \alpha_{1li} HCD_{i,t-l} + \sum_{l=0}^p \alpha_{2li} GRNIVN_{i,t-l} + \sum_{l=0}^p \alpha_{3li} GDPPC_{i,t-l} \\
& + \sum_{l=0}^p \alpha_{4li} EPI_{i,t-l} + \sum_{l=0}^p \alpha_{4li} INST_{i,t-l} + \sum_{l=0}^p \alpha_{5li} EXCH_{i,t-l} \\
& + \sum_{l=0}^p \alpha_{6li} INTR_{i,t-l} + e_{4t}.
\end{aligned}$$

$$\begin{aligned}
[3.7]INST_{it} = & \alpha_{0i} + \sum_{l=1}^p \alpha_{1li} INST_{i,t-l} + \sum_{l=0}^p \alpha_{2li} GRNIVN_{i,t-l} + \sum_{l=0}^p \alpha_{3li} GDPPC_{i,t-l} \\
& + \sum_{l=0}^p \alpha_{4li} HCD_{i,t-l} + \sum_{l=0}^p \alpha_{4li} EPI_{i,t-l} + \sum_{l=0}^p \alpha_{5li} EXCH_{i,t-l} \\
& + \sum_{l=0}^p \alpha_{6li} INTR_{i,t-l} + e_{5t}.
\end{aligned}$$

where $e_1, e_2, e_3, e_4,$ and e_5 are not autocorrelated, Σ is the error correction terms and α denotes the long-run parameters.

5. ESTIMATION ANALYSIS AND RESULTS

5.1 Tests of Cross-Sectional Dependence

Any contemporaneous correlation among the cross-sectional units can be detected by the cross-sectional dependence test. The choice of appropriate unit root and cointegration tests to follow are based on the results obtained from the cross-sectional dependence test.

Therefore, the study used several cross-sectional dependency tests proposed by Pesaran (2004), Frees (1995), Friedman (1940), and Breusch and Pagan (1980) and the results are reported in Table 4. Based on the results, the null hypothesis of cross-sectional dependence is statistically rejected at the 1% significance level by all tests. Therefore, the data series exhibits cross-sectional dependence indicating that the Asian economies are interdependent of each other. The repercussion of such

interdependence is that economic shocks in one country also get transmitted to other economies and the region. The detection of cross-sectional dependence also necessitates the application of second-generation unit root tests as first-generation tests become insufficient for testing stationarity. Table 5 presents the results from the first- and second-generation unit root tests. The detection of cross-sectional dependence in Table 4 implies that the results from the first-generation unit root tests are not trustworthy. Hence, the second-generation tests are applied based on Breitung (2000), Bai and Ng (2004), and Pesaran (2007). Based on the test results, the null hypothesis that all series contain a unit root cannot be rejected.

Table 4: Tests of Cross-Sectional Dependence

Test	Pesaran	Frees	Friedman	Breusch and Pagan
	CD test	CD(Q)	CD	Chi2
RE model	5.347 (0.018)**	4.956 (0.000)***	52.447 (0.000)***	289.86 (0.000)***
FE model	4.345 (0.000)***	3.961 (0.000)***	82.489 (0.000)***	306.561 (0.000)***

Please note that *, **, and *** respectively indicate significance at 10%, 5%, and 1% levels.

Table 5: Panel Unit Root Tests: First and Second Generation

	First-Generation Test				Second-Generation Test		
	LLC	IPS	ADF-Fisher	PP-Fisher	Breitung (2000)	Bai and Ng (2004)	Pesaran (2007)
EPI	8.371***	11.06***	0.004	41.16***	-2.130**	-3.108***	-2.221***
GRNIN T	8,365.95	7.18243	14.80	4.964	-2.462**	-1.752**	-1.257*
GDPPc	-1.08453	-4.947*	81.32***	150.01**	-3.033**	-2.541**	-2.803*
HCD	-2.500**	-1.685**	12.57**	-3.487***	-1.540**	-4.200***	-2.501***
INST	-4.351**	-5.117**	45.66**	75.12***	-2.243	-2.926***	-1.944**
EXCH	-0.396	-1.656	-1.495	-1.668	-0.397	-1.676	-1.768
INTR	-0.315	-1.768	-0.396	-1.656	-1.495	-1.668	0.004
First Difference							
EPI	-	-	-	-	-	-	-
GRNIN T	-	-	-	-	-	-	-
GDPPc	-	-	-	-	-	-	-
HCD	-	-	-	-	-	-	-
INST	-	-	-	-	-	-	-
EXCH	40.07**	57.08**	-2.389**	-3.774**	67.89**	121.57**	-3.268**
INTR	-7.008**	-3.481**	54.09**	198.44**	-8.243**	-3.825**	-4.785**

Note: Greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance index (EPI). Please note that *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels. Source: Authors' estimation.

