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# Analysis of government expenditure and environmental quality: an empirical study using provincial data levels in Indonesia

S Oktavilia<sup>1\*</sup>, A Setyadharma<sup>1</sup>, I F S Wahyuningrum<sup>1</sup>, N Damayanti<sup>1</sup>

<sup>1</sup> Faculty of Economics, Universitas Negeri Semarang, Semarang, Indonesia

oktavilia@mail.unnes.ac.id

**Abstract.** The improvement of environmental quality is expected to increase along with the delegation of financial management authority to regional governments by the decentralization policy. The policy is expected to affect the handling of environmental problems in the regions. This study analyzes the influence of regional government expenditure variables and aggregate economic output variables at the regional level on environmental quality. This study uses cross-section data of 33 provinces in Indonesia in the period 2013–2018. Empirical studies were analyzed using panel data regression models. The results show that government expenditure has a positive and significant effect on the environmental quality index. The economic aggregate output variable has a positive and significant effect on the environmental quality index in Indonesia. This may imply that a rise in the quality of Indonesia's environment is indicated by economic growth through a surge in aggregate economic output.

## 1. Introduction

Economic development, followed by production activities, namely processing inputs or production factors into outputs, is presumed to impact the environment. Several studies have shown that the residues from production and consumption activities by economic actors cannot be avoided [1,2,3]. The increase in economic growth that is driven by production and consumption activities is considered to have a negative impact on the environment. The living environment in Indonesia as a country with an agrarian economy is a spatial unit with objects, forces, conditions and living things, including humans and their behaviors that influence nature itself, the continuity of life, and the welfare of humans and other living creatures [4].

The Indonesian government started by improving at the local level. The regional government is given a mandate by the central government to allocate the Regional Revenue and Expenditure Budget (*APBD*) to overcome damage and improve the respective regions' environmental quality. The central government has established the Environmental Fund Management Agency (*BPD LH*) as a fund management agency for forestry, energy and mineral resources, carbon trading, environmental services, industry, transportation, agriculture, marine and fisheries, and other fields related to the environment [5,6]. Local governments have regional autonomy authority to issue regulations to stakeholders in the use of natural resources.

Economies of scale are measured by aggregate national income (Gross Domestic Product) and per capita income. Economic growth indicates that the aggregate output produced by the population of a country has increased. In other words, the economy and national income are getting bigger [7].



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Government policies support is important in accelerating economic growth and increasing the capacity of economies of scale. The contribution of government through expenditure policy is best discussed by Wagner and Weber (1977) and Keynes (1936) [8,9]. Adolph Wagner, a German economist known for the findings of Wagner's Law. One of the economic laws that states a positive relationship between government spending and economic growth. This finding explains the relationship between the increasing role of state activities in the economy, especially in developing countries. Even in several studies that are currently developing, Wagner's Law remains the main reference point that explains the relationship between government spending and economic growth. Fiscal policy 'the effect of increasing aggregate demand will encourage an increase in production capacity, thus leading to job creation and ultimately increasing household income and consumption. Thus, the Keynesian approach emphasizes that public policy will promote increased short-term economic stability and long-term economic growth [10].

In general, previous studies have examined the relationship between environmental quality and GDP, industrial structure, urbanization patterns, and business [11–14]. However, recently, studies have tried to determine the environmental quality of government spending, regional fiscal, financial situation, and monetary policy (15–17). Research conducted by Adewuyi (2016) found empirical results that an increase in government spending in the long and short term has a positive effect on environmental degradation [18].

Recently, a theoretical explanation of the effect of government spending on environmental pollution was presented by Lopez et al. (2011) [19]. In particular, they emphasized the importance and empirically estimated the impact of the composition of fiscal expenditure on the environment. They argued that changing the composition of government spending on social and public goods reduces environmental damages. This result was caused by a combination of four factors that occur from this shift, namely scale (increased environmental pressure due to more economic growth), composition (increased human capital-intensive activities than capital-intensive physical industries which are more environmentally damaging), engineering (due to energy efficiency of higher employment), and income (where an increase in income increases the demand to improve environmental quality).

The relationship between government spending and economic growth can also be examined using the Armey Curve, first introduced by Armey (1995) [20]. According to Armey, the relationship between government spending and economic growth is parabolic or inversely shaped. The U shape occurs based on the law of diminishing returns in explaining the role of government in the economy. If the government does not play a role in the economy, the resulting output will be low and lead to zero economic growth. However, if the government increases its spending, positive economic growth will materialize, as demonstrated by Mavrov (2007) and Arpaia (2008) [21,22].

