Cuadernos de Economía (2022) Volume 45,Issue 128 Page24-33

Asociación Cuadernos de economía

Cuadernos de economía

www.cude.es

ARTÍCULO

Role of Eco-financing in COP26 Goals: Empirical Evidence from ASEAN Countries

Ho Phi Dinh[1], Ky Nguyen Tran[2], Tien Van Cao[3], Loc Tien Vo[4], Thanh Quang Ngo[5]

[1] *Phan Thiet University, Vietnam; dinhphiho@gmail.com*
[2] *School of Political Studies, University of Economics Ho Chi Minh City (UEH), Ho Chi Minh City, Vietnam; tnky@ueh.edu.vn; ORCID: http://orcid.org/0000-0001-8604-2807*
[3] *The Board of Dormitory Management, University of Economics Ho Chi Minh City (UEH), Ho Chi Minh City, Vietnam; vantien@ueh.edu.vn; ORCID: http://orcid.org/0000-0002-1244-1212*
[4] *Faculty of Accounting and Finance, Van Hien University, 665-667-669 Dien Bien Phu Street, Ward 1, District 3, Ho Chi Minh City, Vietnam; votienloc@hotmail.com*
[5] *School of Government, University of Economics Ho Chi Minh City (UEH), Ho Chi Minh City, Vietnam; thanhnq@ueh.edu.vn*
[*] *Correspondence: thanhnq@ueh.edu.vn; ORCID: http://orcid.org/0000-0001-8357-1957*

Jel Codes:

M14; N14

Keywords: Eco-finance; CO2 emission; energy transition; COP26 goals; ASEAN countries.

Abstract: The current generation is dealing with the greatest effects of global warming, which are much more severe than those visible during the pre-industrial era. To stop further ecological destruction, nations are making great efforts to develop a sustainable environment in the future decades, specifically by 2050. The most recent climate summit, COP26, which provides a road map for achieving environmental sustainability, was prompted by this difficult goal and brought nations together. The current paper aims to investigate how eco-finance affects COP2 targets in ASEAN countries between 2000 and 2020 considering the COP26 resolution. The study evaluates the effect of eco-finance on carbon dioxide (CO_2) emissions and the transition to renewable energy in ASEAN nations. Cross-Sectional Autoregressive Distributed Lag Model (CS-ARDL), an advanced second-generation panel estimation technique, is used for both the long-run and short-run estimation due to the presence of cross-sectional dependency and heterogeneity. The study's conclusions show that eco-finance harms CO_2 emissions but has a favourable impact on energy transition, which can assist ASEAN nations in upholding COP26 resolutions. The policymakers of the chosen economies are encouraged to encourage the financial industry to embrace eco-financing strategies to achieve long-term environmental sustainability based on the findings.

Author Correspondence: thanhnq@ueh.edu.vn
https://doi.org/10.32826/cude.v1i128.703

1. Introduction

The techniques and regulations for preventing and minimizing the adverse effects produced on the atmosphere and ecological environment as a result of the gradual increase in the earth's temperature, commonly known as global warming, are receiving a great deal of attention in recent studies (Sharif et al., 2020; Shibli et al., 2021). Numerous reasons have led to the decline in environmental welfare. Still, human activity, which must be maximized within such activities, is the primary one that demands that social scientists and environmental scientists, in particular, give it more thought (Suki et al., 2022; Tan et al., 2022; Linhai Zhao et al., 2022). To protect the environment for the current generation without endangering the future generation, human practices considered the primary cause of global warming should be seriously addressed and regulated to encourage carbon neutrality in both industrialized and emerging economies. To do this, global agreements have been formed to maintain the global temperature below 2 degrees Celsius and to keep it at or below 1.5 degrees below pre-industrial levels (Chien, Pantamee, et al., 2021; Oke et al., 2021; Linhao Zhao et al., 2021). A recent international summit to change the climate target was the UN Climate Change Summit (COP26), hosted by the UK in 2021. More than 200 countries participated in the most recent climate conference, COP26, which highlighted the need for a comprehensive environmental de-carbonization by 2050 due to the issue raised there. Policymakers and researchers at the conference concluded that any further acceleration of the current global warming is adverse and, therefore, must be curbed a prevented from worsening (Chien, Sadiq, et al., 2021; Ibrahim, 2022; Sadiq et al., 2022).

Among other environmental sustainability goals, COP26 developed new standards for reaching net-zero warming by 2050 and cutting it in half by 2030. For instance, the conference documented pledges to sustain about 85% of the global GDP as part of the net-zero accord. In addition, at least 153 economies back the idea of putting the Nationally Determined Responsible Contributions into practice, which account for roughly 80% of global greenhouse gas emissions (GHGs), to reduce GHG emissions by around 5 billion by 2030 strategically. (COP26 2021). To meet the modified or new pledges, the Glasgow Climate Pact (COP26) strongly emphasized the need to severely reduce coal power, cease deforestation, hasten the transition to electric cars, and reduce methane and other hazardous gas emissions. The critical call for the abolition of fossil fuel subsidies, which are anticipated to exceed $5.9 trillion by 2020 and are responsible for at least 89% of all global carbon emissions, is also promoted by COP26 (Chien, Pantamee, et al., 2021; Ibrahim et al., 2022; Sadiq et al., 2022).

To fulfil the numerous Glasgow Pact promises, the energy transition from fossil fuels to sustainable energy sources continues to be a crucial issue that must be handled honestly. This point of view contends that achieving zero emissions requires an energy transformation. Furthermore, the fact that clean energy has been experimentally regarded as the primary supporter of sustainable development is further evidence that clean energy is necessary to achieve the current global climate agenda. Because fossil fuels continue to contribute to increased GHG emissions despite their rapid decline, more usage of renewable energy is necessary to meet the double concerns. Because of this, it is essential to meet the Glasgow Pact's top priority of using only renewable energy by the year 2050. (Chien, Sadiq, et al., 2021; Ibrahim et al., 2022; Sadiq et al., 2022). Empirical studies have shown that renewable energy is essential for green growth and for, reducing energy use, and diversifying the energy supply in favour of sustainability (Liu, Lan, et al., 2022; Wirsbinna et al., 2021).

To achieve these objectives, the world must transition to a more environmentally friendly, climate-resilient economy, where eco-finance would speed the creation of environmentally friendly infrastructure and innovations that would assist the nations in achieving the climate mentioned above targets (Hartani et al., 2021; Liu, Yin, et al., 2022; Mohsin et al., 2021; J. Wang et al., 2022). Thus, eco-finance, which tries to invest in environmentally benign projects, including forestry, energy efficiency, reduced transportation activity, and energy transition, has become necessary (Hieu, 2022; Kamarudin et al., 2021; Ojogiwa, 2021; Shair et al., 2021). Eco-friendly finance is a necessary component of the transition to sustainability, and its development aims to reinforce financial facets that enhance environmental quality. Numerous past research has shown how eco-finance helps to raise environmental quality. Lan et al. (2022), and Weihong et al. (2022) studies found that using green financing solutions to cut carbon emissions had a favourable impact. Eco-financing enhances environmental quality, as shown by the research of (Meo et al., 2022; Wang et al., 2021; J. Wang et al., 2022). Additionally, eco-financing supports several expensive renewable energy projects, such as nuclear power plants, that would otherwise face significant financial risks and the burden of unfavourable public perception (Bhattacharyya, 2022; Jermsittiparsert, 2021; Khattak et al., 2021).