5.2 Long-Term Equilibrium Relationship

The presence of a unit root (Table 5) allows us to test for the existence or absence of a long-term equilibrium (i.e., cointegration) relationship among the variables accounting for cross-sectional dependence (Table 4). For this purpose, we apply the cointegration test

proposed by Westerlund (2007), which can be applied across both balanced and unbalanced panels. A long-run equilibrium relationship is confirmed if the error correction term is negative and is taken as proof of cointegration. Table 6 reports the results of the cointegration test. The group mean tests (G_t and G_a) test the alternative hypothesis that there is at least one cointegrating relationship. The panel tests (P_t and P_a) test the null hypothesis that there is no cointegration in the panel (Westerlund 2007; Persyn and Westerlund 2008). The results below show that test statistics are significant and reject the null hypothesis of no panel cointegration. Furthermore, the Johansen-Fisher panel cointegration test (Maddala and Wu 1999; Fisher 1932; Johansen 1988) confirms the presence of at least two cointegrating relationships. Therefore, we confirm a long-run equilibrium relationship among the variables, i.e., greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), and institutional quality index (INST), on environmental performance in Asian economies.

Table 6: Cointegration Test Based on Westerlund (2007)

Statistic	Value	Z-value	P-value	Robust P-value
Gt	5.812	-4.282	0.016**	0.020**
Ga	-23.538	-0.684	0.366	0.080*
Pt	-18.282	-6.396	0.001***	0.000**
Pa	-17.362	-1.116	0.288	0.141

Please note that *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels.

5.3 Estimation of Long-Term Parameters

The empirical analysis involving the examination of an equilibrium long-run relationship suggests cointegration among greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), and institutional quality (INST) in environmental performance. Hence, we also estimate the long-run coefficients (parameters) in the long-run equilibrium relation based on fixed and random effect, pool mean group, mean group, and the CCE and CCEMG estimation procedures. The results are reported in Table 7, where we follow the PMG estimator and Pesaran's long-term CCEMG based on Hausman's test. There is strong evidence of a long-run relationship running from greenfield investment, GDP per capita, human capital index, and institutional quality to environmental performance in Asian countries. The economies converge to a 58 long-run % equilibrium association from greenfield investment, GDP per capita, human capital index, and institutional quality to environmental performance in the region. In other words, the economies are adjusted by a 58% long-run equilibrium association between the independent variable and dependent variable environmental performance. Greenfield investment, GDP per capita, and institutional quality positively and significantly affect environmental performance. This implies that an increase in greenfield investment, GDP per capita, and institutional quality in Asian economies contributes to better environmental performance. The results also show that the coefficient for greenfield investment exceeds that for institutional quality and per capita GDP. This implies that greenfield investment contributes more to improving environmental performance than institutional quality and GDP per capita in Asian countries in the long term. Based on our results, a 1% increase in greenfield investment improves environmental performance by 0.14%. Any earlier studies by Adeel-Farooq, Abu Bakar, Olajide Raji (2018) also based on nine developing Asian countries hinted that greenfield improve environmental performance in Asia. Another finding of our analysis is that human capital development induces a significantly negative impact on

environmental performance in the long run, which contrasts an earlier finding by Lan, Kakinaka, and Huang (2012) in the Chinese context. Our results show that a 1% increase in human capital development reduces environmental performance by 0.14%, all other factors remaining constant.