It is reflected in the Regional Revenue and Expenditure Budget (APBD) to maintain and supervise environmental pollution and overcome environmental problems. In the APBD, the local government allocates a productive expenditure budget to various functions, including environmental affairs. This thinking was initiated by Keynesian economists who based their thinking that government variables (especially budget) are considered as one of the variables driving economic growth in a country. The government budget is expected to have a multiplier effect in other sectors of the economy. The multiplier effect of government spending will be even more significant if the government's assumption for productive activities can be fulfilled [23].

With the background of the problem regarding environmental pollution in many provinces in Indonesia and the decline in the environment's quality, the budget allocated specifically for the environment has not been maximized. The research aims to determine the effect of APBD and GRDP on Environmental Quality in Indonesia and prove the Environmental Kuznets Curve with a theory that describes the relationship between environmental quality and economic growth into an inverted U-shaped curve.

The EKC hypothesis is carried out using the quadratic function:  $E_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 (X_{it})^2 + \beta_3 Y_{it} + \epsilon_{it}$ ; with the following terms:  $\beta_2 \neq 0$ , if  $\beta_2 < 0$  then forms an inverted U-curve (EKC) [24], whereas if  $\beta_2 > 0$  then forms a U-curve. However, this study uses the IKLH variable, whose behavior is the opposite of

the environmental degradation variable (pollution or emissions) used in the EKC Hypothesis. The results of this study are empirically able to show the EKC behavior in Indonesia with a U-shaped curve because it uses environmental quality variables.

## 2. Methodology

The analysis model used is a panel data econometric regression model, which is intended to determine the most efficient estimation results because of the increasing number of observations, increasing the degrees of freedom. This study's analysis is tested using three approaches, namely the Common Effect Model, Fixed Effect Model (FEM) and the Random Effect Model (REM), to determine the consistency of the relationship between each independent variable and the dependent variable. Panels were conducted in 34 provinces in Indonesia during the period 2011-2016.

The simplest panel model approach is the Common Effect Model (CEM) or Pooled Least Square (PLS), because it only combines time series and cross-section data into one sequence of data to be analyzed. The FEM approach is assumed to have a slope coefficient of the explanatory variable or the regressor does not vary between individuals. This model assumes that the regression equation from time to time has a constant slope while the intercept varies between individuals. It can also be stated that based on the FEM model, it is assumed that the regressor's slope coefficient does not vary between individuals and over time. Whereas in REM, the intercept is considered a random variable that has an average value. [25]. The empirical model of this research is as follows:

$$EQI_{it} = \beta_0 + \beta_1 GDRB_{it} + \beta_2 GE_{it} + \beta_3 GDRBsqr_{it} + \varepsilon_{it} \quad ; \beta_1, \beta_2, \beta_3 > 0 \quad (1)$$

The equation model (1) is then estimated by applying the log to each variable, as in equation (2)

$$\text{Log}EQI_{it} = \beta_0 + \beta_1 \text{Log}GDRB_{it} + \beta_2 \text{Log}GE_{it} + \beta_3 \text{Log}GDRBsqr_{it} + \varepsilon_{it} \quad (2)$$

This study analyzes the influence of government expenditure variables (GE), aggregate output (GRDB) and the square of national income (GRDBSQR) on environmental quality. The environmental quality empirical model of this study uses the Environmental Quality Index (EQI) variable. Meanwhile, the Gross Regional Domestic Product (GDRB) variable represents the output variable in the economy. Several panel data model selection tests with the Redundant Fixed Effect Test and the Hausman Test were carried out to select the best model [26]. In addition, classical assumption testing is applied as a condition of the least square regression econometric model [25].

## 3. Results and discussion

The results of choosing the model using two tests, namely the Redundant FEM and the Hausman Test, show the results which indicate that the FEM is preferred over the CEM and the REM. The results of redundant fixed effects or likelihood ratio for this model have a probability value of F that is smaller than alpha (0.05), so that H0 is rejected and H1 is accepted, the appropriate model for this result is fixed effects (table 1). Likewise, the Hausman Test's test results show that the P-value of 0.000 is smaller than 0.05 so that the FEM model is preferred over REM (table 2).