The ASEAN economies of Malaysia, Indonesia, the Philippines, Thailand, Singapore, and Vietnam are used as case studies to examine the contribution of eco financing to achieving COP26 objectives. One of the study's key goals is to estimate the impact of eco-finance on CO2 emissions and the transition to clean energy throughout the period of 2000–2019. The main arguments for selecting ASEAN economies include: (1) Due to increased primary energy consumption and the region's continued reliance on non-renewable resources, the ASEAN region ranks as the third-largest emitter of greenhouse gases and generates higher CO2 emissions. This is shown in Figure 1. (Figure 2) (Suki et al., 2022) and (Chien, Hsu, et al., 2022). (2) The ASEAN economies have endeavored to apply several green measures for sustainable growth, taking pollution issues seriously (Chien, Hsu, et al., 2022; Chien, Zhang, et al., 2022; Roh et al., 2016). These countries also created the first eco-finance mechanisms. In 2017, green bonds were first listed in ASEAN. The issue amount increased from just under 1.8 billion dollars in 2017 to more than 3.4 billion dollars in 2019 to 10.2 billion dollars in 2020. The first green bonds from ASEAN nations were issued by Sindicatum Renewable Energy Co Pte Ltd of Singapore, Kasikornbank Public Company Limited of Thailand, UiTM Solar Power Sdn Bhd of Malaysia, and PNB Merdeka Ventures Sdn Bhd of Malaysia in 2017. (3) The ASEAN countries are attempting to speed up their energy transition to ensure sustainable energy consumption, which is crucial for achieving zero emissions targets and sustainable economic growth (see Figure 3). The green or eco-financing approach can help ASEAN economies speed up their energy transition and reduce CO2 emissions, as these two goals have been supported 2022. The COP26 resolutions give a forum for examining the incentives for carbon neutrality and environmental protection, which is the first edition of the current study of the literature. As a result, the concept's novelty considering the just concluded climate change summit welcomes ideas for accomplishing the objectives. • Second, despite numerous studies examining various determinants of environmental quality, studies analyzing eco-finance and environmental quality are uncommon, specifically in ASEAN countries. As a result, the current study will be one of the pioneering efforts toward achieving the carbon neutrality target of the COP26 summit. Therefore, considering the COP26 summit goals, this study contributes substantially to the literature on eco-finance-carbon neutrality targets in general and in ASEAN countries.

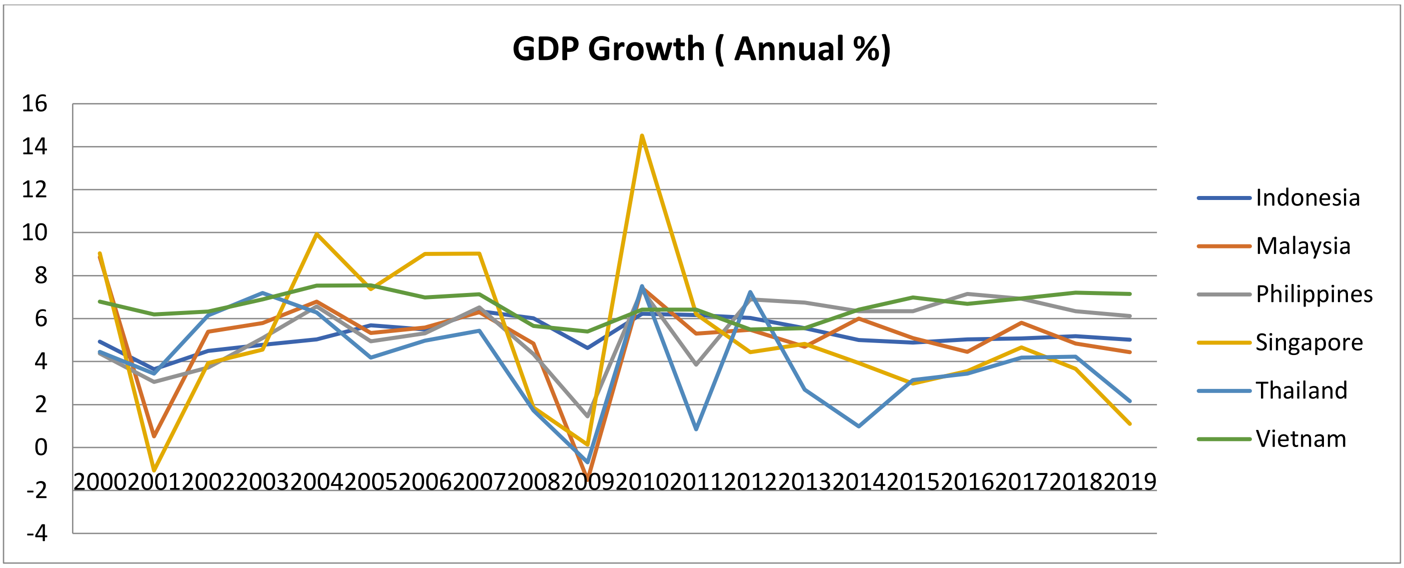

Figure 1. Economic Growth in ASEAN Countries over the 2000-2019 period.
Source: Authors compilation

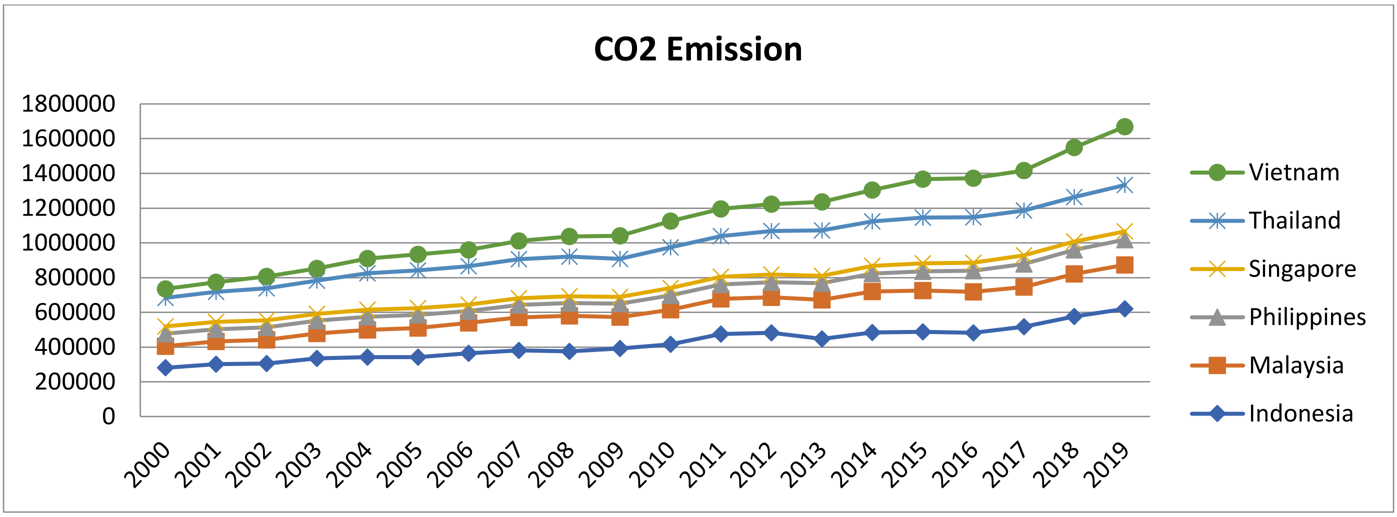

Figure 2. CO2 emission in 6-ASEAN economies over the 2000-2019 period
Source: Authors compilation