Table 7: Estimates of Long- and Short-Run Coefficients (Model 1)

Variables	Fixed Effect	Roun Effect	Pooled Mean Group		Mean Group		DCCE
	SR	SR	SR	LR	SR	LR	LR
Cointeqn				-0.58***		-.89***	
GRNINT	3.67E-12 (4.79E-12)	7.86E-12** (2.70E-12)	0.1981 (.1844)	3.942 (2.361)	2.535*** (.9498)	.1359 (.1427)	9.26e-07 (1.58e-06)
GDPPc	0.0006* (0.0004)	1.81E-05 (6.25E-05)	9.250 (13.34)	120.79 (66.46)	-19.85 (53.77)	-.06448 (2.994)	.000010*** (2.88e-06)
HCD	-0.00073 (0.0016)	-0.0040** (0.0016)	-.0941 (.4253)	-.7488 (.8256)	.9656 (1.568)	-.1429* (.0830)	-1.4744*** (.30405)
INST	5.701** (2.389)	4.526** (2.189)	.1593 (.1824)	1.1217 (1.157)	1.316* (.7910)	.0065 (.1262)	.00539** (.00195)
EXCH	-1.68E-11 (9.82E-11)	3.62E-11 (9.48E-11)	109.098 (111.04)	1,255.9 (825.29)	1.902 (335.22)	25.82 (53.64)	5.05e-06 (.000012)
INTR	133.05** (14.86)	22.51** (5.302)	-.2940 (.3517)	-3.536 (2.804)	.9449 (1.254)	-.2547 (.1891)	-.0059 (.0093)
Haus. Test	0.000 (1.00)						
SampleT*N	192	192	192	192	192	192	192

Note: Greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance index (EPI). *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels.

Source: Authors' analysis.

Table 8 below shows the moderating role played by good institution quality in the environmental performance impact generated by greenfield investment, per capita GDP, and human capital development in the Asian economies. Table 7 shows a statistically positive and significant coefficient on the moderating role of institutional qualities in the effect of greenfield investment on environmental performance. This indicates that a good institution improves indirectly the efficiency of greenfield investment in environmental performance by 13% and 0.34%, according to DCCE estimators. *Ceteris paribus*, when the money is spent judiciously on greenfield investment with good institutional qualities, it enhances the environmental qualities of a nation.

In Table 8 again, the results show that institutional qualities matter and significantly moderate per capita GDP and environmental performance in Asian countries by interacting the institutional qualities with GDP per capita. The interaction coefficient is significantly positive. The moderating effect of a good institution increases environmental performance by 25% and 22 % in PMG and DCCE, respectively. However, even after controlling for institutional differences, Asia remains characterized by the blessing of good institutions via income per capita in the region. Similarly, human capital development investment is significant through good institutions as the coefficient of interaction between human capital development and institutional quality is positive and significantly improved the environmental quality of the region. The finding that institution

qualities matter in the environmental performance of an economy is also evident from an earlier study by Katrakilidis, Kyritsis, and Patsika (2016).

Table 8: Estimates of Long- and Short-Run Coefficients

Variables	F-Effect	R-Effect	Pooled Mean Group		Mean Group		DCCE
	SR	SR	SR	LR	SR	LR	LR
Cointeqn			-0.58***		-.89***		
GRNINT	3.67E-12 (4.79E-12)	7.8E-13** (2.70E-12)	.1981 (.1844)	3.942 (2.361)	2.535*** (.9498)	.1359 (.1427)	9.26e-07 (1.58e-06)
GDPPc	0.0006* (0.0004)	1.81E-05 (6.25E-05)	9.250 (13.34)	120.79 (66.46)	-19.85 (53.77)	-.06448 (2.994)	.000010*** (2.88e-06)
HCD	-0.00073 (0.0016)	-0.0040** (0.0016)	-.0941 (.4253)	-.7488 (.8256)	.9656 (1.568)	-.1429* (.0830)	-1.4744*** (.30405)
INST	5.701** (2.389)	4.526** (2.189)	.1593 (.1824)	.2629** (.1037)	1.316* (.7910)	.2629*** (.1037)	.00539** (.00195)
EXCH	-1.68E-11 (9.82E-11)	3.62E-11 (9.48E-11)	109.098 (111.04)	1,255.9 (825.29)	1.902 (335.22)	25.82 (53.64)	5.05e-06 (.000012)
INTR	133.05** (14.86)	22.51** (5.302)	-2940 (.3517)	-3.536 (2.804)	.9449 (1.254)	-.2547 (.1891)	-.0059 -4.06e-07**
GRNINT*INST	.3840** (.1447)	1.228*** (.0807)	-4.587 (.6767)	.6977*** (.1918)	-8340 (2.522)	13.62*** (.1383)	(3.44e-07) (.2706)
GDPPc*INST	1.0e-04** 9.06e-07	2.9e-07*** 6.17e-07	1.018 (.9102)	2.2e-07** (7.7e-08)	1.366 (2.179)	25.69*** (.2418)	2.20e-06** (7.68e-07)
HCD*INST	.8805*** .2049	.4329*** (.02323)	1.018 (.9102)	-.0987** (.04974)	1.366 (2.179)	25.69*** (.2418)	.6977** (.1918)
Haus. Test	0.00 (1.00)	0.00 (1.00)					
SampleT*N	192	192	192	192	192	192	192

