Green Economy and Sustainable Development in Indonesia: ARDL Approach

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Abstract

This study attempts to determine how the link between air pollution, economic growth, carbon dioxide damage, and life expectancy in Indonesia reflects the long-term and short-term effects of factors connected to the green economy and sustainable development. We take data from the World Bank as a secondary source for the years 2000 to 2020, From our estimation results, we find that the variables we estimate have long-term and short-term correlations such as air pollution and economic growth and economic growth with economic growth in the previous year, in the short term air pollution has a negative effect on economic growth, as well as economic growth in 2016. previously. In contrast to the relationship between the variable economic growth and life expectancy, which is significantly positive, this shows that between the two with increasing economic growth, life expectancy will also increase. The variable of carbon dioxide damage has a positive and insignificant relationship with economic growth.

Keyword : Economic growth, green economy, sustainable development, Indonesia.
JEL Classification : C31, O10, Q56

Received: November 6,2021 Accepted: Desember 1,2021
DOI : 10.54204/TAJI/Vol412022002

Background

A green economy is an alternate vision for growth and development that may lead to economic growth and life improvement while also increasing social and environmental well-being (Li & Leung, 2021). (Isa, Sivapathy, & Adjrina Kamarruddin, 2021) claim that this green economy may also be understood as one that conserves natural resources, emits little to no carbon dioxide into the atmosphere and is socially just. A green economy differs from traditional economic theories in that natural capital and ecological services are directly valued economically, and expenses incurred by civilization are tracked back and turned into liabilities, entities that do not harm or neglect assets (Hidayattuloh, Bambang, & Amirudin, 2020).

Specialized examination of future trends is notably lacking along the evolutionary route of green economy fashion thus far. Numerous studies have solely focused on this portion of the process, and as a result, there are a number of flaws present, including overlapping and imprecise classifications of economic modes and the absence of a mechanical model to characterize these modes (Dogaru, 2021). According to the study's findings Zhang (2022), the following conclusions were reached: First, there are three stages in the overall development of the green economy model. The first is the startup phase when the green economy of final care is the mode. The resource chain's closed-loop green economy is the mode during the second stage of development. The adult stage, when the mode is "from breeding to breeding," comes in third.

Second, there is a mechanism via which GE-II has developed. The foundation of GE-II is the circular economy theory, which has been steadily integrated with other pertinent ideas and technologies, such as clean production, the low carbon economy, the sharing economy, and so on. The growth of the green economy is now trending in the direction of the establishment of an ecological society.

The economy of the nation continues to be heavily reliant on the extractive industry and basic commodities, both of which have a detrimental effect on the environment. Opportunities to support the green economy, such as offering a sizable enough government stimulus, have not been properly taken advantage of. Attracting green investment to Indonesia, and upholding consistency in policies and regulations related to the green economy is one of a number of policy options to promote a shift to a green economy (Martawardaya, Rakatama, Junifta, & Maharani, 2022).

Because conventional economic development models have a detrimental influence at the global and local environment, so the transition from traditional economic development models to green economies and green economy development methods is crucial (Tasri & Karimi, 2014). According to research Ali, Anufriev, & Amfo (2021), like in Ghana, where lack of support for technology transfer and development, the high cost of green technology, the rising threat of climate change, and corruption pose threats to Ghana's efforts to green its economy. The creation of plans by policymakers to address threats and weaknesses as well as capitalize on opportunities and strengths is crucial. To encourage the growth of the green economy, authorities should prioritize science and technology education among other things.

Another research indicated that corporate sector investment in technology, infrastructure, and these factors enhances net exports, fosters economic growth, as well as reduces poverty in Indonesia. A rise in population income and economic expansion that reflects the population has an influence on poverty reduction (Widarni & Bawono, 2022).

Putranto & Irawan (2021) found that poverty is negatively related to GDP and technology inclusion. However, this is positively related to the need for educational investment issued by the Indonesian government. This means that the more poor people are, the government needs more money to subsidize education so that all citizens can get decent and equal educational opportunities. When the poor continues to decrease, the cost of education can be financed independently by the population so that the need for subsidies or education investment is less. If this situation is developed further, it will actually support sustainable development (Mathiasson & Jochumsen, 2022).