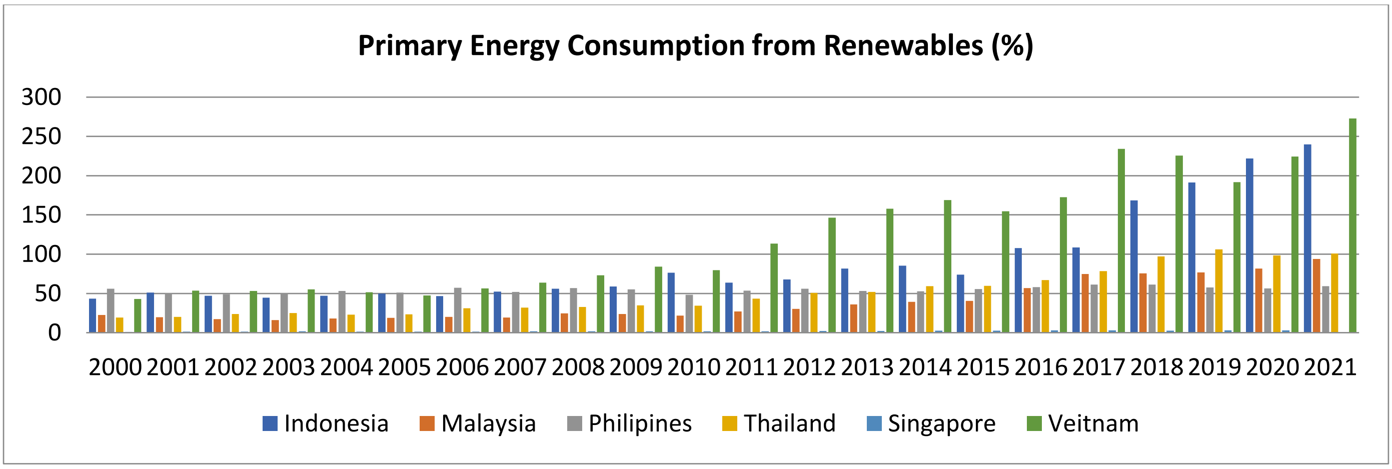

Figure 3. Energy Transition in ASEAN countries (2000-2021)
Source: Author's compilation from the data from Our World in Data (2021)

- Third, and most significantly, there is little information in the literature about the role of eco-finance in the energy transition in ASEAN nations. To our knowledge, the current work is the first to estimate this connection.
- Fourth, in contrast to earlier studies on the relationship between eco-financing and environmental quality and eco-financing and the energy transition, the current study employs CS-ARDL. This second-generation panel data

estimation technique can function more effectively in the presence of cross-sectional dependence (CSD) and slope heterogeneity.

The remaining portions of the study are structured as follows. Section 2 offers a brief and concise summary of the literature to highlight the knowledge gap the current research aims to solve. Data and methodology are discussed in Section 3. Section 4 examines empirical findings, and Section 5 concludes by making worthwhile policy recommendations.

2. Literature Review

According to the G20, "green finance" refers to funding and investments in ecologically friendly growth. Green financing encourages using renewable energy sources in place of fossil fuels by encouraging investment in green energy projects. More direct tactics would be to impose quantitative limits on loans for emission firms and reduce the proportion of bank credit going to fossil fuel industries (Ali et al., 2022; Shah et al., 2021; Zhang et al., 2022). Numerous studies have examined the relationship between green finance and the ecological nexus. However, it is uncommon to find studies evaluating the impact of eco-finance on the energy transition (Fu et al., 2022; Haroon et al., 2021). For instance, J. Wang et al. (2022) examined how green finance affected carbon emissions in Chinese provinces between 2004 and 2018 and discovered that green investment in China was beneficial for meeting CO2 emission reduction targets. X. Bai et al. (2022) and Meo et al. (2022) examined the relationship between green finance and GHG emissions in the major economies that supported green finance between 2008 and 2019. They did this by using data from around the world. Their quantile-on-quantile regression study indicated a negative correlation between green finance and CO2 emissions. To estimate the impact of various green finance investments on CO2 emission throughout 2005–2017 using dynamic panel data estimations, (Wang et al., 2021) also took data from 126 Chinese cities into account.

They concluded that green investments reduced CO2 emissions in Chinese cities. (Sharif et al., 2022) assessed the impact of green finance and green technologies on CO2 emissions for the G7 countries between 1995 and 2018. Using CS-ARDL analysis for empirical research, the authors discovered that green technology and green finance had a detrimental effect on CO2 emissions. Ainou et al. (2022) and Zakari et al. (2021) investigated the impact of green financing on CO2 emissions for the top ecologically investing countries over the 2006–2017 period using practicable generalized least square estimation and discovered that green funding was connected to an improvement in environmental quality in the examined countries. For ASEAN nations, Hieu (2022) looked at the effects of environmental taxes and green investment on CO2 emissions from 1980 to 2020. The Pooled Mean Group panel estimation results show that environmental levies and green investments both have a detrimental effect on CO2 emissions. The relationship between green funding, energy efficiency, green energy use, and CO2 emissions from 2002 to 2018 was also examined by Ahmed et al. in 2022. Results of the Granger Causality Study and Generalized Maximum Likelihood (GMM) analysis showed that green investments, efficient energy use, and green energy were beneficial in encouraging CO2 emission reduction. Ren et al. (2020) and Zhou et al. (2020), and others have also noted the considerable and advantageous effects of eco-finance on environmental conservation.

In addition, S. Wang et al. (2022) investigated how green finance affected investments in renewable energy and energy transition in the E7 nations. The authors discovered that renewable energy investments and energy transition heavily depended on green funding. Li et al. (2022) investigated the impact of geopolitical risk, volatility, and green finance on investments in renewable energy in China for both micro and macro data for 2015–2020. The scientists discovered that while oil price volatility and geopolitical uncertainties were detrimental to renewable energy investment, green financing was helpful in boosting it. Azhgaliyeva et al. (2020)'s analysis of the relationship between green bond policies and issuance for ASEAN concluded that while green policies were successful in promoting the issuance of green bonds, they were ineffective in promoting the development of energy-efficient and renewable energy projects. The impact of green funding on energy efficiency in ASEAN from 2017 to 2020 was studied by Quang et al. (2022). The system GMM analysis's estimation results showed that green financing is a significant factor in the decline of energy efficiency. To evaluate how green bonds impacted investments in renewable energy between 2007 and 2017, Tolliver et al. (2020) examined data from 49 nations. According to the study's findings, green bonds encouraged investment in renewable energy in the countries under investigation.

As a result, studies have shown a strong link between green finance and CO2 emissions and between green financing and energy transition in several nations and panels of nations. However, there is a shortage of in-depth research on developing countries like those in the ASEAN region. Furthermore, the author is aware of no prior studies that examined the impact of eco or green finance on the energy transition in ASEAN nations. These findings motivate present-day scholars to share their knowledge on estimating how green finance influences CO2 emissions and the transition to renewable energy in ASEAN nations.