**Table 1.** Redundant fixed effects tests.

Test cross-section fixed effects			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	18.724496	(32,129)	0.0000
Cross-section Chi-square	285.572292	32	0.0000



**Table 2.** Correlated random effects – Hausman test.

Test cross-section random effects			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	28.142466	3	0.0000

The panel data regression model with FEM in this study has passed the multicollinearity test, indicated by a VIF value of more than 10. Testing of the residuals from the estimation results shows that the empirical model has heteroscedasticity and autocorrelation problems. Heteroscedasticity is indicated by the consistency of the test results using the White Test, Breusch-Pagan-Godfrey Test and Glejser Test. This model is also affected by autocorrelation problems after testing with the serial correlation LM test. However, the problem of Heteroscedasticity autocorrelation can be overcome by applying covariance modifications in accordance with the Heteroscedasticity and Autocorrelation Consistent (HAC) or Newey-West standard approaches [26].

The estimation results with panel data regression show that government spending and aggregate output variables have a positive and significant effect on Indonesia's environmental quality. This is indicated by the P-value, which is less than 0.05 on both variables. The GDRBSQR variable is used to detect whether there is an Environment Kuznets Curve phenomenon in Indonesia. With significant results and positive coefficients, it means that the curve is U-shaped. However, because the variable used is the environmental quality index (EQI), this indicates that Indonesia's condition of environmental quality is getting better as the economy of scale increases (table 3).

**Table 3.** Estimation results.

Variable	Coefficient	t-Statistic	Prob.
LOG(GDRB)	1.109102	2.281834	0.0241
LOG(GE)	0.030460	2.651122	0.0090
LOG(GDRBSQR)	8.951854	2.182093	0.0309
C	37.03830	2.379179	0.0188

The aggregate output variable has a positive and significant effect on environmental quality with a coefficient of 1.109. This means that an increase in aggregate output in the economy by 1 percent can increase the environmental quality index by 1.11 percent. This figure is a positive signal for environmental development in Indonesia. This result is in line with the research of Beckerman (1992), Balsalobre-Lorente, et al. (2017) and Kang and Hwang (2016), which emphasize the requirements for economic growth to get environmental improvement [27–29]. Beckerman admits that sustainable environmental degradation in the short term will bring about environmental improvement in the long term by following economic growth because getting rich is a particular way to improve environmental quality. In addition, Heyes' (2002) research also states that the ecological economy needs to be emphasized because the natural environment has an aggregate carrying capacity, limiting the maximum level of sustainable economic activity [30].

The government expenditure variable (GE) also indicates a positive and significant relationship (table 2). An increase in government spending by 1 percent influences improvement on environmental quality by 0.03 percent. Increased government spending indicates that it is being spent regarding the sustainability of development and the environment. Increased government spending in various sectors can reduce environmental degradation and improve environmental quality. Central government spending as the holder of large budgetary power can drive pollution up or down. However, the increase in spending based on environmental functions is expected to reduce environmental pollution. This study's results are in line with the reallocation of the composition of government spending on public goods to reduce pollution while increasing total government spending has two effects on environmental damages [19].

The Kuznets phenomenon, which is illustrated by the behavior of the quadratic variable of national income, shows the results of the identified curve inversely to U. This shows consistency with the two previous variables, namely Indonesia towards increasing national income, which can improve environmental quality. If the research conducted by Idris and Primiana (2015) shows the relationship between economic growth and the quality of the environment in Indonesia, such as the letter U. Initially, the growth of national income will bring about a deteriorating environmental quality. However, it will experience a reversal; namely, an increase in national income will improve environmental quality [31]. The finding confirms this result that the effect of government spending variables and aggregate output is in line with the environmental quality index.

#### 4. Conclusion

This study finds that government spending and aggregate output in Indonesia positively and significantly affect environmental quality. The direction of development towards sustainable development is increasingly becoming evident in Indonesia. This sound signal needs to be pursued continuously by increasing production activities that are environmentally friendly. The increase in aggregate output will be in line with the improvement of the environment in Indonesia. Apart from that, government spending is also allocated by considering the quality of the environment. Policies in public spending and development are implemented with due regard to environmental quality. This research's novelty is the use of environmental quality indicators in analyzing the relationship between environmental variables and economic activity, which is chosen to represent the model. Besides, this study analyzes local government expenditure variables in Indonesia to represent government spending nationally. This study has a limitation that the government spending variable does not explicitly represent expenditure in the environmental sector. So, it is suggested that for future research, government spending can be analyzed in more detail.

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