Journal of Management Studies and Development
Vol. 3, No. 02, pp. 69-80
journal.iistr.org/index.php/JMSD
DOI: 10.56741/jmsd.v3i02.503

Dynamic Analysis of Environmental Degradation and Economic Activities in the Asia-Pacific Region

[1]Yova Tri Lestari*, [1]Mahrus Lutfi Adi Kurniawan, [2]Zafar Khan
Corresponding Author: * mahrus.kurniawan@ep.uad.ac.id
[1] Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[2] Abasyn University, Peshawar, Pakistan

ARTICLE INFO

Article history
Received XX July 2022
Revised XX August 2022
Accepted XX August 2022

ABSTRACT

Economic growth is crucial for assessing a country's economic success, measured by its per capita income increase over time, primarily through Gross Domestic Product (GDP). This study investigates the impact of Gross Fixed Capital Formation (GFCF), energy consumption, CO2 emissions, and renewable energy on economic growth in the Asia-Pacific region from 2016 to 2021. Using the Difference Generalized Method of Moments (Difference GMM) and Stata 14, the findings show that GFCF positively influences economic growth in developing countries but not significantly in developed ones. Energy consumption positively affects economic growth in developing countries, but not in developed ones. CO2 emissions have no significant impact on economic growth. Renewable energy negatively affects economic growth in developing countries, while its impact is insignificant in developed ones.

Keywords
CO2 Emissions
Difference GMM
Energy Consumption
GDP
Renewable Energy

Introduction

Economic growth serves as a vital indicator of a country's success in its economic realm, reflecting how economic activities contribute to the continual increase of a nation's per capita income. It signifies a transformative process in a country's economy through the economic activities conducted by its society and other communities, enhancing the productivity of goods and services [1],[2]. Gross Domestic Product (GDP) is a key measure to gauge economic growth [3]. Analyzing economic growth data in the Asia-Pacific region from 2016 to 2021, encompassing both developed and developing nations, reveals fluctuating growth patterns. The economic downturn experienced by all Asia-Pacific nations in 2020, attributed to the COVID-19 pandemic, was mitigated by economic recovery efforts in 2021, leading to renewed growth as economic activities were optimized.

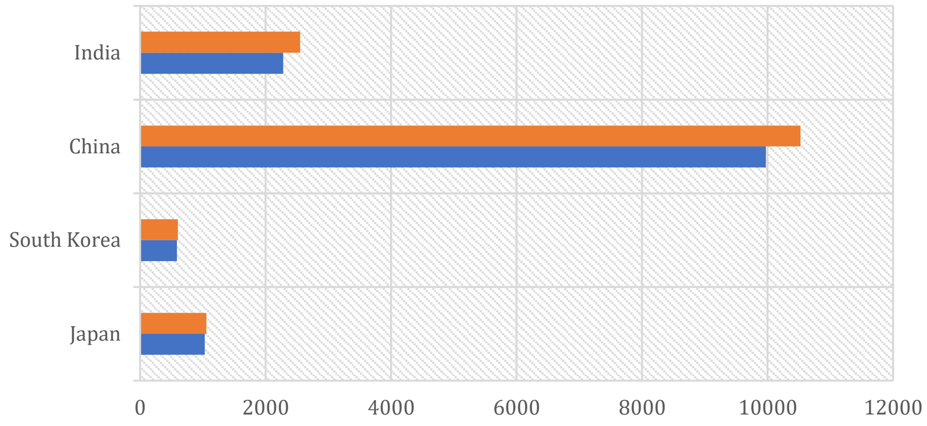
Gross Fixed Capital Formation (GFCF), considered a proxy for investment, influences economic growth by being a part of the expenditure side in GDP formation [4]. Additionally, energy consumption is crucial for economic activities, with higher consumption indicating domestic industrial development that propels the economy [2]. However, excessive use of energy derived from natural resources like oil, gas, and coal can adversely impact the environment [5]. Data from Ref. [6] highlights significant energy consumption in Japan (18.37%), South Korea (12.43%), China (141.80%), and India (32.77%), with China leading in economic growth. The average economic growth from 2016 to 2021 confirms China's remarkable performance, with a 6.14% average growth rate surpassing other Asia-Pacific nations.