3. Data and Methodology

The main objective of the present study is to estimate the role of eco-finance in COP26 goals in ASEAN countries. For this purpose, the researchers study the impact of eco-finance on CO2 emission and energy transition over the 2000-2020 period. In addition to eco-finance, non-renewable energy consumption and renewable energy consumption are taken as control variables in the CO2 emission model and industrialization and economic growth are taken as control variables in the energy transition model. To fulfil these objectives, two models for empirical estimation are proposed as follows:

$$CO_{2it} = \beta_1 + \beta_2 EF_{it} + \beta_3 RE_{it} + \beta_4 NRE_{it} + \mu_{it} \quad (1)$$

$$ET_{2it} = \beta_1 + \beta_2 EF_{it} + \beta_3 GDP_{it} + \beta_4 IND_{it} + \mu_{it} \quad (2)$$

Where,

CO_2	=	Carbon dioxide emission
EF	=	Eco-finance
RE	=	Renewable energy consumption
NRE	=	Non-Renewable energy consumption
GDP	=	Economic growth
IND	=	Industrialization
i	=	cross-section
t	=	period

A detailed description of the study variables is given in Table 1 below.

Table 1. Variable Description and Data Sources

Variables	Measurement	Data Source
CO2 emission	CO2 emission (kilo-ton)	WDI
Energy transition	Primary energy consumption from renewable.	Our World in Data
Renewable energy	Renewable energy consumption (quadrillion btu)	EIA
Non-renewable energy	Non-renewable energy consumption (petroleum/other liquids (quadrillion btu)	EIA
Eco-finance	Green bonds	Climate Bonds Initiative
Economic growth	GDP growth (annual %)	WDI
Industrialization	Industry Value Added (% of GDP)	WDI

3.1 Cross-sectional Dependence (CSD) Test

To handle observed and unseen common elements, such as globalization, any pandemic, or financial and economic crises, (Pesaran, 2015) advises employing the CSD test. It is crucial to resolve the confusing circumstances in the CD test before moving on to the unit root test. After looking at CSD in the data, it is simple to evaluate by applying the unit root test series. If the CSD test is not performed, the results would be biased by stationarity, size distortion, and questionable co-integration effects. After the CD estimate, the stage evaluates the panel data's unit root test. However, if non-stationarity does occur, it is dealt with using scientific techniques. Pesaran (2007) created a method called second-generation unit root analysis, which is used with data to address the problems with CD and the consequences of data heterogeneity.

First and second-generation unit root tests may occasionally miss structural breakdowns in the data caused by global and local events. The third unit root test, created by J. Bai et al. (2009), enhances the data reliability by making the sample more unpredictable. The problems of CSD, heterogeneity and structural fractures are all solved by this method. To enhance the data and guard against structural fractures, this study employs the second and second-generation tests for unit roots. The CSD technique successfully addressed the heterogeneity and CSD difficulties. It demonstrated the structural fractures in temporal dimensions that had previously been unsuccessful in both the first and second generations of testing.

3.2 Testing for Cointegration

According to Pesaran et al. (2008), the slope heterogeneity in the data is assessed using a standard and slightly modified version of Swamy (1970)'s test. Although homogeneity data support the theory, a different viewpoint reveals that there are places with various slopes. First-generation test results are erroneous despite the estimations' lack of CSD because size distortion prevented the resolution of the CSD. To deal with CSD, heterogeneity, non-stationarity, structural disturbances, and slope homogeneity in data, a trustworthy technique known as "co-integration" is utilized (Banerjee et al., 2017; Westerlund et al., 2008). These methods deal with the co-integration of the variables and structural breakdowns. Westerlund (2007) can solve the issue of CD presence and heterogeneity but not the structural gap.

To overcome the difficulties posed by CD, slope heterogeneity, and correlational errors, the method developed by (Westerlund et al., 2008) inevitably takes into account the structural breaks of various dimensions independently rather than at once as the first or second-generation test estimations do. The current work builds on the co-integration linkages of the conclusions based on robust and weak data distribution by using a second estimation based on common correlated effects means group. According to Banerjee et al. (2017), this approach successfully allays worries about CSD, stationarity problems, and regression model bias.

3.3 CS-ARDL Analysis

The short-run and long-run coefficients are calculated using CS-ARDL estimation. Due to its strict constraints regarding slope heterogeneity, endogeneity, and CSD, this approach outperforms other estimation techniques. Earlier studies employed conventional methods to assess the variables influencing CO2 emission and the energy transition. Because various model components could result in dependent cross-section error terms, these results can be disputed. Unobserved common model elements may impact the shift to new energy sources and CO2 emissions. As a result, if unobserved common CO2 emission components for various cross sections are combined with explanatory variables, sensitive estimations may result. Due to its strict assumptions, the study used Chudik et al. (2015)'s CS-ARDL estimate approach. This is how the CS-ARDL equation may be expressed:

$$\Delta Y_{it} = \varphi_i + \sum_{l=1}^{p} \varphi_{it} \Delta Y_{i,t-1} + \sum_{l=0}^{p} \varphi'_{il} EXV_{s,i,t} + \sum_{l=0}^{1} \varphi'_{il} \overline{CSA}_{i,t-1} + \varepsilon_{it} \quad (3)$$

Where CSA and denote cross-sectional means $\overline{CSA}_t = (\Delta\bar{Y}_t, \overline{EXV}_{s,t})'$variables, i.e., EXV's represent explanatory variables.

4. Results and Discussion

The CSD test must be carried out to safeguard the data from skewed and biased statistical statistics. Table 2 shows the results of the CSD test, which demonstrate that CD is one of the factors. Because of this, every other variable that influences how the ASEAN countries operate their economies is directly impacted when a financial or economic shock occurs in one of the factors.

Table 2. Results of CSD

Series	Test stat /p-values
CO2	10.011*** (0.000)
EF	20.103*** (0.000)
RE	20.023*** (0.000)
NRE	19.108*** (0.000)
ET	22.012*** (0.000)
GDP	16.117*** (0.000)
IND	22.202*** (0.000)
*** denotes significance at 1 percent.	

Table 3 shows the Pesaran (2007) test results, which show that all variables are stationary as the null hypothesis, according to the stated requirements, is rejected after the CSD in the data has been checked. The second generation unit root test conducted by J. Bai et al. (2009) confirms the occurrence of stationarity at different orders in ASEAN countries' data, much like the first generation unit root test did. The problem of structural breaks is thus resolved, and using the (Pesaran et al., 2008) testing method, the finding of homogeneity shows the outcomes that confirm the null hypothesis. The findings presented in Table 4 reveal that slope heterogeneity exists in the present data.

Table 3. (Pesaran, 2007) Test Findings

	Level			Difference		
Variables	**CIPS**	**M-CIPS**			**CIPS**	**M-CIPS**
CO2	-3.114***	-4.062**			-	-
EF	-4.103***	-5.110**			-	-
RE	-4.111***	-5.031**			-	-
NRE	-3.031***	-4.112**			-	-
ET	-4.110***	-5.101**			-	-
GDP	-3.411***	-4.020**				
IND	-4.010***	-5.010**				
J. Bai et al. (2009) **Test Findings**						
	Z	P_m	***P***	***Z***	P_m	***P***
CO2	0.501	0.604	14.231	-3.110***	4.013***	55.032***
EF	0.400	0.501	20.010	-4.012***	5.011***	46.031***
RE	0.353	0.424	17.110	-4.027***	6.050***	70.106***
NRE	0.561	0.601	24.040	-4.110***	4.108***	44.055***
ET	0.462	0.515	16.117	-4.043***	6.002***	62.013***
GDP	0.343	0.581	17.012	-3.021***	6.106***	45.106***
IND	0.445	0.629	16.213	-4.010***	4.040***	54.010***
*** and ** indicate 1 and 5 percent significance.						