In order to promote consumption and economic growth while still focusing on sustainable development, it is crucial to study how technology and economic infrastructure have developed (Ozturen & Ozgit, 2022). A function or role in promoting economic growth is played by the infrastructure that underpins the economy and supports consumer demand. A very significant economic supporting infrastructure at Indonesian economy is backed through the greater extent of consumption among Indonesians, is the development of roads in terms of seamless distribution alongside conventional marketplaces (Subagyo & Sulisnaningrum, 2021).

Education-related human capital investments have a significant influence on economic growth and have the same driving forces as Internet access and health. This demonstrates how crucial human capital investment is to boost economic growth (Afriani, 2021). This study attempts to determine how the link between air pollution, economic growth, carbon dioxide damage, and life expectancy in Indonesia reflects the long-term and short-term effects of factors connected to the green economy and sustainable development.

Research Method

We take data from the World Bank as a secondary source for the years 2000 to 2020, the following variables will be analyzed using two different time series models. The country's GDP is used as a measure of economic growth in this study. air pollution (CO2), life expectancy (LE), and carbon dioxide damage (CDD) are independent variables of this study because they serve as indicators of how these two variables are related in the long and short term to economic growth. We use the following econometric model:

$$EG_t = \beta_0 + \beta_1 EG_{t-1} + \beta_2 CO2_{t-1} + \beta_3 LE_{t-1} + \beta_5 LE_{t-2} + \beta_6 LE_{t-3} + \beta_7 CDD_{t-1} + e_t$$

Where,
EG : economic growth
CO2 : air pollution
LE : life expectancy
CDD : carbon dioxide damage
e : Error term
t : Time series

In this study, dynamic ARDL was applied. According to Khan et al.(2020) when the independent variables experience a shock, the ARDL model may be used to study, simulate, and predict it. If there is a cointegration relationship between research variables, ARDL simulation models may be used.

Result and Discussion

Table 1 displays descriptive data based on the study's variables.

Table 1. Descriptive statistics

	EG	CO2	LE	CDD
Mean	4.906346	31.99656	68899.95	2.353634
Median	5.051428	31.15531	69029.00	2.270669
Maximum	6.345022	54.57823	71908.00	3.703188
Minimum	-2.069543	8.466164	65772.00	1.445983
Std. Dev.	1.776214	13.16451	1964.395	0.638991
Skewness	-3.184847	0.026908	-0.101068	0.410022
Kurtosis	13.27099	1.904084	1.708812	2.264740
Jarque-Bera	121.7219	1.003273	1.423355	1.010900
Probability	0.000000	0.605539	0.490820	0.603234

Sum	98.12692	639.9312	1377999.	47.07268
Sum Sq. Dev.	59.94378	3292.782	73318085	7.757877
Observations	20	20	20	20

The results of descriptive statistics are expressed in terms of mean, min, max, and Std Dev. EG Mean 4,906, EG Min -2,095, EG Max 6,345, EG Std Dev 1,776. CO2 Mean 31,9, CO2 Min 8,46, CO2 Max 54,57, CO2 Std Dev 13,16, and so on. EG is Indonesia's economic growth, CO2 is air pollution, LE is life expectancy, and CDD is carbon dioxide damage.

Stationary tests should be performed before using the ARDL model to predict values. By analyzing the error components, which include the possibility of autocorrelation if the series is not stationary, Augmented Dickey-Fuller (ADF) can determine whether the series is not stationary. Stationarity test results are presented in table 2.

Table 2. Unit Root Test on EG, CO2, LE and CDD data

Variable	Unit Root	ADF Test stat.	Signif.	Description
Air Pollution (CO2)	Level	-2.256784	0.1966	
	First Diff	-4.237742	0.0054	Stationer
Economic Growth (EG)	Level	-0.527808	0.8660	
	First Diff	-1.929268	0.3129	
	Second Diff	-3.319458	0.0293	Stationer
Life Expectancy (LE)	Level	-5.356536	0.0007	Stationer
Carbon Dioxide Damage (CDD)	Level	-1.320052	0.5992	
	First Diff	-4.718010	0.0016	Stationer

The EG data were stationary at the second difference, CO2 and CDD data were stationary at the first difference, while the LE data were stationary at the original level. Since all the data are stationary we can continue to estimate the ARDL

