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IMPACT OF PANDEMIC COVID-19 AND ECONOMIC ACTIVITY ON AIR QUALITY IMPROVEMENT

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Abstract

Pandemic covid-19 presents a policy of tightening the mobility of the population, which directly impacts the reduced mobility of transportation, private transportation, and public transportation. Economic activity also under pressure from the existence of pandemic covid-19, in which economic activity is a source of air pollution for a large part of the country. The purpose of the study to find out the impact of pandemic covid-19 and economic growth on air quality during the pandemic is in 2020. The research method uses a multiple regression approach with a sample count of 80 countries. The results showed that economic growth has no impact on improving air quality and does not prove the environmental Kuznets curve between development and air pollution. In contrast, the increase in cases of covid-19 has the effect of lowering air pollution in each country. This condition occurs because covid restricts the population to activities, which also affects the activities of the company to produce.

Keywords: *PM25; Air Pollution; Economic growth; Pandemic Covid 19; Air Quality Improvement*

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INTRODUCTION

The Covid-19 pandemic has become a global threat, spreading suffering and kills and bringing the world to a new habit. A pandemic not only seen the problem as a health crisis that is happening in the world. This case is also an economic, social, and humanitarian crisis that forces many countries' policies (Sayekti et al., 2020). These policies include social distancing, physical distancing, self-isolation, and micro and macro scale restrictions or lockdowns (Khari et al., 2020). ultimately the policy affects population mobility, economic activity, and other activities.

The impact on changes in population mobility early in the pandemic can be seen in the United Kingdom, which experienced a 63% decline in overall community mobility, with retail and recreation areas (85%) and transit stations (75%). Still, non-residential and non-garden have increased 5% since tightening started, increasing 2–3% per week (Drake et al., 2020). The effectiveness of social distancing in the United States shows that more people stay at home on weekends, especially on Sundays (Pan et al., 2020). The New York study, which took a different policy from state and local governments, has dramatically changed mobility behavior in affected cities (J. Zhang et al., 2021). In the lockdown status in France, there was a change in mobility before and during the lockdown. On a local and state scale, this has resulted in a 65% reduction in total mobility across the country and includes reduced short-distance mobility (Pullano et al., 2020).

Reduction in community mobility stay at home also occurred before and after the instruction related to tightening, even voluntarily (Lee et al., 2020). Another response in the USA to the stay-at-home policy causes about a 5% reduction in the average daily mobility of humans (Xiong et al., 2020). Although the tightening effects were reducing passengers on trains and other modes of transportation, it also increases the use of private modes of transportation [8]. This condition can be drawn red thread that the tightening policy has restricted people's activities and encouraged people to stay at home. In terms of environmental health, this condition has a beneficial effect because people's mobility uses transportation modes, sources of pollution, or air pollution.

Another impact of a pandemic besides mobility is economic activity, which decreased. China experienced a decline in economic growth despite already taking control measures (Kraemer et al., 2020). These losses are not only at the national level but also in the corporate sector, as well as individuals (Hadiwardoyo, 2020). On a more micro-scale, society also experienced a decrease in income (Sayuti & Hidayati, 2020). Another side of the economy affected is employment, decreased revenue, and general

harm to all sectors of the economy (Erero & Makananisa, 2021; Hanoatubun, 2020).

The sectors most affected are transportation, tourism, trade, health, and other sectors, especially the household sector (Susilawati et al., 2020). Other effects of covid-19 to macroeconomic conditions and the agricultural industry (Y. Zhang et al., 2020) in grassroots, the covid pandemic harms employees, customers, supply chains, and financial markets (Açikgöz & Günay, 2020). The general condition of the economic downturn, both national and household, also affects the environment, especially air pollution. An assumption is that available economic activity also describes and is related to production activities. Meanwhile, it is difficult for production activities to be separated from the adverse effects, including environmental pollution.

