THE EFFECT OF INDUSTRIAL SECTOR AND TRANSPORTATION SECTOR ON CO2 EMISSIONS IN INDONESIA

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Abstract

Environmental quality is an important aspect of life. This study aims to analyze the effect of industrial sector GDP and transportation sector GDP on environmental quality in terms of carbon dioxide emissions in Indonesia. This analysis uses multiple linear regression models with the Ordinary Least Square (OLS) method. The results of the analysis show that the GDP of the Industrial Sector has no significant effect on CO2 emissions, while Transportation GDP has a significant and positive effect on CO2 emissions, this is supported by the Environmental Kuznet Curve (EKC) theory.

Keywords *: carbondioxyde emission, GDP of industry sector, GDP of transportation sector*

1. INTRODUCTION

The main objective of a country is success in economic development for the welfare of its people. Activities in economic development must have implications for the environment. Economic activities cannot be separated from the use of natural resources, so that it will reduce the availability of natural resources itself and cause environmental damage, such as water and air pollution. This shows that an economic system and the use of natural resources are interdependent. The sustainability of natural resources is indicated by the importance of a sustainable economic development system by observing the effects of extracting natural resources and emissions from pollutants released into the environment (Tisdell, 2009: 265).

Based on Pasal 28H paragraph (1) and Pasal 33 paragraph (4) of the 1945 Constitution of the Republic of Indonesia, it is a key provision regarding the regulation of environmental norms in the constitution. In succession the two Articles read as follows:

Article 28H paragraph (1):" Every person has the right to live in physical and spiritual prosperity, to have a place to live, and to have a good and healthy living environment and the right to obtain health services ".

Article 33 paragraph (4): "The national economy shall be carried out based on economic democracy with the principles of togetherness, fair efficiency, sustainability, environmental insight, independence, and by maintaining a balance between progress and national economic unity". Based on the above article, it is clear that the 1945 Constitution of the Republic of Indonesia has also accommodated constitutional protection for its citizens to obtain an adequate living environment and guarantee the maintenance of a sustainable environmental order due to the negative impacts of economic activity. national. This provision implies that every citizen has the right to and

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obtain a constitutional guarantee (constitutional guarantee) to live and obtain a good and healthy living environment to grow and develop.

Economic development has more or less polluted the surrounding environment and resulted in a decrease in the quality of the environment. Indonesia, which is one of the developing countries, has a goal of increasing GDP from various sectors. In this research, it is more discussed in the industrial sector and the transportation sector. GDP data for the industrial sector and the transportation sector can be seen in Figure 1.

Figure 1. GDP data for the industrial sector and the transportation sector
2000-2019
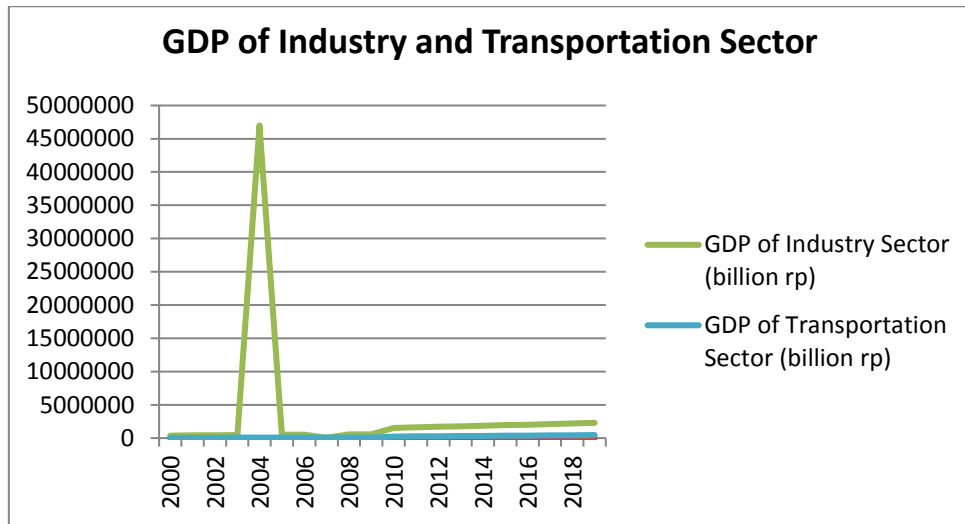
Source : BPS (2020)

According to Kuznet (1955), development without paying attention to the preservation of nature and the environment only creates damage to the environment itself. So there is the Environmental Kuznet Curve theory which shows the relationship between economic growth and environmental degradation. According to this theory, when a country's income is still low, increasing income is of particular concern, so that production and investment will be increased by ignoring environmental quality problems.