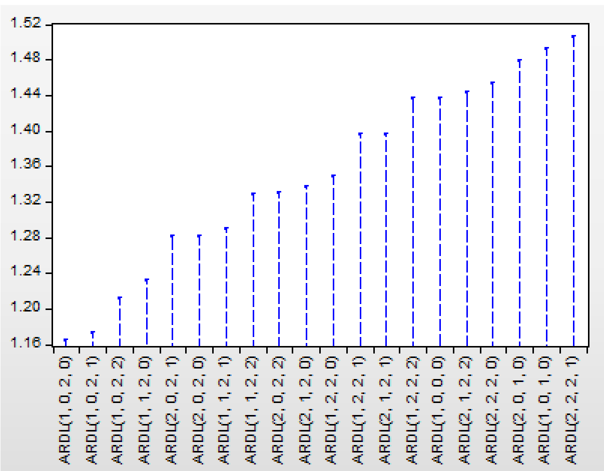

Figure 1. Optimum Lag Test

Optimal lag testing is performed to determine which lag is appropriate for use in the next test; as shown in the picture above, 1,0,2,0 lag is the most recommended.

Tabel 3. ARDL bounds test

Test Stat.	Value	Significant	I(0)	I(1)
F-stat.	4.820504	5%	2.79	3.67
K	3	2.5%	3.15	4.08
		1%	3.65	4.66

Asympotic : n=1000

According to the findings of the ARDL model's Limit Test, shown in Table 4, the model's F-statistical value of 4.820504 is more than the upper limit value at the 5 percent level and even greater than the upper limit value at the 2.5 percent and 1 percent levels. This suggests that the three variables examined in this study namely economic growth, air pollution, life expectancy, and carbon dioxide damage, are cointegrated across time, or that the four variables move in the same direction.

Tabel 4. ARDL analysis results

Variable	Coef.	Std. Error	t-Stat.	Prob.*
EG(-1)	0.243682	0.759189	0.320976	0.7542
CO2	-0.092002	0.035383	-2.600138	0.0247
LE	-0.073960	0.051710	-1.430269	0.1804
LE(-1)	0.177749	0.096502	1.841914	0.0926
LE(-2)	-0.103386	0.045878	-2.253491	0.0456
CDD	3.365304	1.314331	2.560470	0.0265
C	-38.08437	46.51824	-0.818698	0.4303
R-squared	0.716058	Adjusted R-squared		0.561180

The R-squared and R-squared values of the adjusted ARDL model varied between 0.71 and 0.56. The Adjusted R-squared value of 0.56 implies that each of the independent variables in the ARDL model, namely air pollution, life expectancy and carbon dioxide damage, can explain 56 percent of the variation in the dependent variable of economic growth. This shows that the research model is good enough to be researched.

Judging from the ARDL estimation results, the CO2 variable has a coefficient value of -0.092 which indicates that the air pollution factor is a factor that affects economic growth. For example, when the increase in air pollution levels by 1% will result in a decrease in Indonesia's economic growth by 9.2 percent. This indicates that with the increase in air pollution, the productivity of the population in this case their life expectancy decreases which will affect economic growth in Indonesia.

Table 5. analysis results in the long term and short term

Variable	Coef.	Std. Error	t-Stat.	Prob.
C	-38.08438	46.51824	-0.818698	0.4303

EG(-1)*	-0.756318	0.759189	-0.996219	0.3406
CO2**	-0.092002	0.035383	-2.600138	0.0247
LE(-1)	0.000403	0.000631	0.638497	0.5362
CDD**	3.365304	1.314331	2.560470	0.0265
D(LE)	-0.073960	0.051710	-1.430269	0.1804
D(LE(-1))	0.103386	0.045878	2.253491	0.0456

From the table above, the relationship between the variables EG and EG(-1) is significantly negative, as well as the CO2 variable which is also significantly negative, this means that in Indonesia in the short term air pollution has a negative effect on economic growth, as well as economic growth in the previous year. It is different from the relationship between the variables EG and LE(1-) which is significantly positive, this indicates that between the two with increasing economic growth, life expectancy will also increase.

Conclusion

We find that the variables we estimate have long-term and short-term correlations such as air pollution and economic growth as well as economic growth with economic growth in the previous year, in the short term air pollution has a negative effect on economic growth, as well as economic growth in the previous year. It is different with the relationship between the variables of economic growth and life expectancy which is significantly positive, this indicates that between the two with increasing economic growth, life expectancy will also increase. The variable of carbon dioxide damage has a positive and insignificant relationship with economic growth.

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