Table 4. Heterogeneity analysis

DV: CO2	
Test Stat	**Test and Prob-value**
Delta- tilde	63.136*** (0.000)
Adjusted -Delta tilde	87.096*** (0.000)
*** denote 1% significance level	

Westerlund et al. (2008) developed the panel co-integration approach to show the long-term relationships between the variables. The CO2 emission model in Table 5 and the energy transition model in Table 6, respectively, are the results of this methodology. When the variables' significant values are considered, it is discovered that the alternative hypothesis is supported. The long-term co-integration of independent and dependent variables has been demonstrated.

Table 5. Cointegration Results Westerlund et al. (2008) (Equation 1)

Test	without break	Mean-shift	Regime shift
DV: CO_2			
$Z_\varphi(N)$	-3.212***	-3.011***	-4.025***
P_{value}	0.000	0.000	0.000
$Z_\tau(N)$	-3.103***	-3.010***	-4.110***
P_{value}	0.000	0.000	0.000
*** represents significance at 1%.			

Table 6. Cointegration Results (Westerlund et al., 2008) (Equation 2)

Test	Without break	Mean shift	Regime shift
DV: Energy Transition			
$Z_\varphi(N)$	-3.112***	-3.031***	-3.015***
P_{value}	0.000	0.000	0.000
$Z_\tau(N)$	-4.113***	-3.110***	-4.000***
P_{value}	0.000	0.000	0.000
*** represents significance at 1%.			

Additionally, we performed the (Banerjee et al., 2017) co-integration test, and the results for the complete sample are shown in Tables 7 and 8 below. Long-term co-integration and a steady association with trend and constant are confirmed.

Table-7. (Banerjee et al., 2017) Co-integration Results (Equation 1)

ASEAN countries	No Deterministic-Specification	With constant	With trend
Explained Variable: CO2			
Whole Sample	-4.010***	-4.001***	-3.121***
Indonesia	-3.200***	-3.030***	-5.016***
Malaysia	-5.101***	-4.121***	-6.110***
Philippines	-5.102***	-4.126***	-6.007***
Singapore	-4.031***	-4.010***	-3.021***
Thailand	-4.005***	-4.405***	-5.110***
Vietnam	-6.010***	-5.010***	-7.106***
With constant, CV is −2.18 and −2.32 at 10%* and 5%**, whereas a CV is– 2.82. and −2.92 with the trend.			

Table 8. Cointegration Results (Banerjee et al., 2017) (Equation 2)

ASEAN Economies	No Deterministic-Specification	With constant	With trend
Explained Variable: Energy Transition			
Whole Sample	-4.510***	-3.021***	-4.041***
Indonesia	-4.220***	-4.050***	-4.116***
Malaysia	-4.111***	-5.022***	-5.100***
Philippines	-3.112***	-3.226***	-4.017***
Singapore	-3.021***	-3.110***	-4.011***
Thailand	-6.035***	-5.105***	-6.010***
Vietnam	-5.013***	-4.110***	-5.115***

With constant, CV is −2.18 and −2.32 at 10%* and 5%**, whereas a CV is– 2.82. and −2.92 with the trend.

After all these preliminary requisites, the study proceeds toward long-run and short-run coefficient estimations by applying CS-ARDL estimation. The findings for Equation 1, i.e., for the CO2 emission model, are provided in Table 9.

Table 9. CS-ARDL Findings

	Short Run					Long Run	
Variables	**Coeff**	**t-stat**	**Prob -value**		**Coeff**	**t-stat**	**Prob- value**
GF	- 0.13***	-3.147	0.030		-0.025***	-4.109	0.000
RE	-0.292***	-3.354	0.010		-0.186***	-2.116	0.004
NRE	0.245***	4.432	0.041		0.236***	3.044	0.000
ECT (-1)	-0.264***	-3.205	0.022				
CSD-Stat	----------	---------	--------			0.039	0.513

*** show significance at 1 percent level

The first factor that enters the estimation with statistical significance and negatively influences CO2 emissions in the examined ASEAN economies is eco-finance as assessed by green bonds. For every unit increase in eco-finance, CO2 emissions fall by 0.133 units in the short term and 0.025 units in the long term. The predicted results align with a study by Sharif et al. (2022), which claims that green investments negatively impact CO2 emissions in G-7 nations. The findings concur with those of Zakari et al. (2021), who examined the top investing nations for environmental protection and concluded that buying green items helps preserve the environment. This result is anticipated because purchasing eco-friendly products, like green bonds, guarantees that things that enhance environmental quality are used.

As a result, there will be less pollution. For ASEAN nations, Fu et al. (2022) and Hieu (2022) also significantly support our findings. Second, according to our estimation results, non-renewable energy has a positive, both short- and long-term impact on CO2 emissions, while renewable energy has both negative and long-term implications. Each unit increase in the usage of renewable energy reduces CO2 emissions by 0.29 units in the near term and 0.18 units in the long term, respectively. In contrast, if non-renewable energy demand rises by one unit, it increases by 0.25 units and 0.23 units over the medium and long term. The results are in line with those of Hanif et al. (2022) for ASEAN nations, Jun et al. (2022) for the highest emitters, and Ibrahim (2022) for Gulf nations, who contend that renewable energy reduces CO2 emissions while non-renewable energy increases them. These results make it abundantly clear that using renewable energy helps achieve COP26 goals since it promotes sustainable development by reducing CO2 emissions, whereas increasing non-renewable energy causes CO2 emissions.

Table 10 provides the results of Equation 2, or the energy transition model, correspondingly. According to the CS-ARDL estimation coefficients for both the short and long runs, all variables are significant at a 1% level.

As can be observed from both short-run and long-run estimations, the coefficient for green bonds has been determined to be statistically significant at 1%. It shows that for every unit increase in eco-investment, energy transition increases by 0.20 units in the short term and 0.11 units in the long term.

Table 10. CS-ARDL Results
Equation 1. DV=Energy Transition

	Short Run				Long Run	
Variables	Coeff	t-stat	Prob -value	Coeff	t-stat	Prob- value
GF	0.203***	2.127	0.000	0.115***	3.149	0.001
GDP	0.092***	2.154	0.000	0.236***	3.260	0.023
IND	0.033***	3.233	0.000	0.066***	4.184	0.000
ECT(-1)	-0.264***	-3.205	0.022			
CSD-Stat	----------	----------	--------		0.094	0.443

*** show significance at 1 percent level

This would back up the assertion that green financing, such as investments in green bonds, has a strong and favourable relationship with assets in the wind, hydro, and solar energy equities. Raising the amount of eco funding, which is unquestionably a panacea for environmental quality, can boost the investment dynamics for renewable energy sources. The results align with those of Tolliver et al. (2020). They contend that green financing is necessary for renewable energy assets to be financed to achieve the emission reduction goals outlined in the Paris Agreement. According to S. Wang et al. (2022) and Li et al. (2022), investment in green financing has a positive impact on the energy transition.