Based on data from the Ministry of Environment, CO_2 emissions have increased from 2000 to 2019. This proves that there has been a decrease in environmental quality, especially air quality. Figure 2 shows the CO_2 emission data for 2000 - 2019.

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Figure 2. CO2 Emission Data in Indonesia, 2000 – 2019
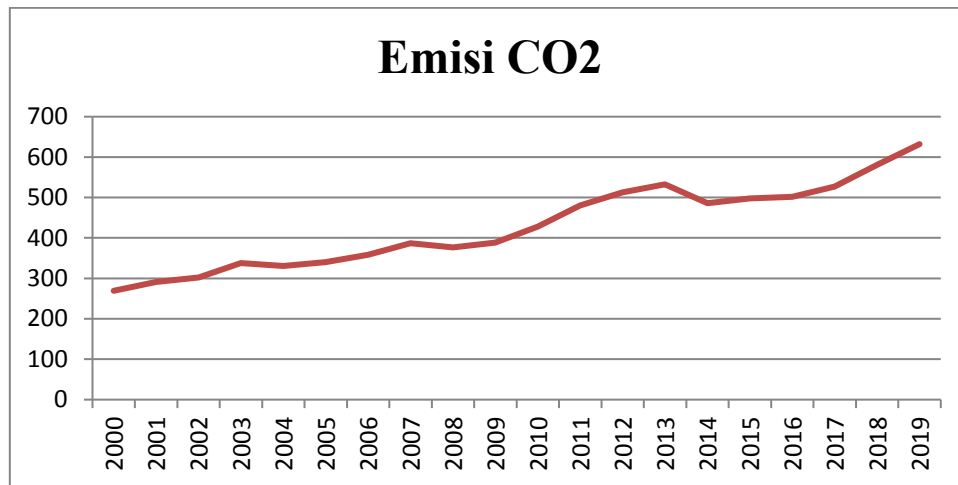
Source : KLH (2020)

This causes income growth to be accompanied by an increase in pollution and environmental damage. Economic growth is driven by increasing economic activity from various sectors, but this also has a negative impact on the environment. One of the negative impacts referred to is air quality pollution which is indicated by the presence of CO2 emissions, which can trigger the Greenhouse Gas (GHG) effect.

Formulation of The Problem

The increasing growth of the transportation and industrial sectors is considered to be able to increase CO2 emissions. This causes air pollution which is one of the problems faced by several regions including Indonesia. The increasing use of transportation causes higher fuel combustion, resulting in an increase in CO2 emissions. In time this will also hamper economic growth. The quality of the environment has an impact on the healthy lifestyle of the community which will also benefit from an economic side. Therefore, the problems formulated in this study are: How does the GDP of the Industrial Sector and the GDP of the Transport Sector affect the quality of the environment when viewed from CO2 emissions in Indonesia?

Research Purposes

The purpose of this study was to determine and analyze the effects of The effect of GRDP of industrial and transportation sectors together on CO2 emissions?

Benefits of Research

The results of this research are expected to provide academic and practical benefits, therefore the benefits of this research include:
1. Academically, the results of this study are expected to contribute to the field of health and environmental economics
2. In practical terms, the results of this study are expected to provide information and become a discussion material for policy makers in terms of environmental quality management for economic growth.
3. In general, the results of this study can provide a reference for further studies

1. LITERATUR STUDY

Environmental Quality

The environment is seen as an asset capable of providing various benefits. The environment is the most special asset in that it is able to provide a system that supports the existence of life, although as an asset there must be an increase through other assets or at least to prevent improper depreciation of the environment, because the value of environmental assets is so important for the survival of life (Tietenberg and Lynne, 2011: 17) According to Tietenberg and Lynne (2011: 31), the environment as a public good is not only a charming sight, but also clean air, clean water sources and biodiversity conservation. However, consumption of public goods cannot be separated and without exception, especially environment and natural resources where one person uses natural resources does not reduce the availability of natural resources for future generations.

Economic Growth

According to Soekirno (2000: 10), economic growth is the development of activities in the economy that causes goods and services produced in society to increase and the welfare of society to increase. This can be seen and measured from the development of national income (Gross Domestic Product) at constant prices from year to year. Gross Domestic Product (GDP / GDP) is the market value of all final goods and services produced in the economy during a certain period of time. Based on this idea, GDP describes the economic activity of a country in a certain period of time. In carrying out these production activities, of course there are production factors used, namely, human resources, natural resources and capital.