On the flip side, high economic growth resulting from continuous and environmentally unfriendly economic activities can lead to environmental degradation. Environmental degradation signifies a decline in environmental quality due to the imprudent utilization of natural resources to meet human needs [7]. The current global concern revolves around environmental issues, especially with the escalating global warming and climate change caused by greenhouse gas emissions. Surface warming on Earth is attributed to gases like carbon dioxide (CO2), methane (CH4), nitrogen (N2O), and fluorine-containing gases accumulating in the atmosphere and altering radiative balance [8].

The Asia-Pacific region is the world's largest carbon emitter, and combating climate change heavily relies on Asian nations reducing their dependence on coal. In 2020, the region contributed 52% of global CO2 emissions, as reported in the Statistical Review of World Energy. Data from Indonesian Statistics Center Review of World Energy for 2020-2021 indicates an increase in CO2 emissions in Japan, South Korea, China, and India.

Fig. 1 illustrates CO2 emissions from 2020 to 2021, depicting increases in emissions for Japan, South Korea, China, and India. China, with the fastest economic growth, experienced a significant rise in CO2 emissions from 9974.30 million tons in 2020 to 10523 million tons in 2021. Utilizing renewable energy is proposed to counterbalance this, aiming to reduce fossil fuel usage and mitigate environmental degradation, including CO2 emissions.

 P-ISSN 2962-5955 ● E-ISSN 2962-5467



	Japan	South Korea	China	India
2021	1053.7	603.8	10523	2552.8
2020	1029.5	588.8	9974.3	2281.2

Fig. 1. CO2 emissions from 2020 to 2021

The Paris Agreement, established as an international legal commitment during COP21 in 2015, targets limiting global temperature increases to below 2°C above pre-industrial levels and striving for a 1.5°C increase. Countries like China and Japan are making strides in renewable energy adoption to meet these goals. Research by Ref. [9] highlights the positive significant impact of renewable energy on economic growth in 38 countries globally, including Asian regions like Korea, Japan, Australia, Thailand, China, and India. To bridge research gaps, this study employs the Difference Generalized Method of Moments (Difference GMM) methodology to examine the relationship between environmental degradation, represented by CO2 emissions, and economic growth in 16 Asia-Pacific countries.

Based on the outlined issues, the objectives of this research are as follows:

1. To examine the influence of Gross Fixed Capital Formation (GFCF), Energy Consumption, CO2 Emissions, and Renewable Energy on economic growth in the Asia-Pacific region.
2. To discern the variations in the impact of Gross Fixed Capital Formation (GFCF), Energy Consumption, CO2 Emissions, and Renewable Energy on economic growth between developed and developing countries in the Asia-Pacific region.

Methods

A. Research Design

A quantitative descriptive methodology is employed in this investigation. Utilizing research tools and quantitative or statistical data analysis, quantitative research, stemming from positivist thinking, is utilized to explore a specific population or sample and validate hypotheses. The emphasis on cause and effect (causal) relationships is crucial for the quantitative approach to determine how different variables are interconnected. Therefore, both independent and dependent factors are employed in this research to ascertain the extent of the influence of independent variables on the dependent variable. On the other hand, descriptive analysis is a technique to portray data in the phenomenon under discussion using a collected sample. However, this technique aims to draw conclusions that are generally acceptable [10].

In this study, a cross-sectional approach is employed, focusing on a specific point in time. The unit of analysis is the Asia-Pacific region, comprising developed countries such as Japan, South Korea, Singapore, Hong Kong, Australia, and New Zealand, as well as developing countries including Bangladesh, China, India, Indonesia, Malaysia, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam. The time frame for the study spans from 2016 to 2021.