Note: Greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance index (EPI). *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels. Source: Authors' calculation

Table 9: Granger Causality Test Results

Dependent Variables	Causation Sources (Independent Variable)						Long-term ECT
	Short-run						
	Δ EPI	Δ GRNINT	Δ GDPPc	Δ HCD	Δ INST	Δ EXCH	
Δ EPI		(23.815)	(0.033)**	(0.033)**	(0.033)**	(0.033)**	-.89***
Δ GRNINT	(3.30)**	(2.13)**	(21.204)**	(0.033)**	(2.91)**	(58.38)**	-.89***
Δ GDPPc	(0.510)**	(2.13)**	-	(0.033)**	(4.55)**	(5.64)**	-.89***
Δ HCD	(8.67)**	(1.18)	(0.386)**	-	(2.12)**	(0.035)	-.89***
Δ INST	(-13.59)**	(15.12)**	(4.55)**	(4.94)**	-	(1.55)	-.89***
Δ EXCH	(0.70)	(58.38)**	(5.64)**	(0.66)	(5.26)**	-	-.89***
Δ INTR	(-8.37)	(10.50)**	(0.16)	(4.30)**	(0.17)	(0.32)	-.89***

Greenfield investment (GRNINT), GDP per capita (GDPPc), human capital index (HDI), institutional quality index (INST), exchange rate (EXCH), interest rate (INTR), and environmental performance index (EPI). *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels.

Source: Authors' calculations.

Thus, the overall results confirm that environmental performance is influenced by FDI, economic activities, and openness. A feedback causal relationship exists between environmental performance and greenfield investment in Asian economies, confirming earlier findings by Adeel-Farooq, Abu Bakar, and Olajide Raji (2018) for 10 Asian countries and Kasman and Duman (2015) for 15 developed economies from Europe. This implies that greenfield investment, GDPPc, human capital development, and good institutional quality have an impact on environmental performance in Asian economies. We also observe a bidirectional causal relationship between per capita GDP, institutional quality, and human capital development in the region. The same result is found by Kasman and Duman (2015) and Kahouli (2018). Greenfield investment, institutional quality, per capita GDP, and human capital development are important determinants of environmental performance in the Asian economies. Therefore, designing sound environmental policies to limit the cost of environmental hazards in the region necessitates accounting for institutional quality in Asia.

6. CONCLUSIONS AND FUTURE RESEARCH

This study explored the dynamic causal relationships between greenfield investment, GDP per capita, human capital index, institutional quality, and environmental performance for 45 Asian countries over the period 2000–2018. Panel data estimations accounting for cross-sectional dependence, endogeneity, and heterogeneity across individual cross sections were employed for this purpose. The application of the statistical techniques was motivated by the need to differentiate between the short- and long-term causality relationships. We find from our analysis that the promotion of environmental quality in Asia through economic policies is dependent on the institutional factors governing these policies.

Our results indicate that greenfield investment with strong institutions is conducive to a better environment in Asian countries. Therefore, the pollution haven hypothesis in the Asian region can be moderated by good regulation when good institutional factors are in place. However, environmental performance is significantly positively impacted by per capita GDP, thereby signaling support for the environmental Kuznets Curve hypothesis. Contrary to our expectation, human capital development has a negative impact on the environmental performance of this region.

The study is significant as the findings of this study are useful in terms of evidence-based policy making in regard to solving environmental problems not only in Asia but also other developing regions globally. The interaction of institutional quality is positive and significantly improves the environmental performance of Asia through economic growth and human capital development. In fact, the influence of human capital development became positive after the moderating role of institutional quality in the region. This indicates that good institutions matter in ensuring the performance of the environment in Asian countries. Additionally, policy makers should encourage strategic policies on greenfield investment, strong institutions, and improving the per capita income of the residents in the region for widespread Asian environmental sustenance.

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