The Relationship between Economic Growth and Air Pollution

According to Hanley and Edward (2009: 38), the environment provides many goods and services that are important to the economic system and people's lives, namely: 1. The environment acts as a provider of materials and energy sources 2. The environment acts as a collection of waste from production and consumption activities 3. The environment provides the most basic necessities of life The mass of material from the environment that enters the economic system and accumulates, then is returned to the environment which is referred to as waste (Tietenberg, 2011: 18). Excessive waste will pollute both air and water so that it also has an impact on reducing environmental values. Economic activities that aim to improve people's lives tend to rely on the exploitation of natural resources and are not accompanied by actions to conserve the availability of these natural resources. Economic growth can be seen in the increasing GDP, but there is pollution or environmental damage which is also increasing. Economic activity and pollution are directly proportional, where the higher the economic activity, the more pollutants produced will increase. Environmental damage caused by human production and consumption activities is called an externality.

According to Fauzi (2006), externalities are the impact of an action by a certain party on another party in the form of positive or negative impacts, or in formal economic terms as a net cost or benefit, from the actions of one party towards another party. Environmental damage such as air pollution includes negative externalities. Externalities occur when a person's actions have an impact on another person or group of people without any compensation, resulting in inefficiencies in the allocation of

production factors. External externalities are basically due to human activities that do not follow environmental economic principles. The market can be an efficient allocation of resources if the assumptions are met, including that actors are rational, have perfect information, markets are in the form of perfect competition, and goods are private. But in reality, these ideal assumptions are difficult to fulfill. As a result, there is a market failure where the market mechanism cannot function efficiently in allocating economic resources that exist in society and among others are caused by externalities. When externalities occur, market prices do not reflect marginal social costs or marginal social benefits, resulting in inefficiencies in resource allocation.

Based on the impact, the deterioration of environmental quality is considered a negative externality. Negative externalities, namely the impact of an activity that is detrimental to other parties without any compensation from the party carrying out the activity.

The first theory that describes the relationship between environmental degradation and a country's economic growth rate is the Environmental Kuznet Curve (EKC) theory. According to this theory, when a country's income is still low, efforts to increase a country's income will be the country's main concern. So that an increase in production and investment will be carried out which will encourage an increase in income by disregarding problems of environmental quality. As a result, the quality of the environment will decline even though conditions for income growth continue.

Previous Research

Similar research has been conducted and has produced several conclusions regarding environmental quality. Below are some of the previous researches of this kind. Gupito (2012) conducted a study to determine the per capita GRDP linkage of the industrial, agricultural and forestry transportation sectors to environmental quality measured by CO2 emissions (case study in: 30 districts / cities of Central Java province, 2009-2010). This study uses CO2 emissions as the dependent variable and the GRDP of the industrial sector, GRDP of the transportation sector, GRDP of the agricultural sector and GRDP of the forestry sector as independent variables. In this study states that the transportation and forestry sector have a positive and significant effect on CO2 in the districts / cities of Central Java province. Meanwhile, the industrial and agricultural sectors have a negative or insignificant effect on CO2 in districts / cities of Central Java province.

Hutabarat (2010) conducted a study on the effect of industrial sector GDP on environmental quality in terms of sulfur and CO2 emissions in five ASEAN member countries for the period 1980-2000. Where the domestic product in the industrial sector is the dependent variable. Meanwhile, sulfur emissions per capita and CO emissions per capita are independent variables. In this study it was found that overall this research proves that the growth of sulfur and CO2 emissions from year to year is in line with the increase in GDP in the industrial sector.

Fasikha and Yuliadi (2018) conducted a study on the effect of environmental changes on per capita income in ASEAN countries for the period 2005 - 2015. Where CO2 emissions had a positive and significant effect on GDP per capita in nine ASEAN member countries for the period 2005-2015. In this study, it was found that ASEAN countries for the period 2005-2015 indicated the Environmental Kuznets Curve (EKC) hypothesis in industrial economics in which the amount of CO2 emissions and GDP per capita simultaneously continued to increase and had not yet reached a turning point. The

results also show that energy use and Forein Direct Investment (FDI) have a positive and significant effect on GDP per capita in nine ASEAN member countries for the period 2005-2015. This research was conducted to determine the impact of economic growth from the industrial and transportation sectors on environmental quality in terms of CO2 emissions which refers to the Hutabarat research. However, Hutabarat's research is only on the industrial sector regarding environmental quality in terms of sulfur and CO2 emissions. Another difference in the dependent variable Hutabarat's research is the GDP of the industrial sector, while sulfur and CO2 emissions are independent variables and use the Fixed Effect Model (FEM) with panel data analysis.