B. Data

In this research, quantitative and panel data are employed. Quantitative data are utilized to examine causality, and it involves information that can be input into statistical measurement scales and described in numerical units. Secondary data, collected specifically for this research, are accessed through reputable official websites. Five variables are used in this analysis, and data for these variables are sourced from the official websites of the World Bank and British Petroleum Statistical. This study focuses on four variables that may influence economic growth in the Asia-Pacific region from 2016 to 2021. The variables used in this research are as follows:

Table 1. Operational Definitions

Variable	Symbol	Operational Definition	Unit	Data Source
Economic Growth (Y)	GDP	Rate of economic growth conditions in 16 Asia-Pacific countries	Percentage	World Bank
Gross Fixed Capital Formation (X1)	GFCF	Gross Fixed Capital Formation (GFCF), also known as "investment"	Percentage	World Bank
Energy Consumption (X2)	CE	Measures the total energy demand of a country	Percentage	Indonesian Statistics Center
CO2 Emissions (X3)	LnECO	Gas from combustion processes containing carbon compounds transformed into logarithmic form	Million Tons	Indonesian Statistics Center
Renewable Energy (X4)	RE	Energy derived from natural resources that can be renewed	Percentage	Indonesian Statistics Center

C. Data Analysis Techniques

Data panel consists of time series and cross-sectional data merged. This study employs a cross-section of 16 countries in the Asia-Pacific region and a time series spanning from 2016 to 2021. Illustration of the panel data regression model using cross-sectional data:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \quad \text{....................} (1)$$

I= 1,… N : T= 1,…T

Where:
N: Number of observations
T: Number of time periods
N x T: Number of panel data

The steps to be undertaken in this research are as follows:

1. Describe each variable in the study for an overview.
2. Present the results of tests conducted on the entire panel data, including CEM, FEM, REM, GMM, and Diff GMM tests.
3. Estimate the economic and environmental growth model using the Diff GMM method.
4. Conduct statistical tests such as t-tests and F-tests, as well as goodness-of-fit tests for Diff GMM.
5. Interpret the research findings.

D. Panel Data Regression Model

The estimation of the panel data regression model can be done through three approaches.

1. Common Effect Model (CEM)

   Utilizes either Small Squares or Ordinary Least Square (OLS) approaches to estimate the panel data model. Equation for the general CEM model:

$$Y_{it} = \beta_0 + \beta_1 x1 + \beta_2 X_2 + \cdots + \beta_j X_{jit} + \varepsilon_{it} \quad \text{....................} (2)$$

   Ignores individual and temporal dimensions.

2. Fixed Effect Model (FEM)

   Indicates that differences in intercepts can explain individual differences. Employs dummy variables to precisely indicate intercept differences. General equation for the FEM model:

$$Y_{it} = \beta_{0it} + \beta_1 X_{it} + \beta_2 X_{it} + \cdots + \beta_j X_{jit} + \varepsilon_{it} \quad \text{....................} (3)$$

3. Random Effect Model (REM)

   Computes panel data with disturbance factors correlated across individuals and time. Two methods for REM estimation: Least Square Dummy Variable (LSDV) and Generalized Least Square (GLS). Equation for the REM model:

$$Y_{it} = \beta_{0it} + \beta_1 X_{it} + \beta_2 X_{it} + \cdots + \beta_j X_{jit} + (\pi_i + \varepsilon_{it}) \quad \text{....................} (3)$$

4. Generalized Method of Moment (GMM)

Addresses endogeneity issues in dynamic panel data. Two estimation methods: Difference GMM and System GMM. Equation for the research model in this study:

$$\mathrm{GDP}_{it} = \beta_0 + \beta_1 \mathrm{GDP}_{i.t-1} + \beta_2 \mathrm{GFCF}_{it} + \beta_3 \mathrm{CE}_{it} + \beta_4 LnECo_{it} + \beta_5 RE_{it} + \varepsilon_{it}$$

Where:

Ln : declares data transformed into natural logarithmic forms
GDP_{it} : economic growth rates in 16 Asia Pacific countries
$\mathrm{GDP}_{i.t-1}$: lag of variable economic growth rates in 16 Asia Pacific countries one year earlier
GFCF_{it} : Gross Fixed Capital Formation
CE_{it} : Energy consumption
LnECo_{it} : CO2 emissions
RE_{it} : Renewable energy
β_0 : Constant
β_{1-5} : Coefficient
ε : Error term
i : cross-section
t : year

A technique based on Difference GMM that can produce reliable estimates for equations with individual effects, lagged dependent variables, and non-strictly exogenous exogenous variables. Transformation of the equation to address time-invariant variables, but endogeneity issues persist due to unobserved fixed effects. Adjustments made to the error term to overcome endogeneity issues. GMM estimation requires tests and assumptions for validity. GMM assumes linearity, but errors do not contain autocorrelation. Important assumption as GMM uses lags as instrumental variables.