Second, it has been determined that economic expansion helps with the switch to renewable energy. If economic growth grows by one unit, there will be increases in the energy transition of 0.092 and 0.23 units over the short and long terms, respectively. This conclusion could be explained by the fact that more resources are available for investments in renewable energy due to higher levels of economic growth, which make an energy transition viable. In their respective studies, prior studies by Al-Mulali et al. (2013), Apergis et al. (2010), Ergun et al. (2019), Tugcu et al. (2012), and Omri et al. (2015) all strongly concur with our findings and draw the same conclusion. Finally, the favourable impact of industrialization is consistent with studies by Hussain et al. (2021) and Bhattacharya et al. (2017), which found a positive association between industrialization and the usage of clean energy. In terms of coefficient, we discover that if industrialization rises by one unit, there will be an energy transition of 0.03 units in the short term and 0.06 units in the long term.

5. Concluding Remarks and Policy Recommendations

As a result of the continuing increase in global warming, many stakeholders have emphasized the necessity for effective and urgent efforts to avert future unbearable impacts on human survival and the long-term sustainable environment for both present and future generations. At multiple UN climate conferences, the most recent of which was the just concluded COP26, this disadvantageous condition has been repeatedly brought up and has been the focus of discussions. Therefore, the current study evaluates how eco-finance contributes to meeting CO26 objectives. The study specifically calculates the impact of eco-finance on CO2 emissions and the energy transition because these two factors are crucial in determining whether the COP26 targets were accomplished. Due to data availability, the analysis includes information on six ASEAN economies: Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam. Prior literature gave these nations very little consideration when estimating the contribution of eco finance to reducing CO2 emissions.

Additionally, there is virtually no research on the role of eco-finance in these nations' energy transformation. The current study has filled these research voids. To account for the presence of CSD and data heterogeneity, the second-generation estimation technique of the CS-ARDL is applied in the current work. The results show that while CO2 emissions are negatively impacted by eco financing (as measured by green bonds), energy transition is positively impacted. Additionally, we discover that using renewable energy reduces carbon emissions, whereas using non-renewable energy increases CO2 emissions. Similarly, eco-finance and industrialization were also important drivers of the energy shift.

Considering these findings, this paper recommends that ASEAN nations adopt policies that employ fiscal assets to channel social capital and credit financing into environmentally friendly securities, debts, and investments to stimulate eco-finance development. The government has to make green initiatives a higher priority during the review process and develop a green funding model that is more effective and efficient. Reductions in the issuance and trading thresholds for green securities should be part of government strategy in ASEAN developing countries. ASEAN countries could embrace eco financing to raise money for environmental betterment. To extend the range and duration of our sample, we advise further study.

Acknowledgement

This research is partly funded by the University of Economics Ho Chi Minh City (UEH), Vietnam.

References

Abdul Hamid, B., Azmi, W., & Ali, M. (2020). Bank Risk and Financial Development: Evidence from Dual Banking Countries. *Emerging Markets Finance and Trade*, *56*(2), 286-304. https://doi.org/10.1080/1540496X.2019.1669445

Ainou, F. Z., Ali, M., & Sadiq, M. (2022). Green energy security assessment in Morocco: green finance as a step toward sustainable energy transition. *Environmental Science and Pollution Research*, 1-19. doi: https://doi.org/10.1007/s11356-022-19153-7

Al-Mulali, U., Fereidouni, H. G., Lee, J. Y., & Sab, C. N. B. C. (2013). Examining the bi-directional long run relationship between renewable energy consumption and GDP growth. *Renewable and Sustainable Energy Reviews*, *22*, 209-222. doi: https://doi.org/10.1016/j.rser.2013.02.005

Ali, M., Ibrahim, M. H., & Shah, M. E. (2022). Impact of non-intermediation activities of banks on Economic Growth and Volatility: An Evidence from OIC. *The Singapore Economic Review*, *67*(01), 333-348. doi: https://doi.org/10.1142/S0217590820420023

Apergis, N., Payne, J. E., Menyah, K., & Wolde-Rufael, Y. (2010). On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth. *Ecological Economics*, *69*(11), 2255-2260. doi: https://doi.org/10.1016/j.ecolecon.2010.06.014

Azhgaliyeva, D., Kapoor, A., & Liu, Y. (2020). Green bonds for financing renewable energy and energy efficiency in South-East Asia: a review of policies. *Journal of Sustainable Finance & Investment*, *10*(2), 113-140. doi: https://doi.org/10.1080/20430795.2019.1704160

Bai, J., & Carrion-I-Silvestre, J. L. (2009). Structural changes, common stochastic trends, and unit roots in panel data. *The Review of Economic Studies*, *76*(2), 471-501. doi: https://doi.org/10.1111/j.1467-937X.2008.00530.x

Bai, X., Wang, K.-T., Tran, T. K., Sadiq, M., Trung, L. M., & Khudoykulov, K. (2022). Measuring China's green economic recovery and energy environment sustainability: Econometric analysis of sustainable development goals. *Economic Analysis and Policy*, *75*, 768-779. doi: https://doi.org/10.1016/j.eap.2022.07.005

Banerjee, A., & Carrion-i-Silvestre, J. L. (2017). Testing for panel cointegration using common correlated effects estimators. *Journal of Time Series Analysis*, *38*(4), 610-636. doi: https://doi.org/10.1111/jtsa.12234

Bhattacharya, M., Churchill, S. A., & Paramati, S. R. (2017). The dynamic impact of renewable energy and institutions on economic output and CO2 emissions across regions. *Renewable Energy*, *111*, 157-167. doi: https://doi.org/10.1016/j.renene.2017.03.102

Bhattacharyya, R. (2022). Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges. *Green Finance*, *4*(1), 1-35. doi: https://doi.org/10.3934/GF.2022001

Chien, F., Hsu, C.-C., Sibghatullah, A., Hieu, V. M., Phan, T. T. H., & Hoang Tien, N. (2022). The role of technological innovation and cleaner energy towards the environment in ASEAN countries: proposing a policy for sustainable development goals. *Economic Research-Ekonomska Istraživanja*, *35*(1), 4677-4692. doi: https://doi.org/10.1080/1331677X.2021.2016463

Chien, F., Pantamee, A. A., Hussain, M. S., Chupradit, S., Nawaz, M. A., & Mohsin, M. (2021). Nexus between financial innovation and bankruptcy: evidence from information, communication and technology (ict) sector. *The Singapore Economic Review*, 1-22. doi: https://doi.org/10.1142/S0217590821500181

Chien, F., Sadiq, M., Nawaz, M. A., Hussain, M. S., Tran, T. D., & Le Thanh, T. (2021). A step toward reducing air pollution in top Asian economies: The role of green energy, eco-innovation, and environmental taxes. *Journal of Environmental Management*, *297*, 113420. doi: https://doi.org/10.1016/j.jenvman.2021.113420

Chien, F., Zhang, Y., Sharif, A., Sadiq, M., & Hieu, M. V. (2022). Does air pollution affect the tourism industry in the USA? Evidence from the quantile autoregressive distributed lagged approach. *Tourism Economics*, 13548166221097021. doi: https://doi.org/10.1177/13548166221097021