Environmental pollution is a significant consideration for a country in determining its economic pattern. Economic activity has two effects at once, both positive and negative effects. The negative impact of economic activities can also be seen from industrial activities, whose presence has many adverse effects such as water pollution, air pollution, and others (Ridwan, 2010). Another link can also be seen in low-income countries, as an increase in gross domestic product per capita causes environmental pollution (Rofiuddin et al., 2019). Meanwhile, most countries also show that economic growth is associated with increased atmospheric pollution (Esso & Keho, 2016). It cannot be denied that an increase in economic activity also harms environmental pollution. This condition is a consideration for the state to carry out large-scale exploration in some countries.

The Environmental Kuznets curve hypothesis regarding the relationship between economic growth and pollution can also be seen from the results of empirical studies, which show that there is an inverse U curve relationship between economic growth and changes in environmental quality (Bartz & Kelly, 2008; Firdaus, 2017; Pajooyan & Moradhasel, 2008; Rofiuddin et al., 2017). Other studies in ASEAN countries showed there is the Environmental Kuznets Curve hypothesis (Fasikha & Yuliadi, 2018). In terms of causality, there is causality between CO_2 emissions and economic growth (Saboori et al., 2014). Meanwhile, other results show a unidirectional causality relationship between PM2.5 and economic growth (Zhu et al., 2019). But the different behavior or different inputs in a country will also have other effects. The results of empirical studies found no significant relationship between economic growth and CO_2 emissions (Salahuddin & Gow, 2014).

Along with an increase in environmental policy tightening, it influences increasing PM2.5 emissions. However, there is no significant correlation, and in phase

three, there is an effective and negative correlation (Ouyang et al., 2019). The impact of economic growth on air pollution intensity varies between developing and developed countries. In developing countries, it occurs through changes in the structure of economic activities, while in developed countries, it occurs through the sum of the scale effect and income effect (Kukla-Gryz, 2009).

The increase in covid-19 cases in its development has become a general concern for the public and policymakers. The community reduces their mobility, and policymakers take steps to minimize instances of covid-19. A tendency for the severe level is also in line with the status of the policy provided. Some are at the social distance level until there is a lockdown. Other effects, of course, have a good impact on reducing environmental pollution. The results of empirical studies show that the lockdown has reduced nitrogen dioxide concentration and particulate matter weighted about 60% and 31% in 34 countries, especially in reducing transport sector emissions (Venter et al., 2020). The results of other studies illustrate that the Covid-19 pandemic has caused a 25.5% decrease in NO_2 comparison with previous years (Berman & Ebisu, 2020). This condition may have decreased the number of deaths during covid-19. Reducing air pollution itself can also provide positive benefits in lowering preventable non-communicable diseases (Dutheil et al., 2020).

Other evidence regarding the lockdown imposed during the Covi-19 pandemic on pollution, the case in Spain, shows that the 4-week lockdown significantly impacts reducing NO_2 levels in all cities except Santander (small city), including CO, SO_2, and PM_{10} in some cities (Briz-Redón et al., 2021). In other words that Covid-19, which forces people to stay at home, has an impressive effect on reducing the environmental pollution.

Based on the description above, it is essential to analyze the effect of economic activity during the Covid-19 pandemic on improving environmental quality. Previous studies have shown an influence, even a causal relationship, between economic activity and environmental pollution. In addition, it is also necessary to see firsthand the effect of the covid-19 case on reducing environmental pollution, considering that the Covid-19 pandemic presents many policies that inhibit, reduce or stop community mobility activities. This study analyzes the effect of economic activity and covid on air quality.

LITERATURE REVIEW

Economic Growth

Economic growth is the expansion of economic activities that cause the quantity and quality of products and services produced in a community to increase, as well

as the community's prosperity (Sadono, 2006). Economic growth is one sign of an economy's success in developing. The quantity of growth reflected by changes in national output determines the economic success of a country (Faried, Annisa, 2019).

Economic growth is defined as an endeavor to increase production capacity in order to produce more output, as measured by Gross Domestic Product (GDP) and Gross Regional Domestic Product (GRDP) in a given region (Rahardjo, 2013). This Gross Domestic Product can reflect a country's economic performance, so the larger the GDP, the better the country's economic performance (Arsyad, 2010). This means that Gross Domestic Product (GDP) is a measure of economic growth since it tracks the movement of income and spending across the economy over time (Mankiw, 2007)

Economic growth is the long-term process of increasing output per capita. The focus is on three aspects: process, per capita output, and long-term sustainability (Boediono, 1999). Economic growth can also be defined as an increase in a country's long-term capacity to offer various economic benefits to its population. Advances in technology, as well as technological, institutional, and ideological adjustments to various existing conditions, have made it possible to increase capacity (Todaro, 2000).