Results

A. Descriptive Analysis

In Table 1, statistical analysis of the variables is presented, serving as a crucial component in the research model to illustrate data outcomes, answering the researcher's inquiries. Moreover, this data from the research model can be utilized to illustrate the model during regression analysis on panel data.

Table 2. Panel Data Summary Statistics

Variable	Observations	Mean	Std. Dev	Min	Max
Economic Growth	96	3.246	3.670	-5.918	8.948
Gross Fixed Capital Formation (GFCF)	96	27.670	6.812	14.645	43.940
Primary Energy Consumption	96	15.342	33.894	0.366	157.647
CO2 Emissions	96	5.664	1.469	3.127	9.261
Renewable Energy	96	0.714	1.803	0.005	11.320

Based on the descriptive statistics of the variables used in the research model, as shown in the table above, the descriptive analysis for each variable includes the following:

1. The study comprises 96 observations. The average economic growth during the period 2016-2021 is 3.246%, with a standard deviation of 3.670%. The lowest and highest economic growth rates are -5.918% and 8.948%, respectively.
2. The Gross Fixed Capital Formation (GFCF) variable has an average over the period 2016-2021 of 27.670%, with a standard deviation of 6.812%. The lowest and highest GFCF rates are 14.645% and 43.794%, respectively.
3. The variable representing primary energy consumption has an average of 15.342% over the period 2016-2021, with a standard deviation of 33.894%. The lowest and highest rates of energy consumption are 0.366% and 157.647%, respectively.
4. The average value of the CO2 emissions variable is 5.664 million tons, with a standard deviation of 1.469 million tons. The lowest and highest values for CO2 emissions are 3.127 million tons and 9.261 million tons, respectively.
5. The renewable energy variable has an average over the period 2016-2021 of 0.714%, with a standard deviation of 1.803%. The lowest and highest rates of renewable energy consumption are 0.005% and 11.32%, respectively.

B. Results of Panel Data Analysis

The results of the panel data analysis using Stata 14, including Common Effect Model (CEM), Fixed Effect Model (FEM), Random Effect Model (REM), and Difference Generalized Method of Moments (Diff GMM), are presented in Table 2 and Table 3.

Table 3. Full Model Panel Data Test Results

Variable	CEM	FEM	REM	Diff GMM
Economic Growth	-	-	-	-0.394
	(0.000)***	(0.000)***	(0.000)***	
Gross Fixed Capital	0.177	0.997	0.233	1.658
Formation (GFCF)	(0.010)**	(0.000)***	(0.005)***	(0.000)***
Energy Consumption	0.035	1.752	0.020	2.141
	(0.416)	(0.017)**	(0.668)	(0.000)***
CO2 Emissions	-0.141	-4.410	-0.092	2.192
	(0.716)	(0.324)	(0.852)	(0.354)
Renewable Energy	-0.618	-6798	-0.468	-8.977
	(0.385)	(0.015)**	(0.494)	(0.000)***
Constant (C)	-0.963	-1.406	-2.656	-76.960
DiagnosticTools				
Hansen'sJTest(UjiSargan)	0.184	-	-	-
AR(2)Test(UjiAbond)	0.645	-	-	-

Remark:
The values represent coefficients for each variable, with the associated p-values in parentheses.
Significance levels: *** = 1% (0.01), ** = 5% (0.05), * = 10% (0.10).