Chudik, A., & Pesaran, M. H. (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of Econometrics*, *188*(2), 393-420. doi: https://doi.org/10.1016/j.jeconom.2015.03.007

Ergun, S. J., Owusu, P. A., & Rivas, M. F. (2019). Determinants of renewable energy consumption in Africa. *Environmental Science and Pollution Research*, *26*(15), 15390-15405. doi: https://doi.org/10.1007/s11356-019-04567-7

Fu, W., & Irfan, M. (2022). Does green financing develop a cleaner environment for environmental sustainability: Empirical insights from ASEAN economies. *Frontiers in Psychology*, *13*, 3171. doi: https://doi.org/10.3389/fpsyg.2022.904768

Hanif, S., Nawaz, A., Hussain, A., & Bhatti, M. A. (2022). Linking Non Renewable Energy, Renewable Energy, Globalization and CO2 Emission under EKC Hypothesis: Evidence from ASEAN-6 Countries through Advance Panel Estimation. *Pakistan Journal of Humanities and Social Sciences*, *10*(1), 391–402-391-402. doi: https://doi.org/10.52131/pjhss.2022.1001.0204

Haroon, O., Ali, M., Khan, A., Khattak, M. A., & Rizvi, S. A. R. (2021). Financial market risks during the COVID-19 Pandemic. *Emerging Markets Finance and Trade*, *57*(8), 2407-2414. doi: https://doi.org/10.1080/1540496X.2021.1873765

Hartani, N. H., Haron, N., & Tajuddin, N. I. I. (2021). The impact of strategic alignment on the sustainable competitive advantages: Mediating role of it implementation success and it managerial resource. *International Journal of eBusiness and eGovernment Studies*, *13*(1), 78-96. Retrieved from https://sobiad.org/menuscript/index.php/ijebeg/article/view/393

Hieu, V. M. (2022). Influence of green investment, environmental tax and sustainable environment: evidence from ASEAN countries. *International Journal of Energy Economics and Policy*, *12*(3), 227-235. doi: https://doi.org/10.32479/ijeep.13028

Hussain, M., Bashir, M. F., & Shahzad, U. (2021). Do foreign direct investments help to bolster economic growth? New insights from Asian and Middle East economies.

World Journal of Entrepreneurship, Management and Sustainable Development, *17*(1), 62-84. doi: https://doi.org/10.1108/WJEMSD-10-2019-0085

Ibrahim, R. L. (2022). Post-COP26: can energy consumption, resource dependence, and trade openness promote carbon neutrality? Homogeneous and heterogeneous analyses for G20 countries. *Environmental Science and Pollution Research*, 1-12. doi: https://doi.org/10.1007/s11356-022-21855-x

Ibrahim, R. L., & Mohammed, A. (2022). On energy transition-led sustainable environment in COP26 era: policy implications from tourism, transportation services, and technological innovations for Gulf countries. *Environmental Science and Pollution Research*, 1-17. doi: https://doi.org/10.1007/s11356-022-23165-8

Jermsittiparsert, K. (2021). Linkage between energy consumption, natural environment pollution, and public health dynamics in ASEAN. *International Journal of Economics and Finance Studies, 13*(2), 1-21. doi: https://sobiad.org/menuscript/index.php/ijefs/article/view/693

Jun, W., Mughal, N., Kaur, P., Xing, Z., Jain, V., & The Cong, P. (2022). Achieving green environment targets in the world's top 10 emitter countries: the role of green innovations and renewable electricity production. *Economic Research-Ekonomska Istraživanja*, 1-26. doi: https://doi.org/10.1080/1331677X.2022.2026240

Kamarudin, F., Anwar, N. A. M., Chien, F., & Sadiq, M. (2021). Efficiency of Microfinance Institutions and Economic Freedom Nexus: Empirical Evidence from Four Selected Asian Countries. *Transformations in Business & Economics*, *20*(2B), 845-868. Retrieved from https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=16484460&AN

Khattak, M. A., Ali, M., & Rizvi, S. A. R. (2021). Predicting the European stock market during COVID-19: A machine learning approach. *MethodsX*, *8*, 101198. doi: https://doi.org/10.1016/j.mex.2020.101198

Lan, J., Khan, S. U., Sadiq, M., Chien, F., & Baloch, Z. A. (2022). Evaluating energy poverty and its effects using multi-dimensional based DEA-like mathematical composite indicator approach: Findings from Asia. *Energy Policy*, *165*, 112933. doi: https://doi.org/10.1016/j.enpol.2022.112933

Li, Z., Kuo, T.-H., Siao-Yun, W., & Vinh, L. T. (2022). Role of green finance, volatility and risk in promoting the investments in Renewable Energy Resources in the post-covid-19. *Resources Policy*, *76*, 102563. doi: https://doi.org/10.1016/j.resourpol.2022.102563

Liu, Z., Lan, J., Chien, F., Sadiq, M., & Nawaz, M. A. (2022). Role of tourism development in environmental degradation: A step towards emission reduction. *Journal of Environmental Management*, *303*, 114078. doi: https://doi.org/10.1016/j.jenvman.2021.114078

Liu, Z., Yin, T., SURYA PUTRA, A. R., & Sadiq, M. (2022). Public Spending as a New Determinate of Sustainable Development Goal and Green Economic Recovery: Policy Perspective Analysis in the Post-Covid Era. *Climate Change Economics*, *13*(03), 2240007. doi: https://doi.org/10.1142/S2010007822400073

Meo, M. S., & Abd Karim, M. Z. (2022). The role of green finance in reducing CO2 emissions: An empirical analysis. *Borsa Istanbul Review*, *22*(1), 169-178. doi: https://doi.org/10.1016/j.bir.2021.03.002

Mohsin, M., Kamran, H. W., Nawaz, M. A., Hussain, M. S., & Dahri, A. S. (2021). Assessing the impact of transition from nonrenewable to renewable energy consumption on economic growth-environmental nexus from developing Asian economies. *Journal of Environmental Management*, *284*, 111999. doi: https://doi.org/10.1016/j.jenvman.2021.111999

Ojogiwa, O. T. (2021). The crux of strategic leadership for a transformed public sector management in Nigeria. *International Journal of Business and Management Studies*, *13*(1), 83-96. Retrieved from https://sobiad.org/menuscript/index.php/ijbms/article/view/481

Oke, D. M., Ibrahim, R. L., & Bokana, K. G. (2021). Can renewable energy deliver African quests for sustainable development? *The Journal of Developing Areas*, *55*(1). doi: https://doi.org/10.1353/jda.2021.0022

Omri, A., Daly, S., & Nguyen, D. K. (2015). A robust analysis of the relationship between renewable energy consumption and its main drivers. *Applied Economics*, *47*(28), 2913-2923. doi: https://doi.org/10.1080/00036846.2015.1011312

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265-312. doi: https://doi.org/10.1002/jae.951

Pesaran, M. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric Reviews*, *34*(6-10), 1089-1117. doi: https://doi.org/10.1080/07474938.2014.956623

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, *142*(1), 50-93. doi: https://doi.org/10.1016/j.jeconom.2007.05.010

Quang, P. T., & Thao, D. P. (2022). Analyzing the green financing and energy efficiency relationship in ASEAN. *The Journal of Risk Finance*, *23*(4), 385-402. doi: https://doi.org/10.1108/JRF-02-2022-0046