Environmental pollution

Air pollution is a change in the composition of the air from its natural condition, specifically the introduction of pollutants into the air in a sufficient amount and for a long enough time to cause harm to humans, animals, and plants. The Jakarta Regional Environmental Management Agency (Badan Pengelolaan Lingkungan Hidup Daerah Jakarta, 2013)

Carbon monoxide (CO), a major air pollutant coming from human activities, is mostly produced by motor vehicle exhaust fumes in various cities. Thermal NOx (Extended Zeldovich Mechanism), Prompt NOx, and Fuel NOx combine to generate nitrogen oxide (NOx). Sulfur Oxide (SOx), which is produced as a result of the sulfur content in the fuel as well as the sulfur content in the lubricant, is also a source of SOx emissions. HydroCarbon (HC) is produced by a variety of equipment that pollutes the environment. Particulate Matter (PM), often known as dust particles, is a mixture of several components found in exhaust emissions. Not just in solid form, but also in a liquid form that settles in dust particles (Simandjuntak, 2013)

Kuznet Curve

The Environmental Kuznets Curve is a theory that explains economic growth and CO_2 emissions (EKC). According to the EKC hypothesis, economic growth contributes to higher emissions, but additional economic

growth can mitigate environmental deterioration. This is owing to technological advancements and the transition to a service-based economy (Adu & Denkyirah, 2017; Galeotti, 2007; Peng & Bao, 2006; Roca et al., 2001)

Economic expansion, according to the EKC theory, will exacerbate environmental degradation at first. This is because the state will prioritize boosting production over environmental concerns. The ongoing production process will lead to environmental degradation in the form of soil, water, and air pollution. People will become conscious of the importance of good environmental quality as economic expansion progresses. This is known as the turning point, because it is at this moment that environmental deterioration will be reduced as a result of economic growth (Adu & Denkyirah, 2017; Nikensari et al., 2019; Peng & Bao, 2006; Roca et al., 2001)

RESEARCH METHODE

The data used in this study are secondary data on economic growth, covid cases, and air pollution in 2020, with a numbers sample of 80 countries. Selection of sample data based on the completeness of the report. The data sources are World meters, Trading economics, and IQAir.

Economic growth is an increase in the accumulation of overall economic activity in each country in percentage terms. Covid cases are the accumulation of people infected with Covid-19 with a soul unit. Air pollution is air pollution that is showed by pollutants whose position is outside the threshold, while the proxy for air pollution in this study uses PM2.5 with units of point.

Data Analysis

The data analysis method used multiple linear regression analysis. This analysis can summarize the dependence of one variable on another (Gujarati & Porter, 2009). The research model is:

$$PM2.5 = \beta_0 + \beta_1 Growth + \beta_2 Growth^2 + \beta_3 Covid19 + \varepsilon$$

which are aligned by forming a new variable, Growth2, where $Growth2 = Growth^2$ so that the application of the multiple linear regression model in this study is as follows:

$$PM2.5 = \beta_0 + \beta_1 Growth + \beta_2 Growth2 + \beta_3 Covid19 + \varepsilon$$

Note: PM2.5 is a particulate matter, Growth is Economic growth, Covid19 is the numbers of confirmed cases of Covid-19. The results of the regression were tested for the validity of the effect to answer the research objectives.

RESULT AND DISCUSSION

Table 1. Descriptive Statistics

	Growth	PM25	Covid
Mean	-2.419880	19.27590	919440.2
Median	-2.500000	15.80000	187463.0
Maximum	5.900000	77.10000	19974413
Minimum	-8.900000	5.000000	41.00000
Std. Dev.	3.402757	13.10860	2590925.