Table 4. Difference GMM Test Results

Variable	Full Model	Advanced Countries	Developing Countries
Economic Growth	-0.394	-2.664	-0.221
	(0.000)***	(0.075)*	(0.072)*
Gross Fixed Capital Formation (GFCF)	1.658	0.186	1.560
	(0.000)***	(0.861)	(0.000)***
Energy Consumption	2.141	7.507	2.608
	(0.000)***	(0.461)	(0.003)***
CO2 Emissions	2.192	40.427	3.316
	(0.354)	(0.389)	(0.529)
Renewable Energy	-8.977	-86.467	-10.701
	(0.000)***	(0.162)	(0.013)**
Constant (C)	-76.960	-243.191	-103.386
Diagnostic Tools			
Hansen's J Test (Uji Sargan)	0.184	1.000	-
AR(2) Test (Uji Abond)	0.645	0.013	0.429

Remark:
The values represent coefficients for each variable, with the associated p-values in parentheses.
Significance levels: *** = 1% (0.01), ** = 5% (0.05), * = 10% (0.10).

The Difference GMM method applied to developing countries in the Asia Pacific aims to eliminate overidentifying restrictions in the model.

Discussion

A. Impact of Gross Fixed Capital Formation (GFCF) on Economic Growth

From the analysis results using the Difference GMM method, several conclusions can be drawn regarding the impact of Gross Fixed Capital Formation (GFCF) on economic growth in the context of developed and developing countries in the Asia Pacific. The probability value of GFCF in developing countries is 0.000, which is less than the 5% significance level (0.05). This indicates that GFCF has a positive and significant impact on economic growth in developing countries. With an increase in GFCF by 1.560 percent, economic growth in developing countries is estimated to increase. The probability value of GFCF in developed countries is 0.861, which is greater than the 5% significance level (0.05). This indicates that there is no significant relationship between GFCF and economic growth in developed countries. This result is surprising because it is generally expected that investment in the form of GFCF will support economic growth. However, in the context of developed countries, this may not be a significant determinant. The findings of this study are consistent with some previous research [11],[12] indicating that GFCF has a positive impact on economic growth, especially in developing countries. In the context of developed countries, the result showing that GFCF is not significant to economic growth can be explained by the conditions of developed countries, which already have high income levels, high-quality human resources, and the ability to manage their economies independently. Investments are more likely to be diversified or global, such as providing investments to developing countries.

B. Impact of Energy Consumption on Economic Growth

Analyzing the results from the Difference GMM test, the influence of energy consumption on economic growth is examined for both the full model and in the context of developed and developing countries in the Asia Pacific region. The probability values for energy consumption in both the full model (0.000) and developing countries (0.003) are less than the 5% significance level (0.05). This indicates a positive and significant impact of energy consumption on economic growth in both scenarios. An increase in energy consumption by 2.141 percent is associated with a 1 percent increase in economic growth for the full model. In developing countries, a 2.608 percent increase in energy consumption is estimated to result in a 1 percent increase in economic growth. The probability value for energy consumption in developed countries is 0.461, which is greater than the 5% significance level (0.05). This suggests that energy consumption does not significantly impact economic growth in developed countries. This result aligns with expectations, as developed countries are often more focused on energy efficiency, innovation, and better energy management. Hence, their economic growth can be achieved through increased productivity and efficiency without a significant increase in energy consumption. The findings support the hypothesis that increased consumption of fossil energy contributes positively to economic growth, as indicated by previous studies [13]-[15]. The result for developed countries, where energy consumption does not significantly affect economic growth, is consistent with the idea that these countries have invested in energy-efficient technologies and practices. Developed countries, exemplified by Japan, have implemented strict regulations and financial incentives for energy efficiency. Japan's high ranking in energy efficiency, with a score of 63.5, is attributed to stringent energy efficiency regulations, including the use of energy managers and benchmarking systems for reporting annual energy consumption. In summary, the impact of energy consumption on economic growth varies between developing and developed countries, with developing countries benefiting significantly from increased energy consumption, while developed countries focus on achieving growth through enhanced efficiency and technology.