Ren, X., Shao, Q., & Zhong, R. (2020). Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model. *Journal of Cleaner Production*, *277*, 122844. doi: https://doi.org/10.1016/j.jclepro.2020.122844

Roh, S., Thai, V. V., & Wong, Y. D. (2016). Towards sustainable ASEAN port development: challenges and opportunities for Vietnamese ports. *The Asian Journal of Shipping and Logistics*, *32*(2), 107-118. doi: https://doi.org/10.1016/j.ajsl.2016.05.004

Sadiq, M., Ngo, T. Q., Pantamee, A. A., Khudoykulov, K., Thi Ngan, T., & Tan, L. P. (2022). The role of environmental social and governance in achieving sustainable development goals: evidence from ASEAN countries. *Economic Research-Ekonomska Istraživanja*, 1-21. doi: https://doi.org/10.1080/1331677X.2022.2072357

Shah, A. A., Hussain, M. S., Nawaz, M. A., & Iqbal, M. (2021). Nexus of Renewable Energy Consumption, Economic Growth, Population Growth, FDI, and Environmental Degradation in South Asian Countries: New Evidence from Driscoll-Kraay Standard Error Approach. *iRASD Journal of Economics*, *3*(2), 200-211. doi: https://doi.org/10.52131/joe.2021.0302.0037

Shair, F., Shaorong, S., Kamran, H. W., Hussain, M. S., Nawaz, M. A., & Nguyen, V. C. (2021). Assessing the efficiency and total factor productivity growth of the banking industry: do environmental concerns matters? *Environmental Science and Pollution Research*, *28*(16), 20822-20838. doi: https://doi.org/10.1007/s11356-020-11938-y

Sharif, A., Baris-Tuzemen, O., Uzuner, G., Ozturk, I., & Sinha, A. (2020). Revisiting the role of renewable and non-renewable energy consumption on Turkey's ecological footprint: Evidence from Quantile ARDL approach. *Sustainable Cities and Society, 57*, 102138. doi: https://doi.org/10.1016/j.scs.2020.102138

Sharif, A., Saqib, N., Dong, K., & Khan, S. A. R. (2022). Nexus between green technology innovation, green financing, and CO2 emissions in the G7 countries: the moderating role of social globalisation. *Sustainable Development*. doi: https://doi.org/10.1002/sd.2360

Shibli, R., Saifan, S., Ab Yajid, M. S., & Khatibi, A. (2021). Mediating Role of Entrepreneurial Marketing Between Green Marketing and Green Management in Predicting Sustainable Performance in Malaysia's Organic Agriculture Sector. *AgBioForum, 23*(2), 37-49. Retrieved from https://agbioforum.org/menuscript/index.php/agb/article/view/60

Suki, N. M., Suki, N. M., Afshan, S., Sharif, A., Kasim, M. A., & Hanafi, S. R. M. (2022). How does green technology innovation affect green growth in ASEAN-6 countries? Evidence from advance panel estimations. *Gondwana Research, 111*, 165-173. doi: https://doi.org/10.1016/j.gr.2022.06.019

Swamy, P. A. (1970). Efficient inference in a random coefficient regression model. *Econometrica: Journal of the Econometric Society, 38*(2), 311-323. doi: https://doi.org/10.2307/1913012

Tan, L. P., Sadiq, M., Aldeehani, T. M., Ehsanullah, S., Mutira, P., & Vu, H. M. (2022). How COVID-19 induced panic on stock price and green finance markets: global economic recovery nexus from volatility dynamics. *Environmental Science and Pollution Research, 29*(18), 26322-26335. doi: https://doi.org/10.1007/s11356-021-17774-y

Tolliver, C., Keeley, A. R., & Managi, S. (2020). Drivers of green bond market growth: The importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability. *Journal of Cleaner Production, 244*, 118643. doi: https://doi.org/10.1016/j.jclepro.2019.118643

Tugcu, C. T., Ozturk, I., & Aslan, A. (2012). Renewable and non-renewable energy consumption and economic growth relationship revisited: evidence from G7 countries. *Energy Economics, 34*(6), 1942-1950. doi: https://doi.org/10.1016/j.eneco.2012.08.021

Wang, F., Cai, W., & Elahi, E. (2021). Do green finance and environmental regulation play a crucial role in the reduction of CO2 emissions? An empirical analysis of 126 Chinese cities. *Sustainability, 13*(23), 13014. doi: https://doi.org/10.3390/su132313014

Wang, J., & Ma, Y. (2022). How Does Green Finance Affect CO2 Emissions? Heterogeneous and Mediation Effects Analysis. *Frontiers in Environmental Science*, 817. doi: https://doi.org/10.3389/fenvs.2022.931086

Wang, S., Sun, L., & Iqbal, S. (2022). Analyzing green financing role on renewable energy dependence and energy transition in E7 economies. *Renewable Energy, 200*, 1561-1572. doi: https://doi.org/10.1016/j.renene.2022.10.067

Weihong, J., Kuo, T.-H., Wei, S.-Y., et al. (2022). Relationship between trade enhancement, firm characteristics and CSR: key mediating role of green investment. *Economic Research-Ekonomska Istraživanja, 35*(1), 3900-3916. doi: https://doi.org/10.1080/1331677X.2021.2006734

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics, 69*(6), 709-748. doi: https://doi.org/10.1111/j.1468-0084.2007.00477.x

Westerlund, J., & Edgerton, D. L. (2008). A simple test for cointegration in dependent panels with structural breaks. *Oxford Bulletin of Economics and Statistics, 70*(5), 665-704. doi: https://doi.org/10.1111/j.1468-0084.2008.00513.x

Wirsbinna, A., & Grega, L. (2021). Assessment of Economic Benefits of Smart City Initiatives. *Cuadernos de Economía, 44*(126), 45-56. Retrieved from https://cude.es/submit-a-manuscript/index.php/CUDE/article/view/206

Zakari, A., & Khan, I. (2021). The introduction of green finance: a curse or a benefit to environmental sustainability? *Energy Research Letters, 3*(Early View), 29977. doi: https://doi.org/10.46557/001c.29977

Zhang, K. Q., Chen, H. H., Tang, L. Z., & Qiao, S. (2022). Green finance, innovation and the energy-environment-climate nexus. *Frontiers in Environmental Science*, 602. doi: https://doi.org/10.3389/fenvs.2022.879681

Zhao, L., Chau, K. Y., Tran, T. K., Sadiq, M., Xuyen, N. T. M., & Phan, T. T. H. (2022). Enhancing green economic recovery through green bonds financing and energy efficiency investments. *Economic Analysis and Policy, 76*, 488-501. doi: https://doi.org/10.1016/j.eap.2022.08.019

Zhao, L., Zhang, Y., Sadiq, M., Hieu, V. M., & Ngo, T. Q. (2021). Testing green fiscal policies for green investment, innovation and green productivity amid the COVID-19 era. *Economic Change and Restructuring*, 1-22. doi: https://doi.org/10.1007/s10644-021-09367-z

Zhou, X., Tang, X., & Zhang, R. (2020). Impact of green finance on economic development and environmental quality: a study based on provincial panel data from China. *Environmental Science and Pollution Research, 27*(16), 19915-19932. doi: https://doi.org/10.1007/s11356-020-08383-2