2. RESEARCH METHODOLOGY

This research was conducted using secondary data from various appropriate literature. Secondary data used is time series data from 2000-2019. This research was conducted using secondary data from various appropriate literature. Secondary data used is time series data from 2000-2019. The variables used in this study are based on literature studies conducted on journals, previous research and literature related to the problem under study. Data and data sources in this study can be seen in Table 1 below:

Table 1. Data and Data Sources

Variable	Unit	Source
CO2 Emission	Metriks Ton	KLH
GDP of Industrial Sector	Billion Rupiah	BPS
GDP of Transportation Sector	Billion Rupiah	BPS

The definition of each variable in research is:
a. CO2 emissions are gases released from the combustion of compounds containing carbon. CO2 emissions are one of the pollutants to measure air quality
b. Economic growth (GDP) in the industrial sector is a condition in which an increase in the production of goods and services is also followed by an increase in people's income in an area for a certain period of time seen from the industrial sector
c. Economic growth (GDP) in the transportation sector is a condition where there is an increase in the production of goods and services which is also followed by an increase in people's income in an area in a certain period of time seen from the transportation sector.

The analysis uses multiple regression models to determine the effect of GDP in the industrial and transportation sectors on environmental quality in terms of CO2 emissions. The model used to estimate the parameters of economic growth is formulated as follows:

CO2 = Bo + B1 LogPDBindustri + B2 LogPDBTransportasi+e

when :
CO2 = emission CO2 (metriks ton)
LogPDBIndustri = GDP of Industry Sector (billion rupiah)
LogPDBTransportasi = GDP of Transportation Sector (billion rupiah)
Bo = Constanta
B1, B2 = koefisien regression
e = error

3. RESEARCH AND DISCUSSION

The multiple linear regression analysis method is used to analyze the effect of the GDP of the industrial and transportation sectors on CO2 emissions and is processed using SPSS 23. In this analysis the dependent variable (Y) is CO2 emissions and the independent variable is GDP of the industrial sector and GDP of the transportation sector. Based on the least squares method (OLS) from multiple linear regression, the estimation results of the industrial and transportation sector GDP influence on CO2 emissions are as follows:

Table 2. Estimation Results of Multiple Linear Regression

No	Variabel	Regression Coefficient	t-stat	Prob
1	Constant	-872.161	-8,182	0,000
3	LogPDBInd	-9,692	-0,661	0,517
4	LogPDBTrans	263,186	12,265	0,000
	R-Square = 0,914			
F-Statistic = 89,788			Prob (F-Statistic) = 0,000	

Source : Data processed in 2020, n = 20, α = 0,05

The estimation results obtained R^2 value of 0.914. This means that 91.4 percent of the variation in CO2 emission levels in Indonesia can be explained by the variation of the two independent variables together, namely the GDP of the industrial sector (X1) and GDP of the transportation sector (X2). Meanwhile, another 8.6 percent is determined by other variables outside the model used. The regression equation model is obtained as follows:

CO2 = -872,161 – 9,692 LogPDBInd + 263,186LogPDBTrans

Based on the results of the regression test, it is found that the industrial sector GDP does not have a significant effect on CO2 emissions in Indonesia. Meanwhile, the GDP of the Transportation sector has a positive and significant effect on CO2 emissions. Where if the GDP of transportation sector activities increases by one percent, it will increase emissions in Indonesia by 263.186 percent with the assumption of ceteris paribus.

This is in accordance with Kuznet's thought, known as the Environmental Kuznet Curve (EKC) theory. Where when the country's main attention is focused on efforts to increase a country's income by ignoring environmental quality problems. As a

result, the increase in income is accompanied by decreased environmental quality, marked by increased pollution, namely CO_2 emissions.

The transportation sector is one of the sectors that contributes high figures to CO_2 emissions in Indonesia. The more rapid the economic development, the higher the need for transportation services. As a result, air pollution caused by the combustion of fuel oil from motorized vehicles is high in line with the increasing population and economic growth. So that the consumption of fuel oil increases in the transportation sector

4. CONCLUSION

Based on the results and discussion, it can be concluded that the GDP of the Transportation Sector has a significant and positive effect on CO_2 emissions at the 5% significance level. This explains that the increasing GDP of the Transportation Sector will increase the CO_2 emission rate in Indonesia. Meanwhile, the GDP of the Industrial Sector does not have a significant effect on CO_2 emissions.

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