C. Impact of CO2 Emissions on Economic Growth

Examining the results from the Difference GMM test, the influence of CO2 emissions on economic growth is analyzed for the full model, developed countries, and developing countries in the Asia Pacific region. The probability values for CO2 emissions in the full model (0.354), developed countries (0.389), and developing countries (0.529) are all greater than the 5% significance level (0.05). Consequently, CO2 emissions are found to not significantly affect economic growth in the full model and in both developed and developing countries. This result contradicts the initial hypothesis derived from previous studies [2],[16]. The expectation that CO2 emissions impact economic growth is challenged, suggesting that the relationship might be more nuanced and influenced by various factors. The findings imply that the use of energy for economic activities, leading to CO2 emissions, may not be a straightforward driver of economic growth. Factors such as the nature of energy use, whether for productive purposes in industries or for non-productive activities like household consumption, can influence the relationship. In the context of Indonesia, household consumption contributes minimally to CO2 production. The study suggests that emissions from household activities may not have a significant impact on economic growth. This underscores the need to differentiate between sources of CO2 emissions and their economic implications. In conclusion, the analysis indicates that CO2 emissions do not significantly influence economic growth in the studied regions and scenarios. This finding challenges conventional expectations and highlights the importance of considering the specific context and nature of energy use in understanding the relationship between CO2 emissions and economic growth.

D. Impact of Renewable Energy on Economic Growth

Analyzing the results from the Difference GMM test, the influence of renewable energy on economic growth is examined for the full model, developed countries, and developing countries in the Asia Pacific region. The probability values for renewable energy in the full model (0.000) and developing countries (0.013) are both smaller than the 5% significance level (0.05). This indicates that renewable energy has a significant negative impact on economic growth. The coefficients are -8.977 for the full model and -10.701 for developing countries, suggesting that a 1% increase in renewable energy results in a 8.977% and 10.701% decrease in economic growth, respectively. However, in developed countries, the probability value is 0.162, greater than the 5% significance level. Hence, in developed countries, renewable energy is found to not significantly affect economic growth. The results contradict the initial hypotheses derived from previous studies [14],[16] that proposed a positive impact of renewable energy on economic growth. The negative impact observed in the full model and developing countries is explained by the challenges and costs associated with transitioning to renewable energy. Governments' efforts to support environmentally friendly energy transitions may require significant expenditures for technology infrastructure, potentially slowing down economic growth. In developed countries, the lack of a significant impact may be attributed to the continued dependency on non-renewable energy sources, as seen in the example of Japan. The higher reliance on non-renewable energy suggests that the shift to renewable sources has not significantly influenced economic growth in these countries. In conclusion, the analysis reveals a significant negative impact of renewable energy on economic growth in the full model and developing countries, contrary to the expected positive relationship. The findings emphasize the complexities and challenges associated with the transition to renewable energy, indicating that careful consideration is needed to balance environmental goals with economic growth objectives.

Conclusion

In both the full model and developing countries, the Gross Fixed Capital Formation (GFCF) variable demonstrates a favorable impact on economic growth. This implies that an increase in GFCF leads to accelerated economic growth in both scenarios. However, in developed countries, fluctuations in GFCF do not impact economic growth. Whether GFCF rises or falls, it does not influence the pace of economic growth in developed nations. Positive correlation exists between energy consumption and economic growth in both the full model and developing countries. An increase in energy consumption corresponds to an increase in economic growth in these scenarios. In contrast, there is no discernible relationship between energy consumption and economic growth in developed countries. Changes in consumption have no significant impact. CO2 emissions do not influence economic growth in the full model, developing countries, or developed countries. This suggests that changes in CO2 emissions, whether positive or negative, do not affect economic growth. Renewable energy has a negative impact on economic growth in both the full model and developing countries. An increase in renewable energy leads to a decrease in economic growth in these contexts. In developed countries, changes in renewable energy, either increasing or decreasing, do not impact economic growth. There is no discernible relationship between the two variables.

Research Limitations

The study is constrained by limited literature on previous research related to economic growth, Gross Fixed Capital Formation (GFCF), energy consumption, CO2 emissions, and renewable energy. Consequently, the research faces limitations in terms of both research findings and analyses due to the scarcity of existing literature on the mentioned variables.

Conflict of Interest

The authors declare that there is no conflict of interest.