Table 2. The results of the estimation model

Variable	Coeff.	Std. Error	t-Statistic	Prob.
C	19.73419	1.951392	10.11288	0.0000
Growth	1.240278	0.955199	1.298449	0.1981
Growth2	0.207502	0.134902	1.538170	0.1282
Covid19	-2.76E-06	1.24E-06	-2.224143	0.0291**

Note: the dependent variable is PM2.5,

Based on Table 2, the empirical model in this study is:

$$PM2.5 = 19.73419_0 + 1.240278\,Growth + 0.207502 Growth^2 - 2.76\text{E-}06 Covid19$$

These results show that economic growth is not significant to air pollution (PM2.5), as well as gowth2 which does not affect air pollution (PM2.5). Referring to these results, then, in the long run, the Environmental Kuznets curve hypothesis cannot be explained. Meanwhile, the results of Covid-19 show that it can reduce the value of air pollution (PM2.5).

Economic Growth and Air Quality

The results of the empirical study, based on the results, show that there is no effect of economic growth on air pollution, as well as the squared value of economic growth also has no effect. These results illustrate that a decrease or increase in air pollution during the Covid-19 pandemic does not result from structural changes in economic activity. This condition also needs to be understood that the changes in mobility in all sectors of the economy do not significantly affect pollution conditions.

The results not in line with most previous studies that economic activity harms water pollution, air pollution, and increased atmospheric pollution (Esso & Keho, 2016; Ridwan, 2010). The study results are also inconsistent with research conducted in low-income countries (Rofiuddin et al., 2019). Other meanings that economic activities in the COVID-19 pandemic era have different behavior from previous habits. This condition could be because of restrictions on public transportation modes, which also increased in private modes of transportation.

The results also cannot prove the Environmental Kuznets curve hypothesis. This condition can occur because it is shock or unexpected. The fact is that the Covid-19 pandemic in 2021 continues and continues to fluctuate in each country and continues to increase. Referring to previous studies, the results not in line with studies that show an inverse U curve relationship between economic growth and changes in environmental quality (Bartz & Kelly, 2008; Fasikha & Yuliadi, 2018; Firdaus, 2017; Pajooyan & Moradhasel, 2008; Rofiuddin et al., 2017) Likewise, with lessons that assume causality (Saboori et al., 2014; Zhu et al., 2019). However, this research aligns with Salahuddin and Gow's results, showing no significant relationship between economic growth and environmental pollution (Salahuddin & Gow, 2014). This condition clarifies that the decline in economic activity during the Covid-19 period will not necessarily impact changes in pollution.

The Covid-19 epidemic and air quality

The Covid-19 case shows an influence on air pollution with a negative sign coefficient. The condition can also be understood by increasing COVID-19 instances in each country, and tightening policies on population mobility is quite effective. Another factor that cannot be separated because so far, or it can be said, the source of pollution from transportation capital which is used for daily mobility. The glance that the covid-19 case forces many people to reduce their mobility and stay at home.

The results align with studies that show that lockdown policies reduce air pollution (Berman & Ebisu, 2020; Briz-Redón et al., 2021; Venter et al., 2020). The lockdown policy was taken because of an increase in cases. The condition is inseparable because of the psychological influence of the community on the threat of the Covid-19 virus. Another factor because there is the existence of instructions or policies that force people not to move. Another factor is the self-awareness of volunteering to stay at home to protect the family from the threat of a virus that cannot be predicted with certainty. This condition, of course, also results in sources of air pollution, including public and private transportation modes that will stop or decrease, which will improve air quality.

CONCLUSION

From the results and discussion, it can be concluded that the Covid-19 case can reduce air pollution. At the same time, economic growth cannot prove an effect on air quality improvement, nor can it prove the Environmental Kuznets curve hypothesis. This study implies a need for policies related to community mobility in ordinary life, which are regulated so that air quality is getting better, at least not exceeding the safe limit for health.

IMPLICATION AND LIMITATION

The implication of this research is that in order to reduce air pollution, it is necessary to tighten transportation behavior. While the limitation of this study is that the case samples were taken from samples that were completely available and accessible, so that they did not cover all countries in the world

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