References

[1] Zuldareva, F. (2017). Analisis pengaruh konsumsi energi dan emisi CO2 terhadap pertumbuhan ekonomi Di Indonesia periode 1981-2014. *Jurnal Ilmiah Mahasiswa FEB*, *5*(1), 1-13.
[2] Setyowati, V. A., Prasetyanto, P. K., & Hutajulu, D. M. (2021). Pengaruh angkatan kerja, harga minyak dunia, konsumsi energi, dan emisi CO2 terhadap pertumbuhan ekonomi di Indonesia tahun 2000-2019. *DINAMIC: Directory Journal of Economic*, *3*(1), 36-52.
[3] Goodwin, N., Harris, J. M., Nelson, J. A., Rajkarnikar, P. J., Roach, B., & Torras, M. (2022). *Macroeconomics in context*. Routledge.

[4] Rajni, P. (2013). Linkages between Export , Import and Capital Formation in India. *International Research Journal of Social Sciences, 2*(3), 16–19.

[5] Ula, T., & Affandi. (2019). Dampak Konsumsi Energi Terbarukan Terhadap Pertumbuhan Ekonomi: Studi di Asia Tenggara. *Journal of Economics Science, 5*(2), 26–34.

[6] Indonesian Statistics Center Review of World Energy 2022, (71st edition). In Indonesian Statistics Center. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf

[7] Yunhendri, D., & Bustari, M. (2021). *Ekonomi Lingkungan*. Deepublish Publisher.

[8] Abouelfadl, S. (2012). Global Warming–Causes, Effects and Solution'S Trials. *JES. Journal of Engineering Sciences*, *40*(4), 1233-1254.

[9] Bhattacharya, M., Paramati, S. R., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy, 162*, 733–741. https://doi.org/10.1016/j.apenergy.2015.10.104

[10] Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

[11] Andinata, C. P., Adenan, M., & Jumiati, A. (2020). Analisis Pendapatan Nasional di Negara-negara Anggota ASEAN. *Jurnal Ekuilibrium*, *2*(1), 31-44.

[12] Haidar, M. I., & Firmansyah, F. (2021). Analisis pertumbuhan ekonomi negara-negara asean. In *FORUM EKONOMI: Jurnal Ekonomi, Manajemen dan Akuntansi, 23*(3), 593-605.

[13] Berlianto, D. M. F., & Setya Wijaya, R. (2022). Pengaruh transisi konsumsi energi fosil menuju energi baru terbarukan terhadap produk domestik bruto di Indonesia. *E-Jurnal Perspektif Ekonomi Dan Pembangunan Daerah, 11*(2), 105–112. https://doi.org/10.22437/pdpd.v11i2.17944

[14] Majeed, M. T., Anwar, A., & Luni, T. (2021). The Impact of Renewable and Non-Renewable Energy Consumption on Economic Growth: A Global Perspective with Developed and Developing Economies. *Pakistan Journal of Commerce and Social Science, 15*(2), 286–307.

[15] Rezki, J. F. (2011). Konsumsi Energi dan Pembangunan Ekonomi di Asia Tenggara Energy Consumption and Economic Development in South East Asia. *Jurnal Ekonomi Dan Pembangunan Indonesia, 12*(1), 31–38.

[16] Rahman, M. M., & Velayutham, E. (2020). Renewable and non-renewable energy consumption-economic growth nexus: New evidence from South Asia. *Renewable Energy, 147*, 399–408. https://doi.org/10.1016/j.renene.2019.09.007

Authors

Yova Tri Lestari is an alumna of the Development Economics program at Universitas Ahmad Dahlan, Yogyakarta, Indonesia. She has a keen interest in the study of international economics, particularly focusing on the dynamics of global economic interactions, trade policies, international finance, and economic development across nations. (email: yovalestari73@gmail.com).

Mahrus Lutfi Adi Kurniawan is associated with the Economics Department at Universitas Ahmad Dahlan, Indonesia. His academic pursuits focus on macroeconomics and monetary economics. He has made notable contributions to several publications. He completed his Master's degree in Economics and Development Studies at Universitas Sebelas Maret, Indonesia. (email: mahrus.kurniawan@ep.uad.ac.id).

Dr. Zafar Khan is a scholar at Abasyn University Peshawar. He is an Assistant Director Human Resources, Government of Khyber Pakhtunkhwa Food Safety and Halal Food Authority. His core skills include but not limited to human resource management and talent onboarding, conducting interviews, payroll section handling, ERP management, HR information system handling. (email: adzafarkhan@outlook.com).